FINAL IMPACT ASSESSMENT

GRAMYA-II

Uttarakhand Decentralised Watershed Development Project

Submitted by

Sutra Consulting

Watershed Management Directorate

Government of Uttarakhand

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Abbreviations

AAY	Antyodaya Anna Yojana
ABGC	Agri Business Growth Centre
ABSO	Agri Business Support Organisations
AI	Artificial Insemination
ANR	Assisted Natural Regeneration
ARG	Automated rain Guage
AWP	Annual Work Plan
AWS	Automatic Weather Station
BCR	Benefit Cost Ration
BCR	Benefit Cost Ratio
BDC	Block Development Committee
BEF	Biomass Expansion Factor
BPL	Below Poverty Line
BQ	Black quarter
CAA&A	Controller Aid, Accounts and Audit
CartoSAT DEM	Cartosat-1 Digital Elevation Model
CBH	Circumference at Breast Height
CD	Change Detection
CS PRO	The Census and Survey Processing System (Software)
DA	Designated Account
DBH	Diameter of Breast Height
DDO	Drawing And Disbursing Officer
DiD	Difference-in- Difference
DLT	Drainage Line Treatment
DN	Digital Numbers
DOC	Day old chicks
DPD	District Project Director
ERR	Economic Rate of Return
ESA	Environmental and Social Assessment
ESG	Environmental and Social Guidelines
ESG	Environmental Safeguard Guidelines
ESMF	Environment and Social Management Framework
FCR	feed conversion ratio
FF	Farmer Federation
FGD	Focused Group Discussion
FIG	Farmer Interest Group
FMD	Foot and Mouth Disease
FMIS	Financial Management Information System
FNGO	Field Non-Government Organisation
FPO	Farmer Producer Organisation
FRR	Financial Rate of Return
FSSAI	Food Safety and Standards Authority of India
FY	Financial Year
FYM	Farm Yard Manure
GCA	Gross Cropped Area

GIS	Geographic Information System
GoI	Government of India
GoUK	Government of Uttarakhand
GP	Gram Panchayat
GPS	Global Positioning System
GPWDP	Gram Panchayat Watershed Development Plan
GRM	Grievance Redressal Mechanism
HH	Household
HS	Hidradenitis suppurativa
HYV	High Yielding Varieties
IBRD	International Bank of Reconstruction and Development
ICAR	Indian Council of Agricultural Research
ICDS	Integrated Child Development Services
ICM	Integrated Crop Management
ICT	Information and Commnication Technology
IDA	International Development Association (World Bank)
IEC	Information, Education, Communication
IEG	Institute of Economic Growth, Delhi
IGA	Income Generation Activity
IIT	Indian Institute of Technology
INM	Integrated Nutrient Management
IPM	Integrated Pest Management
IPNM	Integrated Plant Nutrient Management
IR	Irrigated
IRR	Internal Rate of Return
IUFR	Interim Unaudited Financial Report
IWMP	Integrated Watershed Management Programme
KVK	krishi Vigyan Kendra
LAI	Leaf Area Index
LDPE	Low-density polyethylene
LED	light-emitting diode
LPG	Liquid Petroleum Gas
LPM	Litres Per Minute
LULC	Land Use Land Cover
LULUCF	Land Use, Land Use Change and Forestry
M&E	Monitoring and Evaluation
MAP	Medicinal and Aromatic Plants
MDM	Minimum Distance to Mean
MDT	Multi Disciplinary Team
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MIS	Management Information System
ML	Maximum Likelihood
MLE	Monitoring, Learning and Evaluation
MOC	Month old Chicks
MPR	Monthly Progress Reports
MSL	Mean Sea Level
MTR	MidTerm Review

MWS	Micro Watershed
NBC	Natural Breeding Centres
NCB	National Competitive Bidding
NDVI	Normalized difference vegetation index
NGOs	Non-Government Organisation
NPV	Net Present Value
NRM	Natural Resource Management
NRSA	National Remote Sensing Agency
NSS	National Sample Survey
OBC	Other Backward Caste
ODK	Open Data Kit
OECD	Organisation for Economic Co-operation and Development
PAD	Project Appraisal Document
PDO	Project Development Objective
PME	Participatory Monitoring Evaluation
PMU	Project Management Unit
PNGO	Partner Non Government Organisation
PoP	Poorest of Poor
POP	Package of Practices
PRA	Participatory Rural Appraisal
PRI	Panchayati Raj Institution
PV	Photovoltaic
PVB	Present Value of Benefits
PVC	Present Value of Costs
PVWP	Photovoltaic Water Pump
RBI	Reserve Bank of India
RF	Reserved Forests
RVC	Revenue Village Committee
SC	Scheduled Castes
SHG	Self Help Groups
SPV	Solar Photovoltaic
ST	Scheduled Tribes
SWAT	Soil & Water Assessment Tool
TAP	Transhumant Action Plan
ULDB	Uttarakhand Livestock and Dairy Board
US$	US Dollars
VG	Vulnerable Groups
VGA	Vulnerable Group Activities
VGF	Vulnerable Grroup Family
VGI	Vulnerable Group Individual
VPKAS	Vivekananda Parvatiya Krishi Anusandhan Sansthan
WAS	Women Aam Sabha
WHO	World Health organisation
WMD	Watershed Management Directorate
WOP	Without Project
WWMC	Water and Watershed Management Committee

Borrowers Report

Uttarakhand is one of the youngest states in India, which was carved out of northern Uttar Pradesh on 9th November 2000, emerging as the twenty-seventh state of the country. Located at the foothills, middle and upper reaches of the Himalayan mountain ranges, it is largely a hilly state, with 92 percent of its area of 53,500 square kilometres having a rugged topography. The state is more vulnerable to severe soil erosion and landslides due to its location, topography and underlying geology. According to the ICAR-National Bureau of Soil Survey and Land Use Planning, close to 50 percent of the state's area is above the tolerance limit of 11.2 tons per hectare per year of soil loss. Watershed development is more relevant for the state of Uttarakhand than most other states in India considering the fragile Himalayan geology and ecosystem. Realizing this importance, an exclusive Watershed Management Directorate (WMD) was established in 1982 to bring all the watershed development projects under one umbrella for its comprehensive implementation and coordination with the relevant line departments, mainly Forest, Agriculture and Rural Development. A decentralized watershed development project, Gramya I was implemented from 2004 – 2012. Gramya I was financed by the World Bank and was successfully implemented by the WMD. Based on the success of the project, World Bank further financed the Uttarakhand Decentralized Watershed Development Project II (UDWDP II) also referred to as Gramya II to focus on rainfed agriculture development through the use of watershed development tools, particularly rainwater conservation and harvesting and land resource management. The project, UDWDP-II was implemented in villages of 82 micro watersheds covering 200,902 Ha of non-arable land in the hills of Middle Himalayas, lying between 700 m and 2700 m above sea level spread in 8 divisions and 527 Gram panchayats. The project focussed on rejuvenating the natural resource base by significantly reducing soil erosion and runoff loss of rainwater, improving groundwater recharge, and reducing sediment load in the tributaries of the Ganges flowing through the state. The project also constructed water harvesting structures and small irrigation systems on 40,000 ha of arable land, and disseminate new technologies for increasing the productivity of cereal, pulse, and oilseed crops in these rainfed areas, and of high-value vegetables in the currently irrigated areas. It also focused on value chains for selected agriculture and horticulture commodities in addition to building the capacity of targeted Gram Panchayats (GPs) for developing and implementing sound watershed management plans. Keeping the sustainability of the project in view and inclusive approach the project also covered landless and vulnerable households involving them in income generating activities. One of the primary strengths of the project was a decentralized planning process done through Gram Panchayat Watershed Development Plan (GPWDP) undertaken with the participatory involvement of GP members, community and women village members through Women Aam Sabhas (WAS) and A Water & Watershed Management Committee (WWMC) constituted at the GP level to facilitate catchment area treatment activities.

The Project came into effect in June 2014. Out of a total project area of 263,837 Ha, the project has treated 200,902 Ha of the non-arable area with multi-species plantation for catchment treatment and watershed interventions. The World Bank Task team provided all the required support to the project implementing entity with regular and scrupulous supervision and guidance where and whenever required. The Bank extended its commendable support to the project in the areas of fiduciary and quality control and quality assurance related issues. Certain innovative procedures like the introduction of PME (Participatory Monitoring and Evaluation), Women Aam Sabha (Women Panchayats), and Gram Panchayat level planning system have proved to be very successful in bringing holistic measures in the planning and development process. All the civil works have been executed following the World Bank procurement guidelines. Proper care has been taken in ensuring the quality of the work. Extensive consultations have been made with the farmers, the primary stakeholders, at every stage of implementation of the project, which has been worked out as a Social Audit.

Social and environment related issues like Gender Development Plans, Tribal Development Plans, security measures for the labour at the work sites, providing a safe and hygienic environment at the work sites, implementation of IPM, INM etc., have thoroughly been addressed. The project has introduced various innovations to establish sustainability in interventions. Innovations such as the provision of pilot funds involving various innovative activities based on the needs of the community and market feasibility were undertaken, initiatives on alternate energy, expansion of animal husbandry activities and agribusiness growth centres were taken up strategically which were not planned initially.

The vulnerable group interventions were a key pillar of support for the landless and vulnerable households. The project supported a total of 14,148 households against the projected end target of 8,895 households. These

beneficiaries were meticulously identified through a 'wealth ranking' exercise, during the preparation of Gram Panchayat Watershed Development plans (GPWDP).

The project information system developed and implemented by the project for effective monitoring had good appreciation from the World Bank and the Government desires to adopt a similar system in other projects also. Dhaspad Gram Panchayat from the Almora district of the project has been awarded the award for the Best Gram Panchayat in the state by the Jal Shakti Ministry, Govt. of India for its watershed interventions.

All the interventions of component 2 and component 3 coupled with decentralized decision making by the project beneficiaries have facilitated/contributed to achieving the enhanced potential of natural resources and augmenting the incomes of the beneficiaries. Improved utilization of natural resources has been demonstrated through the increased area brought under cultivation (reducing the fallow area) as well as expanding the irrigated area through rejuvenation and development of water resources. The project has adequately involved external agencies during implementation and with all the good efforts by the PMU and the support from the World Bank, the project could achieve the expected Project Development Objectives.

The project has demonstrated exemplary results in doubling farm income through strategic synergy between soil moisture improvement, demonstration of integrated crop management practices and cluster development approach. The project has paved a way for a third phase that will focus more on climate resilient approach for hill agriculture and expanding the forward linkages for marketing of agriculture commodities.

1. Executive Summary

Context

Uttarakhand, a hilly Indian state in the Himalayan mountain range, has about 92 percent of its geographical area in rugged topography, over poor geological formation, making it vulnerable to severe soil erosion and landslides. Implementation of sound watershed development strategies is therefore critical for conserving and sustaining the natural resource base and enhancing agricultural productivity. With this in mind the Watershed Management Directorate (WMD) of Uttarakhand initiated the Uttarakhand Decentralized Watershed Development Project Phase I (Gramya) from 2004-2012 implemented with the financial assistance of World Bank. Based on the success of the first phase and envisioning the need to replicate this watershed development in other parts of the state, a second phase of the project was launched.

Gramya II focuses on development of rainfed agriculture through use of watershed development tools, particularly rainwater conservation and harvesting and natural resource management. The project interventions take forward the successful community-based approach of Gramya I and key learnings from the phase to ensure improved implementation and outcomes.

About the Project

Gramya II targets comprehensive development of watershed-based natural resources to sustainably increase their efficiency and to increase the income of over 66,000 rural families in over 1,000 project villages. The total project cost, including contingencies, was Rs. 10,198 M (US$170 million) with project interventions grouped under three major components (outlined below);

- Component 1: Social Mobilization and Participatory Watershed Planning - ensure community-led participation in watershed planning, implementation and maintenance functions in 527 targeted GPs covering 82 micro-watersheds and accounts for 18% of total project costs.

- Component 2: Watershed Treatment and Rainfed Area Development - integrate arable and non-arable land development with a ridge-to-valley comprehensive approach by the communities to conserve and develop the productive potential of natural resources through (i) watershed treatment and source sustainability investments for 218,787 ha of non-arable lands including inter-GP areas; (ii) rainfed agriculture development investments for arable lands (45,050 ha) to conserve soil moisture and enhance rainfed crop productivity in 37,157 ha (net); harvest and recycle rainwater runoff to expand irrigation coverage and enhance productivity of high value crops in 7893 ha (net), and (iii) ensure localized fodder production as a part of moisture conservation package to support cross bred cattle and increase milk productivity for 47,440 households; all at a projected investment cost of 53 percent of total project costs.

- Component 3: Enhancing Livelihood Opportunities - ensure market access and better prices for the high-value vegetable producers (PAD estimate of 20,816 farm families) in 1,066 project villages and supporting individual and group-based income generating activities for the targeted 13,420 vulnerable households as per PAD in the project area. The component would account for 11 percent of the project costs.

Gramya II - Final Impact Assessment

The Gramya II project was being implemented from 2014-21, and an extension of 7 months was granted to the project from July 2021- January 2022, necessary to make good the time lost due to the Covid-19 pandemic. This report is part of the borrower's completion report, and covers seven years of project implementation period from inception in 2014 to January 2022. The report focuses on evaluation of the progress made vis-a-vis target initially set (some of the targets were deliberately kept fluid for experimenting, allowing flexibility for need based interventions and subsequent revision) and assess their outputs and outcomes (impacts), so as to offer reflections and way forward to ensure sustainability of the physical and social infrastructure created and nurtured as part of Gramya II. The evaluation is based on the comparative

analysis of performance in the project areas before (results of baseline assessment conducted in 2014) and after (October-December 2021) and compared to the control areas where no watershed development related activities have been conducted.

A total of 80 project villages and 22 control villages were covered during the final impact assessment. The household survey for project areas covered all the households as covered in the midterm study and 5 percent additional sample from baseline assessment. The total sample for project area was 3,625 households and for control area was 1,040 households. The evaluation findings are drawn through a consultative approach adopted with Watershed Management Directorate (WMD) and all the other state level stakeholders, including field level agencies (ABSO and FNGO). The overall objective of this evaluation is to follow the critical OECD areas of relevance, coherence, effectiveness, efficiency, and sustainability.

Social Mobilization and Building Social Capital

Gramya II, evolved from the learnings of earlier Gramya I, thrusted great emphasis on inclusive community participation and ownership. The project was designed to create and develop capacity of local institutions for enhancing agriculture production systems. The project framework was such that the implementing agency, the WMD, acts only an initiator and facilitator while the responsibility of planning, selection and implementation of activities is on the community thus putting the onus of management on them. The Gram Panchayats (GP) are the central institutions who are supported by the project staff and project partners (Field NGOs, Partner NGOs).

With this context, social mobilization and capacity building to generate useful social capital was an important component for the project's success. Justly so, about 17 percent of the total project cost was allocated for Component 1: Social Mobilization and Participatory Watershed Planning. Under this component, the GP are provided capacity building for implementation of the GPWDP including the identification of specific interventions to increase effective land use and water resource management and develop agriculture and income-generation activities; and development of watershed treatment plans to guide the preparation and implementation of GPWDP. The other crucial component that has helped in successfully building social capital for the project was the formation Mahila Aam Sabhas (also referred to as Women Aam Sabhas-WAS) to promote participation of women. The engagement of FNGO and MDTs ensured continuous engagement with the community for smooth functioning of the Watershed Management Committee, Revenue Village Committees and other community institutions formed.

4416
Institutions Formed (including User Groups, WWMC, RVC, FIG, Farmer Federations)

1 out of 8
Household's part of a community institution

8741
Proposals presented by WAS incorporated in directly GPWDP

311
members elected in various positions in the PRI institutions incl. 196 women

A total of 25560 trainings, workshops and exposure visits have been conducted altogether for village level farmers and staff. The training and exposure visits have created awareness and enabled farmers to physically witness improved technologies in agriculture, horticulture, livestock and agribusiness and also given them a proven example of success. Gramya interventions focused on encouraging the participation of women as well as other vulnerable groups in the training and exposure visits organized. Participation of women in trainings/workshops and exposure visits has increased from 43 percent in 2014-15 to 56 percent in 2020-21. The greatest impact of Gramya II in the project region is on building gender responsive strategies and encouraging women leadership and their representation in governance. The WAS formation has enabled women to voice their opinions and given a platform to present their issues.

Community consultation for tangible benefits

Assessment was made pertaining to the awareness of villagers on different aspects of the project, i.e., PRA exercises conducted for GPWDP preparation; villagers' participation in the PRA exercises; selection of beneficiaries for various project related activities and incorporation of activities in the GPWDP after screening through Environmental and Social Management Framework (ESMF). 90 percent participants were aware of organization of PRA for preparation of GPWDP in their gram panchayat which pointed towards the fact that PRA for preparation of GPWDP was conducted with good participation by the community and

equal percentage affirmed their participation in PRA exercise. 93 percent of the participants were aware about the procedure followed in selection of project beneficiaries and 91 percent participants were aware about screening of GPWDP activities through ESMF.

To ascertain if complete inclusiveness and equity was maintained in the project activities, participants were asked regarding the justification in selection of beneficiaries during GPWDP preparation with 94 percent of male and 92 percent of female participants responded in affirmative and agreed that complete justification was maintained in selection of beneficiaries while preparation of GPWDP. Overall 94.5 percent of participants agreed to the fact that transparency was being maintained in the selection of beneficiaries from vulnerable and under-privileged sections of the community.

88 percent respondents agreed that transparency was maintained as regards sharing of information on project fund and people are aware about project funds allocation for their respective GPs. An equal percentage affirmed that the financial records are timely maintained and they have access to scrutiny of the same.

Project has made several interventions in terms of capacity building of farmers through exposure visits and trainings on agriculture, horticulture and animal husbandry. People's perception was, therefore, sought to know if these capacity building interventions have had any positive impact on their productivity. On this question, a good 89 percent of participants agreed that increase in productivity has been observed as a result of technical trainings and exposure visits. An overwhelming 95 percent of the participants agreed that technical improvement was as a result of project interventions which points to that fact that the project has been successful in not only reviving the ailing traditional occupations but has also been able to introduce technological advancement in them.

Watershed Treatment and Source Sustainability

About 83 percent of the project area (non-arable) had been treated with resource conservation measures, including the inter-GP area accounting for 44 percent of the project area, which ensured a prioritized ridge-to-valley approach. This effort is complimented through several convergence efforts being carried out by other projects in their respective jurisdictions within the water shed boundaries (viz., Reserve forests).

In Gramya II, 2054 streams were identified (carrying less than 50 percent of their capacity) and selected for treatment. By September 2021 (at full project development), almost 99 percent of the treated water sources have shown positive discharge. Some sources that have not shown significant increments, sustained constant rate of discharge without decline. The increase in water discharge was measured through flow change in litres per minute (LPM) in water sources treated or under treatment in project and showed encouraging improvement. The water discharge rate during mid-term was in the range of 12.3-22.2 percent (pre-monsoon) and 13.8-27.0 percent (post-monsoon) on an aggregate basis. The discharge ratio changed to 13.3-25.0 percent (pre monsoon) and 13.0-33.7 percent (post monsoon) during the final impact assessment. Increased water availability through enhanced stream discharge, indicates reduction in scarcity of water availability for irrigation and domestic use (water scarcity reduced from 73 percent to 48 percent at full development).

About 15 percent of the project's total micro watershed area is categorized as moderately erodible (E-1) and 85 percent as medium to highly erodible (E-2 and E-3, respectively. Project interventions designed to reduce overall sedimentation and runoff losses and to ensure source sustainability by rejuvenating all the affected traditional natural water sources have shown a good impact as per the assessment of WAPCOS. The average sediment yield of the representative micro watersheds was 71.6 tons per ha per year and this has reduced to 69.3 tons per ha per year (17 percent reduction). Almost all watersheds show reduction in surface runoff, more than 60 percent of the watersheds shows increase in lateral flows and 75 percent of the watersheds are showing increase in aquifer recharge. Water budgeting analysis shows that overall surface runoff has increased 1.5 percent, lateral flow decreased 0.7 percent, evapo-transpiration (ET) decreased 4.3 percent, water yield from catchment areas increased 4.9 percent, aquifer recharge increased 3.3 percent, storage increased 0.5 percent with respect to baseline period. Crop-water budgeting promotes water-use efficiency while ensuring upstream-downstream hydro-solidarity for maintaining base flows in the mountain ecosystems.

The project has made important contributions to increasing the area under irrigation. The PAD indicates the target to be cumulative additional area of 7800 ha by end of project with a baseline of 5262 Ha. The net area

to be achieved during the project period was 2538 Ha against which the project resulted in an increase in irrigated area of over 5,359 ha over baseline by converting from rainfed and previously fallow arable areas. The achievement was 211% over the targeted net area of 2538 Hs. The project achieved a cumulative 10,621 ha against targeted cumulative area of 7800 Ha including area during baseline, which was over 200 percent achievement against the target (increased Ha of rainfed area under irrigation)

This is attributed to establishment of irrigation sources in the region such as construction of irrigation tanks, installation of pipelines, solar lift irrigation systems, ponds, and *gul*[1]. With the additional area brought under irrigation, and adoption of water use efficiency through micro-irrigation and mulches, had resulted in an increase of cropping intensity from 172 to 228 percent.

Forestry

As a part of watershed treatment and source sustainability component, the project has undertaken interventions such as afforestation activities, Assisted Natural Regeneration (ANR) of oak trees, plantation for fodder and fuel wood. Implementation of these interventions was the shared responsibility of various stakeholders. Van Panchayats were a key stakeholder group who were primarily responsible for implementation the plantation activities with support from gram panchayats, multi-disciplinary teams and local communities. The progress has been very encouraging with achievement of 3897 ha in afforestation, 552 ha in ANR, 4946 ha in horticulture plantation and 1078 ha in fodder plantation.

21.2%	4.7%	73%	87%
Increase in Biomass	Barren land covered with afforestation	Survival rate of plantation	GPs reported decrease of Fodder load on forest

This has resulted in a positive change of 21.2 percentage point of increase in biomass over the baseline. The biomass of the treated areas has increased due to an increase in vegetation cover as a result of plantation initiatives, the increased area under agriculture and protection against grazing. The treated plantation sites have higher values of diversity & species richness as compared to the control sites. Increase in the species richness and diversity index were largely due increase in the moisture content through the various soil and water conservation structures.

The project encompassed activities that aimed at managing natural resources along with improvement in the overall condition of the people residing in the project area through the participation of the local village community in afforestation and plantation activities. Proper selection of local and endemic species suitable for different zones played a very important part in the success of the plantation programme as climatic conditions vary with the altitude and other environmental aspects. The process of plantation i.e. selection and preparation of the site, digging of pits, spacing between the pits, alignment and size of pits, planting of seedlings, protection of plantation sites, weeding and other maintenance operations have been effectively implemented by the community through proper capacity development initiatives.

The areas in the afforestation programme were taken up already had some existing plants, but the density of existing vegetation was less and there were open patches available for the plantation. Under the fuelwood plantation programme, blank patches were taken up for plantation and those species were preferred which provided a good source of fuelwood. In all these plantation models, plantation techniques which included site selection and development, digging and filling of pits, construction of protection wall or fence, plantation of saplings and its aftercare were similar. Plantations also offered important environmental benefits such as sustainable production and improved soil, water quality and salinity mitigation, carbon and biodiversity benefits.

In 86 percent of the GPs, the members were reportedly satisfied with the plantation work in watershed treatment area. The overall average survival percentage within the surveyed sites was around 73 percent with the lowest in Dangi MWS (60 percent) and highest in Kalsi MWS (85 percent). Amongst the project sites surveyed, 57 percent GPs have reported a plantation survival rate between 70-75 percent. 64 percent of GPs where fuel wood plantations were undertaken the overall survival rate is higher at 72 percent compared to

[1] traditional irrigation canals

fodder plantations which is at 65 percent. Wherever there was low survival the primary reason was because of grazing, frost and lack of desired rainfall. 100 percent of the GPs reported participation of the community in the selection of species for plantations and 97.6 percent reported satisfaction on the protection activities undertaken on plantation sites as witnessed.

85.7 percent gram panchayat members indicated that new plantation activities had led to the decrease in time spent in collection of fodder and 100 percent of GP also reported higher impact on income generation activities for women due to plantation activities as a result it has also led to their greater involvement in other institutional activities such as gram panchayat planning meetings, WAS, school committees, etc. 85 percent GPs also reported that women were involved during planning activities of plantation execution.

A greater percentage of households now have access to fodder and grass from their own land, while a substantial decrease in grazing has been reported. Fodder and fuelwood stress on the natural forest has reduced with a lesser number of households collecting them from the forest. There has been a reduction in the quantity of collection of fuel and fodder as the same is available now in own and common land in the village. New plantation activities have led to a decrease in time spent in the collection of fodder. Community reported a major impact on income generation activities for women due to plantation activities which have led to their greater involvement in institutional activities.

The other significant impacts reported are reduction of 4.7 percent barren land in the project area attributable to the forestry interventions, increase in access to fodder and grass by households from their own land with an accompanying decline in grazing time, reduced time for fodder collection and reducing drudgery. Socially, women reported to have a greater say in development planning and in getting more employment opportunities linked to forestry activities.

Agriculture & Horticulture

Agriculture is the mainstay occupation of the people of Uttarakhand. The estimated total cultivated area in the state is 768,000 ha, 54 percent of which is in the hills. The project area has over 60,000 farmers, currently cultivating about 40,000 ha of arable lands. Rainfed cropping patterns are dominated by cereal crops, millet, and pulse crops. Major crops are ragi, wheat, paddy, pulses, rapeseed/mustard accounting for 75 percent of the cropped area in the project villages.

The project has been successful in improving the productivity of irrigated crops by 60 percent and that of rainfed crops by 33 percent. The key factors contributing to the increase in productivity in irrigated crops are extensive field demonstrations of high yielding crop varieties, availability of water, following of crop husbandry practices especially nutrient management with integrated use of FYM, vermi-compost, green manure and adoption of improved techniques. For enhancing rainfed crop productivity, the main thrust has been given for adoption of improved varieties of crops, quality seeds, adopting low water-requiring crops like finger millet, wheat, maize, other nutri-cereals, pulses, and oilseeds based on bio-physical and resource suitability. This is combined with improved crop husbandry and rainwater conservation practices, including life-saving irrigation with stored rainwater at critical stages of crop growth for maximizing productivity. Along with high yielding and hill recommended crop varieties, yield is also attributed to appropriate crop husbandry, integrated nutrient management, adoption of improved crop production technologies and soil moisture conservation practices as recommended under the project.

195%
Overall Cropping intensity

33%
Increase in productivity of select rainfed crops

60%
Increase in productivity of select irrigated crops

67%
Farmers following soil moisture conservation and improved crop management techniques

The Intermediate Indicator 5 shows that over 67 percent of the farmers in the project area practice improved crop production technologies and soil moisture conservation practices. Seed treatment, vermi-compost, bio compost, mulching are some of the popular practices followed by the farmers as a result of the project interventions. The extensive adoption of improved crop production technologies and soil moisture conservation practices has helped considerably in the manifestation of the genetic potentials of HYV in enhanced productivity at the demonstration and adoption plots. Continuous support through extension

services helped create awareness, adoption support and capacity building of the farmers resulting in farmers largely following the recommended package of practices.

The community feedback suggested that majority of the farmers are convinced about the benefits of the recommended techniques and followed nutrient management recommendations, planting high yielding variety of crops, bio-compost pits and vermicomposting. Beneficiaries have appreciated the provision of tools and implements. Promotion of small sized gender friendly tools that are appropriate for use in the hilly regions has been widely appreciated and these equipment are also easily available through custom hiring provision from the federations.

Increase in productivity and production have helped farmers in the project areas experience improved incomes due to satisfactory and reliable yields over the years. Farmers have also benefited from the production and sale of premium quality agricultural produce, which has fetched them the premium price. The project has helped farmers reduce the cost of production by 25-30 percent. This is attributed to the on-farm production of organic inputs (manure, sprays and seeds), using local resources judiciously coupled with 10-15 percent price premium for high quality naturally grown produced has enabled farmers to increase income by almost 50 percent. With increased incomes and lower costs of production and sale, farmers have higher disposable incomes which are being utilised for better farming inputs as well as for satisfying needs of the family. Many farmers are opting to lease the uncultivated lands of neighbouring farmers who have migrated out, thus getting the opportunity to increase their cultivation area. Coupled with availability of irrigation and marketing support through ABGCs and Federations, this has helped farmers further increase their incomes.

Along with increased production, farmers have also adopted improved crop production technologies especially ones that forego the use of chemical and use organic and natural ingredients. Establishment of vermicompost units, use of vermi-wash, herbal pesticides and biofertilizer units are some of these practices that farmers have adopted on a fairly large scale in the project areas. The practice of using organic inputs has increased the potential of farmers to go for organic production. Chemical free produce is not only better market value but also has higher health benefits. Sufficient production for subsistence and income has resulted into the food security of the area. Secure nutrition of the family with diverse and healthy food produced on own farms, good working conditions for both men and women due to less exposure of harmful chemicals, natural farming using local knowledge and tradition as well as new and improved technologies has rejuvenated the interest of farmers in agriculture.

Agribusiness

The agribusiness component of the Gramya 2 project was envisaged to encourage aggregation of farmers into FIGs to allow for collective marketing and further formation of Farmer Federations for the collectivisation and management of FIGs and to explore marketing opportunities for better positioning and marketing of the fresh as well as processed produce. However, over the course of the project, it soon became evident that the production levels of agricultural produce had increased exponentially more than anticipated. The project also successfully aggregated over 10,000 farmers into FIGs by the third year against a target of 6,000 resulting in the need of focused efforts to provide marketing support to the increased volume of production. Thus, the Agribusiness component became an important one for the project and the project interventions were accordingly planned for the growing marketing and value addition needs of the farmers.

The project has also promoted the diversification through adoption of floriculture, horticulture and medicinal plants to gain commercial advantage for the farmers. Moringa, strawberry, kiwi, coloured capsicums, zucchini, broccoli, etc. are some of the promoted crops. A total of 21 FF have been formed till Nov 2021. The progress with respect to self-sustainability of the federations has exceeded the target and volume of marketable produce has increased multifold.

1488
Farmer Interest Groups formed with more than 17000 farmers

21
Farmer Federations formed 1259 FIGs with 13938 farmers

10
Agribusiness Growth Centres created

In addition to the planned efforts for marketing and value addition, the project has established 10 Agribusiness Growth Centres (ABGC) which are managed by federations in areas where marketing efforts were highly necessitated. ABGC are inclusive centres that support the farmers in exploring, developing, processing, marketing, knowledge sharing, information dissemination and financing of the bulk farm produce from the village clusters. There are 6341 members from 556 FIGs linked to the 10 growth centres. The growth centres provide input and output support facilities to the farmers in the nearby village cluster. The following common facilities provided to the farmers;

i. Input delivery providing high yielding varieties of seeds, fertilizers, insecticides, and pesticides.
ii. Animal health services, vaccination, artificial insemination through paravets
iii. Farm machinery bank /custom hiring of equipment
iv. Advisory services to the farmers regarding value chain development
v. Enhancement in the skills of the farmers through trainings and orientation Programs
vi. Facilitating market linkages through buyer-seller meets, e-marketing and networking.
vii. To create a platform to provide service providers for logistic support.
viii. Grading and packaging services and other post-harvest value addition services

The products created by the FIGs and federations are marketed under the 'Gramyashree' brand through outlets at the federation as well as sold to other shops in the areas and in nearby towns and cities. Several marketing linkages have been established with retailers, bulk buyers and industrial to facilitate the sale of the produce in profitable rates along with 10 federation operated stores across the 9 divisions. The federations also have presence on Facebook, Instagram for the promotion and marketing of their products and also take orders via WhatsApp and the website www.gramyashree.in. They also have facilities for accepting online payments and payments through money wallet apps like PhonePe, Google Pay, Paytm etc.

The agribusiness interventions under the project have helped promote value chain addition through formation and capacity building of FIGs and their consolidation into Farmer Federations (FF). A cluster-based approach was adopted and farmers were encouraged to undertake activities in a cluster of two or three villages to achieve economies of scale and develop compact supply chains. The project has connected 17,488 farmers through 1488 FIGs and the groups have been provided extensive capacity building training to be able to function as per group governance norms. The volume of produce marketed by the FIG in comparison to the total production of the member farmers was 72 percent at the beginning which has risen to 82 percent at the end of the project. Additionally, the value of produce marketed by the FIG increased each year at the rate of 100 percentage except in years 2019-21 primarily because of the Covid-19 pandemic.

Animal Husbandry

Uttarakhand is well endowed with a variety of livestock, cattle, buffaloes, goats, and poultry. Gramya II has adopted an integrated approach of livestock development, which includes controlled breeding, adequate feeding, and proper health care management in order to enhance the lifetime productivity of the livestock. Under its livestock breeding program, the project supports natural breeding through establishing Natural Breeding Centres (NBC), Artificial Insemination (AI) through training paravets and mass AI through collaboration with the Animal Husbandry department. These concerted efforts have resulted in the improvement in productivity, health and wellbeing of livestock and thereby improvement in the overall livelihood of the people in the project area.

Breed improvement of local nondescript milch animals including goat, health care services, stall feeding and augmentation of nutritious green fodder are the interventions envisaged under animal husbandry components of the project. Under its livestock breeding program, the project supported activities like (i) Natural breeding through establishing Natural Breeding Centre (NBC) with bulls and bucks of high genetic merits (ii) Artificial Insemination through establishing Paravet Centres run by well trained and equipped Para-veterinarians, who also undertake minor veterinary services in the field and (iii) Mass Artificial Insemination in convergence with ULDB.

Natural breeding is one of the preferred options for breed improvement by pairing of local non-descript milch animals with bulls of high genetic merit. The project has established 1132 Natural Breeding Centres (NBC) for cows, buffaloes and goats at strategic locations covering a cluster of 4-5 villages. AI and minor veterinary services for livestock are provided by 44 paravets trained under the project. Both these interventions- NBC and Paravet centres, have provided an opportunity to earn through livestock breeding

services in the community. The AI records show that that out of 15500 coverings in buffaloes 10300 progenies were born and out of 1537 coverings in cows 780 progenies were born showing a success rate of 50-60 percent. Under the mass AI program of the project in collaboration with Animal Husbandry department, insemination has of animals has been done with ordinary as well as female sorted sexed semen. Mass AI has been done for 2100 cows across the project area and the success rate for ordinary semen was 46 percent and for sex sorted semen was 60 percent.

Genetic improvement programs of the project have produced a sizeable number (9,286) of improved breed milch animals, whereas goat breeding through NBCs has yielded 5,313 improved progenies in the project area. The success rate of NBCs and Paravet Centres in terms of number of services undertaken and number of offsprings born was remarkable in that they altogether attained successful conceptions in 55 percent or more animals. Out of total F1 female progenies born 369 have become the first calver and 1,255 have attained pregnancy, yielding 5-6 times more milk, reduced 8-10 months age at first calving and less dry period by 4-5 months leading to more profitability from the dairy enterprise, as reported by the farmers during the interviews and group discussions. This indicates the overall success of the breed improvement program in the project area.

Animal health care activity is one of the components envisaged by the project for the enhancement of milk production and to reduce the farmers' losses by want of health care service to their livestock holdings. The project has organized several health camps through the project team, Livestock Extension Officers and paravet centres established under the project. It was found that there was a reduction in infertility of the livestock across the target villages and increased awareness among cattle owners about the best practices of cattle rearing like proper nutrition and vaccination against contagious diseases. The health camps have helped the livestock owners in keeping the good health of the animals with a better economic return. Deworming, Vaccination, treatment of sub-fertile animals and veterinary aid etc. helped in saving energy, time and money in treating affected animals

Animal housing, stall feeding and fodder management program has been promoted by the project as means of increasing farming system productivity in the area while at the same time ensuring environmental protection, especially protection of soil erosion from cattle grazing. The livestock sheds/shelters were in great demand from beneficiaries as they provided hygienic space to keep cattle, protected them from harsh weather conditions and prevented them from getting attacked by predators and being stolen. During the group discussions, it was found that stall feeding through mangers ensures hygienic feeding space for the cattle and were beneficial in reducing the fodder to get spoiled and discouraging the practice of open grazing, partially responsible for soil erosion. Animal Chari providing clean drinking water to animals, especially during water scarce summer months have not only saved the precious animal lives but also saved valuable time of animal owner spent on fetching water from sources situated faraway places. The charis constructed for drinking water have helped save on an average of 1 hr. of time per day, 30 hrs. in a month (4-5 person-days), accounting for Rs. 1500-1800, which otherwise they would have spent in fetching drinking water from distant sources. With mangers livestock owners are saving Rs. 1200 per month worth of fodder from spoilage and wastage.

Augmentation of fodder production was one of the key highlights of the projects which envisaged on-farm fodder production through distribution of fodder minikits, Napier crop Broder Plantation and forage row plantation. Due to the introduction of fodder minikit containing improved fodder grasses for on-farm production and Napier crop on-farm boundaries plantation and uncultivated land as well as forage row plantation availability of green fodder have increased significantly. Availability of fodder has also increased in the form of agriculture waste residues (as more agricultural land has been brought under irrigation) and protection of common land from grazing, forage and pasture development programmes in Van Panchayats and Civil Soyam lands, attributing an increased milk production. Availability of fodder in nearby fields, has also reduced the time spent on fodder collection from forest by women and other members of the family due to which they are able to save ~1.5-2 hrs. per day, thus 6-7 wage days per month. This has not only resulted in reduction in hill women's drudgery but has helped them to engage themselves in other gainful activities.

The number of improved breeds of livestock has increased as compared to the baseline level mainly due to breed improvement program of the project and line department as well. The good

performance of milch animals amongst the VG groups has also contributed to the increase in the number of improved breeds in the project area. With the integrated livestock development program of the project has not only resulted in the increase of their lifetime production of milk, meat and other livestock products but also has helped the beneficiary in gainful activities of livestock rearing with better economic return, thus enhanced livelihood and increased consumption of animal meat and milk products.

Alternate Energy

The Project is based on various environmentally sustainable and energy efficient approaches and encourages the adoption of environment-friendly energy sources such as biogas plants, solar power, and pine briquetting. Such alternate energy sources mean less exploitation of the forest resources and reduction in drudgery of women. Across all interventions, successfully, significant changes were made to the initially proposed project design for alternate energy interventions. These adaptations included technical changes, approaches or management systems. The modifications were possible because the Project was flexible enough to adapt to practical needs which arose during the implementation and afterwards. In order to sustain the systems, the availability of maintenance and repair services for the implemented technology was vital. In cases wherever required, maintenance and repair services were an integral part that came along with the installation.

One of the major achievements under the project initiative is the establishment of 24 Solar Powered Lift Irrigation systems bringing in 241.68 ha of area under irrigation. The big advantage of Solar water lift irrigation are long-term lower costs when compared with diesel or electrically (thermal) powered pumps. Other benefits include an annual saving of Rs. 6,77,708 for 7,456 solar lanterns, increased participation in informal social gatherings (78 percent) and sense of security (90 percent) through solar street lights. The shifting of rural household from fuel wood to pine briquettes has reduced the fuel wood needs by 1.1 MT per year per household using it. Studies indicate that on an average each of the beneficiary is able to save a cost equivalent of Rs. 452 per month by replacing the pine briquettes with conventional firewood fuel. In addition, they also earn about Rs. 102 per month from the sale of surplus briquettes providing a better livelihood option. In addition to having economic value, they are environment friendly as they have low Sulphur content, reduces CO_2 and CH_4 emission, thus reducing greenhouse gases and associated climate change and 3 Kg of pine briquettes emits equal heat as 10 Kg of conventional fuel wood emits (according to the heating value). Apart from being a technologically viable aspect, gharat also have an important sociological dimension as they have now become a spot of social cohesion, economically very affordable as different bio-resources easily available in nature for its construction and maintenance**.**

It was recognized that two factors were effective in the sustainability of the component: the sense of ownership, referring to the commitment of the beneficiaries to the project and/or the technology, and the satisfaction level of the users were with the technology in terms of energy supply, reliability and the daily operation of the systems. These are in line with the existing literature on sustainable energy interventions, identifying ownership as one of the factors that contribute to the sustainability of rural projects. The intervention provided evidence that ownership was not a problem if individual households were the owners and took responsibility for the technology, as in the case of the solar lantern, solar street light or solar cookers. Similarly, other interventions had ownership of community-based organizations.

The project encouraged and ensured the adoption of environment-friendly energy sources which eventually results in less exploitation of the forest resources (48 percent of respondents have a dependence on forests for fodder and fuelwood as compared to 66 percent in the baseline) and reduced drudgery for women (decreased time by 2 hrs for collection of fuelwood from forests). Thus the stage is now set for the community and community-based organizations to carry the interventions forward. Overall, it can be effectively concluded that interventions on alternate energy not only has made life easier for

Environmental and Social Safeguards

The project envisaged significant, irreversible impacts due to the appeal of the proposed interventions under INM/IPM. Agriculture is one of the focus sectors under this project, with interventions including introduction of high yielding varieties (HYV) and off-season vegetable cultivation. Specific strategies were adopted with the intent of reducing the use of chemicals and ensuring that wherever it is use, their use is optimized and judicial.

Attributable activities leading to such changes in results could be seen in project area as demonstration activities have been taken up on a large scale. The strategy of having a basket of intervention that are community adaptive has made it more successful. Activities such as deep/shallow ploughing, soil testing in convergence with line department and by project, line sowing, organic mulching, seed treatment, seed replacement, IPM, INM, base dose application, terrace repair were found to be successful intervention with a plausibility of having large scale adoption by farmers. Farmers are now proactive in using seed treatment, bio-compost and mulching as it is seen to be most commonly followed practices. deep ploughing and line sowing are also popular as they are easy to implement and incurs low investment.

Through community consultation, it was heartening to note that nearly 91 percent of respondents were aware of the aspect that screening of GPWDP activities was conducted on the basis of ESMF guidelines. A slightly higher proportion of male respondents recorded awareness (92 percent), compared to female respondents (90 percent). While the project has ensured that the ESMF is adhered to and ESG are followed in undertaking various interventions, there is a need to maintain this focus going forward as well. The community are well aware of the environmental & social safeguard measures and are doing their utmost to carry this forward in their planning process and incorporate the same in the development plan in their GPs.

From the capacity building undertaken under Gramya II, about 78 percent of participants trained under INM/IPM and 80 percent of them being women participants. There has been an average increase of 45 percent in regard to the participants undergoing capacity building under IPM Techniques and 36 percent of them adopting IPM techniques. Similarly, 38 percent of the participants have undergone training on INM with the adoption rate of 88 percent of any INM/IPM technologies. The capacity building was in line of the expectation with 87 percent respondents satisfied with the training content and 31 percent of farmers who have already adopted IPM techniques affirmed in continuing the practices. The ripple effect within communities is evident from the fact that an additional 20 percent farmers adopting use of IPM techniques by observing farmers who have undergone capacity building. With the adoption of INM technologies, there has been an increase in area of 112 ha covered under INM.

It has been in the best interest of the project and community as each member of the village community has taken up full and effective participation in the project. The community has displayed its strong sense of ownership by agreeing to share project costs by contributing time and money for project activities. All individuals, RVC, User Groups, livelihood activity groups and the Water and Watershed Management Committee (WWMC) of the GP have implemented decisions taken by the Gram-Sabha. Further, the GP and RVC have kept everyone well informed on all developments and decisions and consulted the community regularly on all issues. The project has ensured transparency through the accessibility of proceedings and records to all community members. Care has been taken that the disadvantaged groups have profited equally from this project. The GPWDP has incorporated provisions to benefit women, the poor, landless labourers, marginal farmers, members of the Scheduled Castes and Tribes, and transhumant populations. Social equity has been the cornerstone of this project.

Findings suggest that recommended practices related to usage and handling of pesticides are being followed by the farming community to a considerable extent as compared to the inception of the Project. Similarly, the adoption of biopesticides and other environment-friendly applications has been well accepted due to the focussed approach and assistance by the project. This also addresses the SDGs as biopesticide-driven sustainable agriculture can reduce poverty (SDG1: No Poverty) and address hunger (SDG2: Zero Hunger). Stewardship of the natural resources is required for the continuous exploitation of the environment for agricultural productivity (SDG6: Clean Water and Sanitation, SDG12: Sustainable Consumption and Production, SDG14: Life Under Water and SDG15: Life on Land). With the adoption of practices, the community is poised to carry forward sound environmentally friendly approaches from the planning to its execution stage.

For the VGA interventions, as observed from income generated for the year 2020-21, the impact of the Covid-19 pandemic has been negligible. Though the year 2019-20 saw a slight decline in business for the VG enterprises, however, once lockdown restrictions were lifted the businesses were able to revive themselves. This was due to the fact that the activities selected under VGA were based on the day to day necessity of people in the area and were planned in such a way that it could sustain itself as it had no competition and people were able to get the required services in time and thus the business was not impacted.

This intervention is a key pillar of support for the landless and vulnerable households. The project supported a total of 14,148 households against the projected end target of 8,895 households. These beneficiaries were meticulously identified through a 'wealth ranking' exercise, during the preparation of Gram Panchayat Watershed Development plans (GPWDP).

The project also has a special component focused on Indigenous People in these micro watersheds: *Gujjars* and *Bhotiyas/Anwals* are the primary communities practicing vertical transhumance (migrating from higher to lower altitude and back to tide over weather and livelihoods), and are passing through 8 of the 9 project districts. Their duration of stay is for a short time ranging from four days to five/six weeks (as stipulated in Environment and Social Management Framework). They were supported under the project with benefits amounting to Rs. 4.4 million comprising of human and animal health camps were organized, in addition, they were provided with complementary support in the form of basic necessities (viz., blankets, tents, solar lanterns, first aid kits etc.). The beneficiaries include 1,351 transhumant families and 62,947 livestock.

Impacts on income generation

The project has created diversified sources to enhance income of farmers. While the primary contributor for increased income was through enhancement in farm measures and livestock services, forward linkages for agri marketting has also created further opportunities for income generation for the target beneficiaries.

Income generation for Vulnerable Groups:

The purpose of addressing the needs of the VGA was integral to the inclusiveness approach of the project. It helped to ensure that along with the farming households, the landless and marginal groups were provided support from the project activities and a balanced distribution of benefits was applied. The VGA component consisted of 3% of the project expenditure while resulting in a 3.5% share in the total benefits received from the project. The benefits incurred are over a long period of time and have resulted in an average annual net income of Rs. 12834 (for individual activities) to Rs. 28,418 (for group activities). The VGA beneficiaries are over and above the direct project beneficiaries who benefitted through project interventions in water, land and agriculture activities.

Income generation from Livestock:

Livestock is one of the main secondary sources of income for farming as well as non-farming households in the project area. The investment in Livestock interventions constituted about 2% of the total project cost while resulting in a 2.5% share in total project benefits. However, the benefits accrued and counted here are limited to the increase in milk yield of the milch animals and the fodder production. The interventions under animal husbandry are multi-layered and could not be monetised but have a cumulative impact resulting from the capacity building of paravets, healthcare of animals, provision of shelters, stall feeding, fodder production, breed improvement in cattle and goats through natural breeding centres as well as artificial insemination and increase in milk yield. Along with this, the project also promoted building a cash economy for the beneficiaries through the promotion of small ruminants (goats) and poultry which helped in increasing the economic resilience of the farmers. However, the computation of this resilience will be determined over a longer period of time and cannot be assessed over the duration of the project.

Employment Generation:

The employment generated due to project activities/interventions has been considered as project benefits and valued using appropriate wage rates. Additionally, employment created as a result of the increased farm work resulting from the increase in area under cultivation, and the increased cropping intensity has also been considered in the project benefits. Employment of local villagers in the plantation, land management and construction activities was ensured throughout the project. The local and rural human resources who were involved in the implementation process of various project interventions had provided gainful employment of 89,82,164 person-days.

Economic and Financial Analysis

Economic analysis is conducted after making appropriate adjustments to financial benefits and costs. Economic project costs are estimated after adjusting for transfers, taxes, subsidies, and converting financial prices to economic prices. Economic prices for internationally traded commodities (fertilizer, rice and wheat) are derived and used. The difference in economic and market prices for fertilizers and use of human labour by farmers in the project area has resulted in economic rate of return (ERR) marginally lower than financial rate of return. Present value of discounted project benefits over the project life, due to the project interventions, are estimated at Rs 11.08 billion, contributed by watershed services, forest plantations, agriculture, animal husbandry, agribusiness and IGA. The economic rate of return for the project as a whole is 24.55 percent.

ERR	NPV	BCR	FRR	NPV	BCR
24.55%	11.08	2.52	**26.91%**	12.68	2.74

2. Project Background

2.1 About the Project

The Gramya II (Uttarakhand Decentralized Watershed Development Project – Phase II) project is being implemented in the state of Uttarakhand with the financial assistance of the World Bank. The state is nestled at the foothills, middle and upper reaches of the Himalayan Mountain range with 92 percent of its 53,500 square kilometres area having a rugged topography. Due to its location, topography and geological peculiarity, the state is vulnerable to severe soil erosion and landslides. Additionally, the ongoing climate crisis has further enhanced the need for dedicated interventions to conserve and manage the watersheds to help safeguard the fragile Himalayan geology and ecosystem.

The Gramya II project was conceptualized to build upon the success and learnings of the Gramya I project implemented from 2004-12. The total project cost was 170.0 million US$ with IDA Credit of 121.2 million US$ (71.3 percent), state contribution of 45.8 million US$ (27.0 percent) and beneficiary contribution of 3.0 million US$ (1.7 percent). The Watershed Management Directorate (WMD) is the lead implementation body for Gramya II. The project followed the same successful community-based approach of Gramya I. Its major focus has been on development of rainfed agriculture through use of watershed development tools, particularly rainwater conservation and harvesting and natural resource management.

The Project Development Objective (PDO) of Gramya II is to *increase the efficiency of natural resource use and productivity of rain-fed agriculture by participating communities in selected micro watersheds of the Uttarakhand state.*

The project has been implemented in villages of 82 micro watersheds (MWS) of middle Himalayas, lying between 700 m and 2700 MSL. The MWS were selected following a scientific and meaningful set of criteria including but not limited to the following; location contiguous to Gramya I, not covered by any other similar projects, high vulnerability to soil erosion, degraded and marginal lands, low agricultural productivity and remoteness and inhabited by relatively more SC and ST, the socio-economically marginalized communities.

2.2 Project Components

Gramya II focuses on micro watershed treatment of 220,000 ha of non-arable lands to enhance agricultural productivity on 40,000 ha of adjacent arable land. The project has four core components:

Component 1: Social Mobilization and Participatory Watershed Planning

The social mobilization component focuses on mobilization of GPs in order to prepare integrated and coordinated Gram Panchayat Watershed Development Programs (GPWDP) including the identification of specific interventions to increase effective land use and water resource management and develop agriculture and income-generation activities; and development of watershed treatment plans to guide the preparation and implementation of GPWDP. It focuses on increasing stakeholders' participation in GPWDP preparation especially participation of women by forming Mahila Aam Sabhas (also referred to as Women Aam Sabhas) and ensuring smooth functioning of the Watershed Management Committee and Revenue Village Committees.

Component 2: Watershed Treatment and Rainfed Area Development

The Component aims to enhance biomass production, increase productivity of rainfed and irrigated crops, and improve discharge from the identified water sources. It supports GPs in implementing GPWDP through:

Sub-Component 2a - Watershed Treatment and Water Source Sustainability

This sub-component focuses on GPWDP implementation for effective management of land and water resources for improving groundwater recharge, reducing runoff and soil loss, and harvesting rainwater for irrigation through watershed treatment initiatives & source sustainability. The core objective is to carry out watershed treatment activities including construction and rehabilitation of check dams, ponds, irrigation channels and tanks, and roof water harvesting structures; preparation of agriculture terraces and vegetative field boundaries; and rehabilitation of bridle paths, small bridges and culverts. The sub-component also focuses on carrying out water source sustainability activities including, inter alia construction and/or

rehabilitation of soil conservation structures; border plantation of grasses; carrying out of forestry activities; and promotion of alternative energy source practices.

Sub-Component 2b - Rain fed Area Development

This sub-component aims to increase the productivity of field and horticultural (mainly vegetables) crops grown in the project watersheds. It also supports the provision of improved seeds and promote innovative agronomic technologies in rainfed and irrigated areas. It includes demonstration of high yielding agricultural crops (for rainfed & irrigated area), poly tunnel, polyhouse, vermi-compost, orchard development, homestead plantation & seeds and seedlings distribution. Additionally, there is also a sub-component of Animal Husbandry program, under which interventions are undertaken in Para vet (AI services), Animal Chari and Shelter/shed, Veterinary camps, Manger & Natural Breeding Centres along with a fodder production program focused on Napier plantation.

Component 3: Enhanced Livelihood Opportunities

This component supports agribusiness development, improving livelihoods of vulnerable groups, and assist Gramya-I GPs in consolidating watershed development activities. It has following three sub-components:

Sub-Component 3a - Agribusiness Support

This sub-component promotes agribusiness development and support through formation and capacity building of FIGs and their consolidation into FF, development of agribusiness plans and supply chains (including marketing support, collection, grading, packaging and processing centres) with technical backstopping by project teams; and Capacity building of community-based institutions (FIGs and water harvesting structure user groups). In the selected divisions, agribusiness activities are being phased in with emphasis on formation of viable FIGs, dissemination of technologies, production and distribution of quality seeds and seedlings, training through demonstrations and establishment of linkages.

Sub-Component 3b - Support for Vulnerable Groups

This sub-component promotes equity in project benefit through support to vulnerable transhumant, landless and marginal farmer households for improving their livelihoods. Income generating activities, e.g., carpet weaving, handicrafts; livestock rearing, etc. are supported through livelihood activities supported under the GPWDP and the formation of vulnerable groups of marginal farmers owning less than 0.1 ha land.

Sub-Component 3c - Consolidation of Gramya I Activities

This sub-component focuses on the repair of the damaged assets created in Gramya I and strengthen the business planning and management capacity of Farmers Federations formed under Gramya I to develop them as sustainable producer businesses.

Component 4: Knowledge Management and Project Coordination

This component includes capacity development of all stakeholders for promoting convergence in selected micro watersheds. This component supports extensive interdepartmental consultation and planning exercises.

Sub-component 4a - Knowledge Management

This sub-component covers institutional strengthening and capacity development activities covering a variety of thrust areas ranging from natural resources management, agriculture systems, development, skill development, livelihood enterprise development, gender sensitization, governance, legal issues, institutional strengthening, general awareness building etc. for GPs, VPs, farmers, livelihood groups, project staff, NGOs and other stakeholders. The activities include training and workshops, skill development, exposure visits, farmer field schools, hands on demonstrations, etc. for different groups of stakeholders. Other institutional strengthening activities include establishment of division-level training cells and development of model micro-watersheds as on-site demonstration and training sites for training farmers, village communities and project functionaries.

Sub-component 4b - Project Coordination

This sub-component finances the management and supervision of Project implementation. The component also supports the management of project implementation including monitoring and evaluation through an ICT-based monitoring information system and social accountability and grievance redressal mechanism.

3. Project Description

3.1 Project Approach

An ICAR analysis in 2018 showed that close to 50 percent of the state's area is above the tolerance limit of soil loss. Sheet erosion and landslides contribute substantially to soil loss resulting in the decline of productivity of agricultural land. The major causes of erosion in the state could be attributed to weak geological formation, active seismicity and deforestation, anthropogenic activities like uncontrolled deforestation and shifting cultivation. In this context, the project has undertaken several watershed treatment measures both at catchment and command areas to retain soil moisture regime, rejuvenate water sources and increase people's participation in adopting similar measures and in turn gain benefits out of it.

Gramya II was designed to be planned, implemented, managed, and owned by the community through a participatory approach involving all stakeholders at various levels. The project was implemented over seven years from 2014 to 2021 spread across three phases- preparatory phase, planning stage and implementation & consolidation phase.

A watershed is a hydrological unit from which runoff drains and is collected through a common outlet. The catchment area of a stream or river in which water is collected is also a watershed. Every stream, tributary, or river has an associated watershed, and small watersheds aggregate together to become larger watersheds. Watershed development is necessary to be adopted for the conservation, regeneration and judicious use of the natural resources- land, water, plants and animals. The approach of watershed development projects has shifted from being a scientific proposition to a more people driven initiative where community participation and hydrology are applied in combination. Development activities can take place in a planned and efficient way if they are implemented at the watershed level which is also the naturally developed unit of human settlements. Watershed development projects comprise of interventions that focus on conserving soil and water for rainfed agriculture, recharging of underground water, and capturing surface runoff into ponds, trenches and other similar structures meant for water storage. Watershed development is a primary tool of the Government of India (GoI) to increase agricultural productivity and reduce rural poverty.

The project engaged partner NGOs to direct implementation activities involving planning, implementation and management of the project. Major investment has been on catchment area treatment of about 220,000 ha of non-arable land in the hills, ranging in elevation from 700 m to 2,700 m above sea level. This has helped to rejuvenate the natural resource base by significantly reducing soil erosion and runoff loss of rainwater, improving ground water recharge, and reducing sediment load in the Ganges and its tributaries flowing through the state and expected to continue in the coming years. The project has constructed water harvesting structures and small irrigation systems catering to 40,000 ha of arable land, and disseminated new technologies for increasing productivity of cereal, pulse, and oilseed crops in these rainfed areas, and of high-value vegetables in the irrigated areas. It has contributed to develop value chains and infrastructure for selected agriculture and horticulture commodities in addition to building capacity of targeted Gram Panchayats (GPs) for developing and implementing sound watershed management plans.

3.2 Project Area & Beneficiaries

The project area for Gramya II covered villages of 82 micro watersheds of Middle Himalayas, lying between 700 m and 2700 m above sea level. The focus of this project was to develop and enhance productivity of rainfed areas by adopting a participatory watershed management approach therefore about 527 GPs of state which have maximum problems of erosion, poverty and lack of infrastructure facilities were chosen for the implementation of the project.

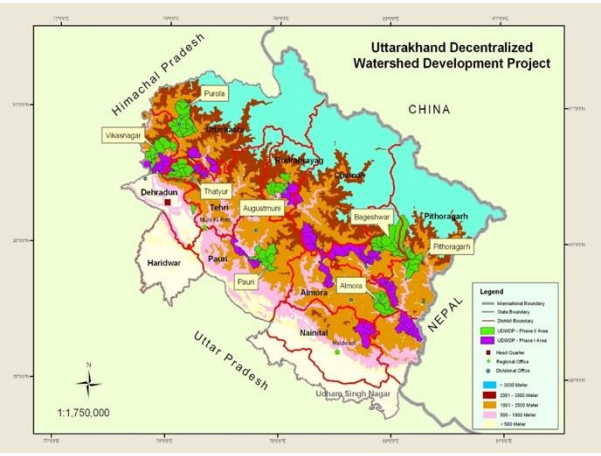


Figure 1: Coverage Area of Gramya II

Table 1: Coverage Area of Gramya II									
District	No. of MWS	Area (ha.)	Forest Area (ha.)	Agriculture Area (ha.)	Barren (ha.)	Gram Panchayat			No of Revenue Villages
						No.	Area (ha.)	Population	
Almora	9	28396	14987	12303	1106	87	24421.12	48642	188
Uttarkashi	17	45103	31233	9727	4143	68	9820.12	37918	120
Dehradun	9	29242	8778	8270	12194	56	21016.77	35794	76
Thatyur	13	31730	11977	8306	11447	78	17833.16	36577	143
Rudraprayag	6	19201	11609	7449	143	61	7885.40	45559	107
Pithoragarh	9	25739	17206	6350	2383	63	21791.12	30138	147
Bageshwar	11	55296	35666	6672	12920	43	34456	33420	78
Pauri	7	26713	9373	10980	6360	62	12091.42	22046	175
Model MWS	1	2417	1365	789	95	7	4023.41	2928	23
Total	**82**	**263837**	**142194**	**70846**	**50791**	**527**	**153338.5**	**293022**	**1057**

The project covers 527 GPs and expected to benefit about 66,352 households and a population of almost 30 lakh individuals. The key stake holders in the project are medium and small farmers, vulnerable groups, PRI institutions, line departments and Watershed Development Directorate, the nodal agency for implementing the project. Gramya II is by far the largest, most inclusive and most comprehensive watershed development project implemented in the state of Uttarakhand.

3.3 Project Budget Allocations

The project cost was 170.0 million US$ with IDA Credit as 121.2 million US$ (71.3 percent), State contribution as 45.8 million US$ (27.0 percent) and beneficiary contribution as 3.0 million US$ (1.7 percent). Following is the status of expenditure as of Jan 2022.

Table 2: Project Budget Allocations (at project conception)								
Project Components	Project Cost		IDA Financing		GoUK Financing		Beneficiary Contribution	
	Million US$	%	Million US$	%	Million US$	%	Million US$	%
Social Mobilization and Participatory Watershed Planning	21.95	14.4	8.84	8.3	53.6	0.0	0.00	0.0
Watershed Treatment and Rainfed Area Development	87.97	57.8	70.36	65.9	16.7	44.3	7.77	99.2
Enhancing Livelihood Opportunities	17.05	11.2	13.64	12.8	20.0	53.1	0.06	0.8
Knowledge Management and Project Coordination	25.32	16.6	13.98	13.1	35.2	93.4	0.00	0.0
Total Project Cost	**152.29**	**100.0**	**106.82**	**100.0**	**37.70**	**100.0**	**7.83**	**100.0**

The actual project amount disbursed under IDA financing was 107.28 million US$ with 38.31 million US$ as GoUK Financing and 7.83 million US$ Beneficiary Contribution. The reduction in the budget was a result of the fluctuation of the SDR US$ value.

3.4 Institutional and Implementation Arrangements

Implementation of Gramya II was done with the successful involvement of three important stakeholder groups: (i) Village communities and GPs; (ii) WMD; and (iii) NGOs and other service providers. The key Panchayat level institutions involved in implementation of the project include Gram Sabha, Gram Panchayat, Water and Watershed Management Committee, Revenue Village Committee, Mahila Aam Sabha, Van Panchayat. The various field level stakeholders involved are the Multi-Disciplinary Teams (MDT), FNGO, and Agribusiness Support Organization (ABSO) and District Level Watershed Committee.

4. Project Relevance, Efficiency & Effectiveness

4.1 Project Objectives Design

The Gramya project was designed to addressed the development concerns of the hilly terrain of Uttarakhand where 80 percent of the population are dependent on agriculture and face challenges such as lower crop yields in rainfed agriculture, poor in-situ rainwater conservation and loss of fertile top soil due to rapid water runoff. In Uttarakhand, majority of the farmers are marginal and average land ownership is 0.43 ha. as against the national average of 1.08 ha. and about 10 percent of the cultivable land remains unutilized[2]. Farmers practice sustenance agriculture, growing only a few crops in the year, majority of which are cereals. Due to the topography of the region, irrigation is also rare and a large portion of farming is done as rainfed. The farmlands also face threat from wild animals such as monkeys, wild boars and porcupines, that destroy the crops and often lead to farmers abandoning cultivation. As farming is not a lucrative source of income, out migration is high, especially in the hill districts of the state.

The green revolution technologies did not benefit India's rainfed areas, which constitute 65 percent of the total agriculture in the country, as they were pertinent to well-endowed irrigated regions. With the scope for expansion of irrigation limited, the need is to increase the productivity in rainfed areas. The project design is aligned with this objective and aims to increase rainfed crop yields by utilizing watershed development tools, such as rainwater conservation and harvesting. The project design also enables implementation of sound watershed development strategies critical for conserving and sustaining the natural resource base and enhancing land resource management.

At the inception stage, the project selected the target areas such that were highly vulnerable to effects of natural resource degradation, with majority marginal and small farmers who were dependent on rainfed farming and areas which were not part of any development projects since last 5 years. This ensured a homogenous group of watersheds which had the highest possibility of interventions and perceivable impacts. The project has 2,63,837 ha of land in 82 micro watersheds which have been comprehensively treated through project activities and in convergence with different line departments.

Capacity building and social mobilization

The project objectives focus on watershed treatment and rainfed area development through a decentralized mode of community engagement. The project design follows a participatory approach with PRI as the centre of implementation. Gram Panchayat Watershed Development Plans (GPWDP) are prepared and implemented by PRIs with the project providing extensive training and hand-holding support from the beginning which resulted in all common assets created by the project in being well maintained and owned by the community with a transparent social auditing mechanism. One of the pre-requisite element of preparation of GPWDP were increased participation of gram panchayat (GP) and communities during formation of Watershed Management and Revenue Village Committees so that GP capacity is built and there is fostered ownership of the plans. The project has ensured this by involvement of Field- NGOs as well as internal multi-disciplinary teams (MDTs) by engaging with the community to improve this participation.

Project has followed a systematic process of identification of beneficiaries through consultation with key village personnel and panchayat members, poverty profiling of households, pre-group formation meetings and promotion of institution. PRA exercise such as wealth ranking and resource mapping exercise has been carried out during the project initiation stage to categorize households by poverty levels. Project has developed inclusive strategies to benefit 66,352 households which includes 31,023 C category households identified through PRA exercise. Post that trainings and exposure visits of various types were imparted for all stakeholders to implement the activities efficiently. In order to bestow fiscal empowerment, GP assistants were appointed and trained to handle books of accounts. A total of 527 GP assistants were appointed and remunerated from the GP fund for handling the books of account.

For training and capacity building, the project design included establishing collaborations with research institutions and universities leading to improved knowledge among the stakeholders such as Soil Conservation Research Institute, KVK Dhakrani, Green Foundation, G.B.P. Agri. & Tech. University

[2] All India Report on Agriculture Census, 2015-16

Pantnagar/Rishikesh, Kotdwar, Indian Veterinary Research Institute Bareilly, Y.S. Parmar University, Potato Research Institute, Watershed Project Solan and Nahan, HP, Biodiversity conservation Kotamalla, Srinagar University etc. The synergy in knowledge management has helped in the selection of appropriate technologies for dissemination, selection of varieties for recommendations and effectively a higher adoption of the recommendations of the project.

Comprehensive watershed treatment

The project design focused on treatment of 2,63,000 ha at the micro-watershed level in a ridge to valley approach covering the inter-GP areas. This has been done through 82 micro watershed plans prepared for undertaking various source sustainability measures, drainage line treatments and water conservation and harvesting structures. The major investment has been on catchment area treatment of non-arable land in the hills, ranging in elevation from 700 m to 2,700 m above sea level with the holistic objective of rejuvenating the natural resource base by significantly reducing soil erosion and runoff loss of rainwater, improving ground water recharge, and reducing sediment load in the tributaries of the Ganges flowing through the state of Uttarakhand. The project also included construction of water harvesting structures and small irrigation systems on 40,000 ha of arable land, disseminating new technologies for soil moisture conservation and reducing soil degradation due to unscientific agriculture practices. The project design contributed directly in rejuvenating dried up stream sources and capillary-based water springs by establishing rainfall runoff capture and infiltration of recharge pits at strategic locations in the watersheds. An integrated approach was adopted through land-water management and source rehabilitation by enhancing moisture retention and biomass production. The overall focus was on improving water availability through watershed treatment to increase agriculture productivity, improve livelihoods in the rainfed areas and reduce poverty.

Synergy between watershed treatment and agriculture

Aligning with the project objective of increasing efficiency of natural resources resulting in increased agriculture productivity, the project promoted adoption of appropriate resource conserving and productivity enhancing technologies. Keeping in view future water stress conditions and limitations of irrigation in the Uttarakhand context, emphasis was given on rainfed agriculture production.

a. Increased area under agriculture: The state has 88,000 ha of current fallow land out of which 6 percent is in the project area. The project identified these fallow lands and efforts were made for converting them into cultivable lands either under vegetables, cereals or orchards. A total of 2,530.88 ha of the fallow land was brought under cultivation through the interventions of irrigation and water availability was the second crucial factor addressed by the project to bring more area under agriculture. Irrigation has been provided to an estimated 5,359.3 ha additional area by converting about 15 percent percent of rainfed areas into irrigated areas. The cropping intensity of the project has increased to 161 percent in rainfed agriculture and 227 percent in irrigated.
b. Seed replacement: Introduction of short duration crop cultivars to facilitate reduction of both evaporation and transpiration. The project introduced short duration, high yielding varieties as in case of maize, rice, mustard, soybean, french beans, green peas, capsicum, tomato, as also varieties suited for hill areas and climate resilient varieties developed for the hills by VPKAS especially in cereals and millets. The project has also established a seed production organisation (farmer federation) in Almora division, which has produced and distributed over 110 tonnes of seeds of different crops such as millets, cereals, oilseeds and others contribution to the seed replacement with certified seeds.
c. Crop production technologies**:** The extensive adoption of improved crop production technologies and soil moisture conservation practices has helped considerably in the manifestation of the genetic potential of high yielding varieties (HYV) in enhanced productivity at the demonstration and adoption plots. Soil moisture conservation practices such as mulching, zero tillage, mix cropping, in combination with new crop production technologies such as IPNM measures, use of bio-compost, vermi-compost, line sowing, etc. have been widely promoted. In addition, farmers have also been provided with means for protected cultivation through the provision of polyhouses in different sizes for the cultivation of vegetables and other high value crops. Approximate 96,000 sq.m. of area has been brought under polyhouse utilised for domestic and commercial purpose. Use of water efficient practices such as line sowing, mulching, zero tillage and efficient irrigation

techniques such as drip and sprinkler have been introduced to farmers.

Flexibility of Interventions

The project design has been very flexible to meet communities' priority requirements by allowing important interventions to be included under the project aegis with due diligence. The project has gone beyond the envisaged design to bring in innovations at various levels through various dimensions. The following certain interventions taken up by the project to multiply program benefits show the flexibility in its design to promote innovation & meet the needs of the beneficiary community.

a. Introducing pilot funds: The project had a provision of pilot funds under which projects which were not budgeted for under the main project expense were explored and those that were aligned with the goal of increasing agriculture productivity and improve marketing linkages were approved and implemented for the benefit of the farmers. Project has approved proposals worth a budget of Rs. 61.28 million for pilot activities involving various innovative activities based on the needs of the community and market feasibility. These activities included those that were implemented on a limited budget but due to the successful implementation, had a demand for more from the community (such as solar powered water lifting pumps, geo-membrane lined water tanks), innovations which would allow farmers increase the benefits from agriculture activities (such as chain link fencing, produce transport trolley, packaging and grading centres) and activities that had a high returns for the farmers and thus were requested by many beneficiaries (such as integrated farming, poultry, goatery, fisheries).
b. Alternate energy initiatives: Climate change has resulted in higher temperatures across geographies, erratic rainfall more frequent or intense extreme weather events. These adversities affect the hills not just in terms of disastrous events but also in reducing the efficiency and altering the availability of power. Climate change impacts on transmission and distribution networks can result in higher losses, changes in transfer capacity and particular physical damage. The promotion of alternate energy initiatives was done to build climate resilience in the community and provide alternate to the finite sources of fuel which are in further limited measure in the hill regions. The project has promoted solar power (lights, pumps, cookers) biogas, pine briquettes and hydro power (gharat-traditional water mills) in various numbers across the project areas. More than 16,500 units of various alternate energy measures have been provided to give a convenient, cheap and reliable source of energy for the hill population. Among most prominent alternate energy measures such as solar lanterns the annual savings is approximately Rs. 100 per annum on electricity per household per electric bulb. The other alternative energy equipment provided through the project such as solar powered street lighting, biogas, etc. have also contributed to savings at various levels. The promotion of alternate energy was adopted looking at the needs of the local population, the limitations of the hilly terrain and with a view to combat the negative effects of climate change. Moreover, these units generate power with very little to no air pollution and thus have low to insignificant carbon footprint in their operation.
c. Resource collaboration for expansion of animal husbandry activities: Limited resources for health management and non-descript breeding of animals was the factor limiting livestock production in the state. While the project itself supported livestock farmers through housing, mangers and charis to promote a stall feeding system instead of open grazing, the project also explored progeny improvement through resourcing services from other line departments for natural breeding as well as artificial insemination and provision of health services. The project has procured bucks and bulls of improved progeny from Animal Husbandry department for establishing natural breeding centres. synergy was established between the communities and the Animal Husbandry department to incur surplus benefits through health camps and benefits in terms of reduction of fodder wastage, saving in veterinary expenses, improved milk yield saving of time for fodder collection have been observed based on survey data and field visit discussion.
d. Evolution of growth centre concept: Conventionally, post-harvest value addition and collection centres are the main stay support activities provided for market linkages. However, the project has gone beyond this concept and ten Agribusiness Growth Centres (ABGC) have been established to ensure backward and forward linkages in agriculture production. These centres were not part of the

original project design however, they emerged from the pre and post-harvest and marketing needs of the farmers owing to increased production and expansive aggregation into Farmer Interest Groups (FIGs). The ABGC are aimed at providing one stop service to farmers through services such as farm inputs, custom hiring, technical know-how, aggregation, post-harvest services, marketing support as well as a platform for value addition.

e. Branding and marketing strategy: In order to build an appropriate forward linkage for the produce, the project has taken a bold step in creating its own brand 'Gramyashree' under the gamut of which 56 product variants have been developed across 14 product categories. The project has integrated technologies in multiple ways for branding and marketing. A Gramyashree app has been developed to expand the farmer to trader sales and establish seamless communication between farmers, domestic traders/mandis, online markets, exporters, agro processors and retailers. A turnover of Rs. 1.69 million has been generated through the sales via Gramyashree app and 309 vendors including wholesaler and retailers who have registered on the app. Other than this 9 inside state outlets have been established under the brand and 515 different marketing avenues utilized to sell 'Gramyashree' products with brick and mortar stores being the most utilized marketing channel category. A website wwww.gramyashree.in has also been launched from where customers from all over India can place their orders for the Gramyashree products. The website and product supply chain is being managed by Khyarsi Growth centre. Overall, it is indicative of the robust strategic design being built to sustain the marketing linkage.

In implementation as well, the project has taken a vanguard approach and distinguished itself with innovative technological interventions to suit location-specific challenges. Based on local needs, the project has implemented ropeway trolleys for transporting farm surplus from downstream valleys (through mechanized pulley) and from high altitude fields (through gravitational pull mechanism), lifting of stream water by using solar power, geo-membrane lined low cost water storage tanks, and others.

Bringing robust technology for implementation and efficient monitoring

Science and technology introduction along with participatory approach as envisaged in the project design has been introduced and led to the monitoring of comprehensive project objectives as well bring about distinguishing technological interventions. The project team prepared comprehensive treatment plans for both GP areas and non-GP areas part of the micro watersheds. The GPWDP consists of activities which are to be implemented in the areas which fall in the jurisdiction of GP. For areas which are out of the jurisdiction of the GP but lie in the MWS (primarily reserve forest areas), comprehensive MWS plans were prepared by WWMC and Van Panchayat with help, coordination and consultation of project team and concerned Forest Division in a manner that complements the GPWDPs. MWS plans following a ridge to valley approach for undertaking sustainable springshed management in the inter GP areas ensuring reduced soil erosion and enhanced source sustainability of water and drainage line treatment.

Weather parameters are important data sets for hydrological monitoring and eight micro-water sheds were carefully selected in each district of the project for carrying out morphological analysis and water balance model validation. A consulting firm (WAPCOS) was commissioned to construct weirs and set up gauge monitoring, following which 4 Automated Weather Stations (AWS) and 16 Automated Rain Gauges (ARG) have been installed across 8 representative micro watersheds whose data will be used by project team for SWAT modelling in future. WAPCOS has also established one weir in each representative micro watershed (total 8) to measure the stage discharge of identified streams under the project (both treated and untreated). Training has been imparted on discharge measurement using current meters. Minimum 5 team members of the project staff and community members are trained to do the hydrological monitoring through field measurements.

Management Information System (MIS) and Geographic Information System (GIS) are vital pillars of the project. An in-house GIS based open data kit (ODK) App 'Pratyaksh' was developed and used regularly to obtain information, photos and GPS readings of assets created in the field on GIS platform as a tool of evidence based monitoring. Land based activities such as plantation areas, fodder and orchard development etc. are captured using GPS to develop GIS. Process monitoring and onsite monitoring of GPWDP and MWS plan implementation using GIS tools was carried out by the M&E Cell of WMD. The ODK App provides a

way to collect and store geo-referenced information, along with a suite of tools to visualize, analyse and manipulate ground data for specific needs.

Relevance to state priority on doubling farmer's income

The project has been designed in alignment with the 10 point strategy of Uttarakhand Government for doubling of farmers' income. Following are the highlight strategies ingrained in the project:

i. Strengthening of water harvesting potential, water conveyance and improving traditional water storage structures
ii. Adoption of cluster approach for holistic development and productivity enhancement through introduction, adoption and popularization of high yielding varieties
iii. Reduced cultivation cost through improved crop production technologies, farm mechanization and water use efficiency
iv. Supplementing farm income through integration of animal husbandry and livestock· goatery, poultry, fisheries
v. Following an integrated farming system
vi. Reducing post-harvest losses and value addition through improved practices of crop management and post-harvest management
vii. Off-farm income through seasonal and non-seasonal livelihood initiatives
viii. Marketing and value addition to increase value of products and increase market share

The combination of watershed treatment (i.e., land degradation control, natural resource conservation, and water harvesting), agriculture demonstrations, and agribusiness development contributed an average 37.6 percent increase in beneficiaries' income. The agriculture income as a share of total household income is about 10.3 percent for the project sample. For farmers directly benefitted by the agriculture interventions of the project, the income increase has been more significant than the overall sample. average annual income of Rs. 14,109 for each farmer associated with the project FIG registering a 183 percent increase due to project interventions as compared to 2015-16 income of farmers.

Despite unexpected challenges and slowdown of activities due to the pandemic, the project has not only achieved the targets envisaged but also gone beyond to incorporate an expansive agribusiness component in the portfolio. This success demonstrates the impact of bottom-up planning for effective conservation and management of natural resources for capturing productivity gains from resilient watersheds.

4.2 Effectiveness

Quality and Timeliness of Inputs

The project duration was of 7 years, from 2014 to 2021 (effective since 15th July 2014). Project activities have been by and large undertaken in a timely manner. Activities follow a process of maturity at the village level. With seamless cooperation of almost all stakeholders, timeliness of activities was maintained throughout project period. Except in Uttarkashi division, because of external factors, the progress of work was slow in initial years not conforming to the proposed timelines envisaged. Eventually, in 2019, the progress was resumed as the implementation was taken up directly by the project team to meet the project targets. Quality of activities was ensured through regular supportive supervision and handholding by FNGO and ABSO during project execution. The project also ensured regular monitoring and monthly reporting of progress from all divisions through monthly progress reports (MPR)

The four key components of the program followed a systematic linkage of activities and process of maturation. Activities such as developing agribusiness linkages were given due emphasis and were focused on when there was an increase reported at agriculture production levels. The components have complemented each other and the effectiveness of implementation is seen in the watershed treatment and rainfed agriculture activities where most of the targets have been over achieved due to adequate construction of water harvesting structures and drainage line treatment activities, soil conservation measures and propagation of crop production technology resulting surplus benefits. Timely training and capacity building activities gave adequate push at operational level to achieve the targeted output.

The project effectiveness is also visible in the social inclusion component where among the C category households, 14,148 members are engaged in entrepreneurship activities and effectively managing their day to day business activities. 7701 individual IGA activities were analysed out of which 81 percent are showing positive net profit from entrepreneurship activity. Among group VGA activities 854 activities were analyzed and 83 percent are showing positive net profit from entrepreneurship activity. A 10-15 percent of the enterprises reported negative returns, primarily because the business did not survive the Covid-19 pandemic period. The businesses were constantly showing positive returns till 2019 after which there was a decline in net gains during last two business years.

Monitoring of Activities

The project has developed a robust monitoring system through which the interventions are monitored. State Steering Committee and District Level Watershed Committees are constituted. The State Steering Committee Comprises of Secretary level officers and concerning Head of Departments, Chaired by the Forest and Rural Development Commissioner (FRDC) Govt. of Uttarakhand. The committees role is to Facilitate inter-departmental coordination, policy decisions and the Overall approval to work plans of WMD. The committee reviewed the project progress at half yearly and annual intervals. The District Level Watershed Committees comprises of district level officers, Chaired by the Zila Panchayat Chairperson and members secretary, and the concerning DPD. The role of the committee is to facilitate inter-departmental coordination and convergence with other programmes. The District Level Watershed Committees monitor project progress at quarterly intervals.

For internal monitoring financial progress reports are generated regularly using FMIS, the MIS maintains household wise database for beneficiaries pertaining to each activity. An app called 'Pratyaksh' has been developed for regular monitoring of field level assets through photographs and GIS based data. External monitoring agencies for monitoring & evaluation and hydrological monitoring is on board and has monitored the progress and reported interim results of the project development objectives at regular intervals.

Achievement of Outputs

The project has been able to over achieve most of the output targets as envisaged till the end of the project. Component 1 on social mobilization and participatory watershed planning had two critical outputs on which the entire implementation plan was dependent. The project has achieved 100 percent targets and successfully developed 527 GPWDP plan and 79 MWS Plans and implemented them in a participatory manner. Rest three MWS have no inhabitants and thus were excluded. The GPWDP plan was the base over which the Annual Work Plans were developed each year and community needs were included through participatory planning and as per available GP budget envelop. 527 GPWDP were successfully implemented out of which most of the planned activities were related to water and natural resource management (relative to a target of 60 percent), such as off-farm and on-farm soil conservation and drainage line treatment, afforestation and fodder development. Component 2 Watershed Treatment and Rainfed Area Development had several outputs which have been achieved on a surplus to achieve greater benefits from watershed treatment and increased agricultural outputs. The project has exceeded all the targets of project development objectives and also surpassed the endline targets for the key performance indicators. The details of the same are elaborated in further sections.

4.3 Implementation Efficiency

The efficient implementation of the project can be witnessed in the fact that majority of the project development objectives have been over achieved, some with a significant margin. The project has also been able to make a significant change in the perspective of the target beneficiaries through increased adoption of new and improved technologies for water harvesting and conservation, rainfed and irrigated agriculture as well as animal husbandry. The final impact assessment shows that soil moisture conservation practices and new technologies of crop production are adopted by 65.7 percent of the farmers in the project area and 99 percent of beneficiary farmers follow at least 1 of the demonstrated practices.

Under the social mobilization objectives, as a result of project interventions, 78 percent households participated in GPWDP preparation in 527 GPs (51,755 HH out of 66,352 HH). Inclusion was a centre point of the social mobilization and 70.1 percent of the total vulnerable households participated in GPWDP preparation (21,747 out of 31,203) along with 36.1 percent women participation (41,482 out of 1,16,341). The project has been able to achieve satisfactory results in financial audits of GP for 100 percent of the

financial audits as well as in the social audits conducted for participatory monitoring and evaluation of project activities.

MWS Plans were focused on stream source treatment and rejuvenation, soil conservation, and forestry (afforestation and assisted natural regeneration of oak forests) in inter-GP areas and reserve forests leading to a comprehensive treatment of 2,30,000 ha. The catchment area treatments have resulted in an increase in water discharge rate in pre-monsoon and post monsoon period. It also resulted in increased water flows throughout the year by reducing the water scarcity for 25 percent of the target beneficiaries.

The project activities have helped in enhancing the efficiency of natural resources use through catchment area treatment, source sustainability, water harvesting and irrigation structures contributing to increase in water discharge for 99 percent of the treated water sources, conversion of 2530.88 ha fallow land into cultivable land and conversion of 6,238.7 ha of rainfed land into irrigated land. The analysis by the hydrological monitoring agency, WAPCOS, indicates that the average water yield of the sample 8-micro watersheds during base line period was 42.4 million cum which has increased to 44.5 million cum at the time of final impact assessment. The yield of the watersheds is considered as the available water after removing the evapo transpiration loses and is the sum of surface, lateral and returns flows. The difference of about 2.07 million cum (4.9 percent) is the average again for the watersheds which is contributing towards moisture retention. Almost all watersheds show reduction in surface runoff and more than 60 percent of the watersheds showed an increase in lateral flows. The results indicate that the watershed treatment in the area has been effective in terms of source water conservation, increased stream flow and groundwater discharge. This is indicative in the impact of improved productivity in the selected watersheds in both irrigated and rainfed agriculture.

The NDVI estimation and ground truthing process indicated that there is an increase of about 21.2 percent in the biomass and vegetative coverage and the project has been efficient in meeting the envisaged target by covering an area of 10474 ha under plantation. The treated plantation sites show higher values of diversity and species richness as compared to the control sites. Land use land cover maps have been prepared with the help of 2019-20 images. A comparison indicates an average 5 percent increase in agricultural land, 0.3 percent increase in forest and 1.3 percent reduction in land with or without scrubs in the watersheds with respect to baseline period. The conservation and protection activities have also helped create a conducive environment for the endemic species to regenerate and grow. Increase in the species richness and diversity index were largely due increase in the moisture content through the various soil and water conservation structures.

The project has promoted cluster based approach by forming 165 agriculture clusters in 907 ha. area. 447 vegetable clusters in 1728 ha. area and 318 fruits clusters in 1496 ha. area resulting into a cumulative production of 8336.7 tonnes and equivalent to a value of Rs. 1322.9 millions. The project has made conscious and encouraging efforts to improve the production potential of the region as rainfed areas accounts for 80 percent of the arable land in the State. The watershed treatment and rainfed agriculture interventions have resulted in an increase of production potential by 33 percent. Additionally, a total of 10,621 ha of land have been brough under irrigation and crop productivity in irrigated agriculture increased by 59 percent for the target crops in project area. This has contributed in increasing the income of farmers by 37.6 percent. As a result, the agribusiness component was also expanded to facilitate and ensure market linkages for the absorption of the increased production from the target farmers.

The project has formed about 4,343 community groups/institutions for various purposes (user groups, FIGs, WWMC, RVC) and the total group savings has accumulated to Rs. 40.5 million. The institutions are envisaging these funds for operations and maintenance that will arise in the future and for development and expansion of services as required from time to time.

Equity and Environment

Ensuring equitable participation by all groups was one of the key approaches strongly adhered by the project. It was ensured that women and vulnerable households were involved in each stage of the project formulation starting from GPWDP preparation to its implementation. As a result, the representation and participation in local governance platforms has greatly improved and beneficiaries were also extensively

benefited from the project activities. Against an overall grant Rs. 3690.96 L, VGA beneficiaries have earned an overall average net profit of Rs. 445 million (excluding wage and working capital).

Gender Inclusion: The project has substantial gender outcomes in local governance and livelihood development. Women's participation in GPWDP planning and implementation was fostered by 1,017 women village motivators, who were recruited from within the targeted villages. The project created forums such as Women's Aam Sabha at the GP level to ensure women were effectively represented and participated in decision making discussions at Gram Sabha in GPWDP. GP level social audits have been conducted with participation from women and 100 percent GP have received satisfactory social audits. (Detailed further in Social Impacts Section).

Enhancing climate change mitigation and resilience in the watershed ecosystem: The project has also promoted alternative energy based equipment that would reduce dependence on the natural resource base such as promotion of alternate energy sources such as biogas plants, solar cookers/pressure cookers, water mills and pine briquette production, renovation of water mills and solar lift irrigation to reduce dependence on forest fuel wood and promote energy conservation. Under the Project initiative 24 solar powered lift irrigation systems have been established covering 241.68 ha.

The cost-benefit analysis of the project was conducted over a 30-year horizon. The CB analysis indicates that the benefits accrued is substantially more than the investment. Economic analysis was conducted after making appropriate adjustments to financial benefits and costs. The economic rate of return for the project as a whole is 24.33 percent. Net Present Value at 12 percent opportunity cost of capital for 30-year project life is Rs. 12.29 billion. (Detailed assessment has been provided in the chapter on Economic and Financial Analysis.)

4.4 Building the resilience of communities to effects of climate change

Social mobilization and an inclusive approach in targeting all segments of the community in the watershed area has been one of the pillars of the project. This has helped in brining equity in distribution of benefits among the wider populace. The improved social capital wherein 1 out of every 8 household are connected through one or the other community institution is the result of intensive facilitation support by FNGOs and MDT teams. They have ensured more than 70 percent involvement of communities' right from initial project planning process (GPWDP formation) up until the later stage implementation activities and beyond. The project has helped in strengthening the institutional framework of Gram Panchayat through the formation of supportive institutions such as WAS (Women Aam Sabha), user groups, WWMC, etc. and the strengthening of existing institutions such as the GPs and Van panchayats which helped in an efficient and inclusive micro watershed development. This has provided adequate space for all sections of community, including women, to participate and creating an enabling environment that instilled confidence amongst them to effectively participate in statutory body meetings such as Gram Sabha's. This is evident through the increased participation of project farmers in gram sabha meetings as well as their participation in the various project trainings, and other project institutions such as user groups, FIGs, etc.

The project has made a special effort to engage women members in the community in various forums, especially through Women Aam Sabhas (WAS) specifically initiated for improving their role in GPWDP planning process. The WAS have played a key role to bring women members together for one common purpose under a single platform giving them the opportunity for deciding activities as per their requirement. The platform has helped build confidence in women and empowered them in voicing their needs for NRM, agriculture, livelihood and other activities. This empowerment of farmers especially of women is an important positive shift that has happened in the community because of transparency in panchayat activities in discussing their budgets and utilization, exposure to various knowledge centric events, trainings and capacity building, as well as livelihood opportunities facilitated by the project. This has enabled them to prepare for timely identification of the needs, risk assessment for dealing with unforeseen effects of climate change and reaching out for support to relevant individuals or institutions.

The vulnerability to anticipated climate change effects has been addressed by the project through capacity building of communities in terms of climate-resilient agriculture practices, adoption of green technologies, promotion of high yielding, short duration, location-specific, climate-resilient crop varieties, and introduction & awareness of climate mitigation knowledge. The knowledge enhancement coupled with

increased confidence to apply the learnings would play a key role in the future in building the resilience of the communities to the impacts of climate change.

The climate co-benefits of the project activities are visible in the increased carbon sequestration through the increased area under green cover and the subsequent increase in biomass. Additionally, the project is also promoting environmentally sustainable farm activities such as the use of live or napier terrace borders, mulch, zero or minimum tillage, water-efficient micro-irrigation for orchards, mix cropping, stall feeding of animals, etc. which would help in reducing the load on natural resources such as land, water and forests and promote their efficient use for a longer period of time. The adoption of these climate-resilient activities is evident in the adoption levels of natural resource conservation measures (93%) and crop production technologies (65%).

The project has established hydrological monitoring systems which have helped in efficient water budgeting and understanding the water available and source sustainability and water harvesting measures undertaken extensively throughout the project area. This has enabled efficient water conveyance and reaching water to the farm lands thus securing water availability for agriculture. This has allowed farmers to engage in commercial production and increasing their incomes. Water security has increased economic activity, growth of agribusiness, efficient use of natural resources has helped in building resilience of the farming community.

Additionally, the project has also promoted the use of alternate fuels for lighting, pumping and cooking needs. Devices utilizing alternate energies such as solar lanterns, solar street lights, solar-powered water lifting pumps, biogas, water mills, pine briquettes, etc. have been distributed in the community on an individual or community basis. The introduction of these units has helped create awareness in the community as well as bring about a shift in the usage pattern giving alternate fuels preference for their climate-related as well as economic benefits.

The project has made efforts to identify innovative approaches and undertake experimental interventions for improving natural resource use efficiency, improving market demand and providing logistical support and last-mile connectivity for effective marketing of produce. The interventions such as produce transport ropeway, solar-powered water lifting pumps, geomembrane lined water tanks, and agribusiness growth centers have been excellent examples of project flexibility in piloting new interventions and expanding, replicating and scaling them as per the needs of the community and feasibility. The project has acted as a platform for the launch and incubation of these exceptional technological innovations and practices which would contribute to the future sustainability of the communities.

5. Scope of Final Impact Assessment

5.1 Scope

This evaluation is an end of project comprehensive assessment of the Gramya II project through an analysis of its main components. The main purpose is to learn about what worked well, what did not and why, and offer reflections and recommendations. The evaluation findings are drawn through a consultative approach adopted with Watershed Management Directorate and other state level stakeholders, including field level agencies (ABSO and FNGO) The overall objective of this evaluation is to follow the critical OECD areas of relevance, coherence, effectiveness, efficiency, and sustainability.

The purpose of this evaluation is to assess the Watershed program, covering a seven years implementation period (2014-2021), which was extended for 7 Months due to Covid-19 Pandemic. The evaluation framework was built around the causal assumptions in relation to the achieved outcomes. A comparative analysis of performance in the project areas as compared to the control areas has been done under the final impact assessment. The evaluation focuses on the following aspects:

- Evaluating the overall watershed program and related impacts.
- Assessing the attribution of the project activities to project outcomes.
- Identifying the approaches and strategies that have worked best in meeting the project objectives.
- Assessing equity issues and distributional impacts of project investments.
- Evaluating the cost-effectiveness of various components under the project and innovative approaches adopted.
- Evaluating the quality of processes adopted to strengthen local institutions.

5.2 Methodology and Sampling

The evaluation design for Gramya-II is based on a mixed method approach, wherein suitable counterfactual group were established for comparison with the project group. The study framework was designed to capture program processes, outcomes and impact as well learnings for future projects. This required probing into both operations and systems of the project as well achievement of desired outcomes / impacts. The evaluation captured:

- Learning from the project on situation specific strategies and contextual success factors that lead to desired outcome/ impact in different project areas / communities
- Processes and systems supporting the project and if they have supported the desired outcome
- Extent of external factors and community attributes and capacities influencing the outcomes
- Output achievement in different divisions over the duration of the project

The following areas of assessment were coved for the final impact assessment process:

Assessment of Project Relevance

Key areas evaluated to assess relevance are:

Components	Key Research Question
Watershed Treatment-Water source sustainability	• Effective management of land and water resources for groundwater recharge, reducing runoff and soil loss • Conversion of fallow land • Create synergy between watershed treatment and rainfed agriculture • Harvesting rainwater for irrigation • Increased water availability and soil moisture improvement
Rainfed Area Development	• Fallow land conversion • Improve discharge from the water sources • Increased water availability and irrigation facilities • Fallow land conversion • Improve discharge from the water sources • Soil moisture improvement

Components	Key Research Question
	• Decreasing affinity for agriculture due to low productivity and high risk • Incremental area under fodder production • Need for diversification of livelihoods • Stall Feeding • Increased climate resilience • Promotion of alternative energy resources • Increased marketable surplus • Value addition for enhanced return • Agribusiness development for forward and backward market linkages • Benefits (production & marketing) accrued from value addition through FF's
Enhancing Livelihood Opportunities	• Inclusive approach for holistic development • Employment generation for Vulnerable households-landless/migrants • Support to transhumant population

Assessment of Project Effectiveness and Efficiency

The effectiveness of a project is a measure of degree to which performed activities has resulted into intended outputs/outcomes. The key research questions assessed are:

Components	Key Research Question
Watershed Treatment-Water source sustainability	• Increase in effective land use in GP • Inclusion in planning process • Efficient water resource management • Community confidence in Participatory approach • Improvement in Biomass, soil moisture, soil quality • New orchard development, orchard rehabilitation • Availability of adequate quantities of fodder and fuel wood
Rainfed Area Development	• Construction and rehabilitation of WH / SS Structures • Promotion of catchment structures and utilization of rain water • Natural resource conservation measures for soil, water and groundwater • Sustainable enhancement of water discharge • Enhancement of crop productivity of major crops through varietal introductions & improved crop management practices • Introduction and adoption of new technologies • Diversification in crops for high value agriculture • Crop water productivity • Adoption of environment-friendly energy sources • Reduced dependency on fuelwood • Biogas
Enhancing Livelihood Opportunities	• Sustainability of Income augmenting activities • Interventions promoting economic independence among women • Better equity in project benefits by effective implementation

Assessment of Project Impact and Sustainability

The project impacts for intended and unintended impacts of the project were identified to measure during the Final impact assessment:

- Impact on quality of life of targeted beneficiaries, improved livelihoods and living condition
- Impact on reducing vulnerability (food security, indebtedness, distress migration, etc.)
- Impact on Social and economic empowerment among women

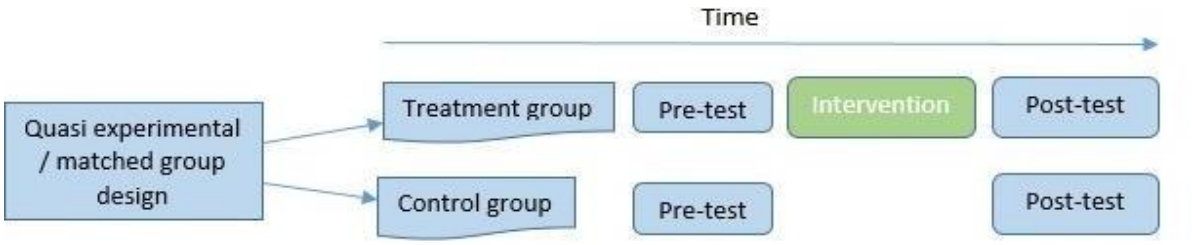
- Impact on cropping intensity
- Increased resilience in project area
- Change in average income of households
- Preserving the cultural uniqueness of the project area

Extent of community ownership and Impact of the Project

- What is community perception of the project and how do they perceive benefits?
- The extent to which the outcomes have reached the beneficiaries
- To what extent disadvantage groups have been included in the project and benefited?
- What is the ability and willingness of the project team to continue activities initiated in the project after the project is completed?

5.2.1 Sampling Design

The evaluation design was based on the most rigorous approach to evaluation and a Difference-in-Difference technique was followed. The difference-in-difference method compares the changes in outcomes over time between a population that is enrolled in a program (the Project group) and a population that is not (the Control group). The difference-in-differences approach combines the two counterfeit estimates of the counterfactual (before-and-after comparisons, and comparisons between those who were part of the project treatment and those who choose are not) to produce a better estimate of the counterfactual. It helps in controlling the factors that vary over time (time-varying factors) which could be a source of bias. The DiD estimation seeks to measure outcomes for two groups – treatment (project) and control (counterfactual) – over a given time period. The control group is not exposed to the treatment and the same units within both groups are observed in each time period, where the average gain in the control group is subtracted from the average gain in the treatment group (see diagram).



With reference to the current design the control or counterfactual units were geographically selected and were located in areas where no watershed development related activities had been conducted. Control areas were selected from 4 different micro-watersheds from where 22 control villages were drawn. A total of 80 project villages and 22 control villages were covered during the final impact assessment. The following household sample was covered:

Table 3: Composition of sample for household survey

District	Project	Control	Grand Total
Almora	683	248	931
Bageshwar	605	77	682
Dehradun	315	109	424
Dehradun-II (PMU Model)	59	36	95
Pauri	444	113	557
Pithoragarh	307	73	380
Rudraprayag	695	77	772
Thatyur	320	13	333
Uttarkashi	197	294	491
Grand Total	**3625**	**1040**	**4665**

Household Sampling – The household survey covered all the project households as covered in the Midline survey and 5 percent additional sample from Baseline assessment.

Additionally, a sample of other stakeholders were covered with an intervention focus to see the most significant benefits accrued, beneficiary satisfaction from Project intervention and distributional impacts.

- Gram Panchayat
- Village level units
- Farmer Interest Groups
- Vulnerable individual and Groups
- Orchard beneficiary

5.2.2. Methodology for Biomass Estimation

Remote Sensing:

Micro-watershed wise Biomass incremental assessment was made using field survey in combination with image processing technique. In the present study panchromatic (PAN) sharpened IRS 1C and IRS 1D with Cartosat 1 was used. The data was procured by WMD from the National Remote Sensing Centre (NRSC) and forwarded to SUTRA for further analysis. The satellite data sets of 2013-2014, 2018-2019 and 2021 provided by NRSC were geo rectified and mosaicked (stitched together).

The satellite image was classified using spectral characteristics into different land cover type's viz. forest, water body, built up, agriculture and barren land etc. Tonal and textural variation plays a major role in the creation of land cover type map. From the field a number of quadrants were laid to study the biomass availability and species distribution. The field data was also used as ground truth to differentiate between various vegetation compositions. The field base sampling has provided with the quantification of biomass in terms of th^{-1}. The field values were later evaluated with reference to NDVI values. The correlation of field sampled values with NDVI vales helps in the development of regression equation to assess biomass in terms of NDVI values using satellite image.

The increment in biomass was estimated considering biomass baseline data of 2013-2014 as reference. A number of field plots (quadrats) were identified within the untreated forest areas nearby the treated area. It is expected that the untreated forests would not accumulate significant amount of biomass within the duration of 1 to 2 years. Similarly, within the treated areas, due to afforestation, maintenance, fencing and protection against grazing and over exploitation, though the natural vegetation (bushes, shrubs and grasses etc.) will grow and accumulate.

The biomass value from the baseline and midterm study estimated through field data collection and satellite image of 2014, and 2019 were compared with the biomass value in Final impact assessment estimated on the basis of field survey and satellite image of year 2021. Further a linear fit equation was developed correlating the biomass values with the NDVI values of same coordinates (pixel) in the years (2014,2019 and 2021) satellite imageries. Using the linear fit equation, biomass for all the micro watersheds was calculated.

Ground Truthing

The ground truthing for biomass sampling was conducted in twelve revenue villages of six development blocks located within six districts of Uttarakhand state. All these were selected from the overall sample of 36 Gram Panchayats (GPs). Four blocks (Jaunpur, Kalsi, Ekeshwar and Augustmuni) from the Garhwal region were identified for field data collection, while two blocks (Kapkot and Dhauladevi) were selected from the Kumaon region. The selected revenue villages from Garhwal region are Quasi, Dilau, Sanj, Dudhau, Khjarbi, Kyarigad, Pali, Rayari, Dankot, Falai, and Patisen. All the selected villages fall within an altitudinal range of 300 m to 2000 m and have a subtropical to temperate climate. Most of the plantations were carried out in the community forests such as Van panchayats, while a few were carried out on Civil and Soyam forest.

Field data for biomass assessment was surveyed in the month of December, 2021-January 2022. To assess the standing biomass, quadrant sampling method developed by Misra (1968) was used in all the selected eleven villages. At all the selected sites, quadrants of size 20 x 25 m for trees, 5 x 5 m for shrub and saplings, and 1 x 1 m for herb species were laid out randomly. Depending upon the plantation area, 3 to 6 quadrants were laid within each treated plantation site.

On the basis of the field data, standing biomass stock was calculated. The standing biomass stock was calculated through the volume equations provided in the Forest Survey of India Report, 1996. In order to extrapolate it for the entire project area, a regression equation was developed between the standing biomass stock (treated and untreated) with the NDVI values of the satellite imageries (2014,2019 & 2021). The linear fit equation further provides the biomass values of the entire project area.

5.2.3 Data Source, Constraints and Limitation

The analysis was primarily drawn from projects year on year improvement through projects internal documents (Sector specific status reports. Budgets and investments) and external evaluation reports such as inception report, Baseline assessment report, midterm assessment report, concurrent monitoring reports, hydrological monitoring reports of WAPCOS. Further to that a context analysis was done through in-depth interviews with local stakeholders in different divisions were done. Quantitative survey tools were used at the household level tool, the GP level and the village level administered through CAPI for the project and control sites. Semi structured tools were used for assessing sector specific interventions such as Agriculture & horticulture. Institutional, FIG level, VGA level, animal husbandry intervention and NRM. The qualitative tools included the Key Informant Interview schedule. The household data collection tool had comprehensive sections covering income, debt, savings, membership in community institutions, land use, asset ownership, social capital and such. The GP schedule on the other hand focused on procedural details on implementation including levels of awareness, meeting schedules, nature of participation, monitoring processes followed. (The detailed tools are attached as Annexure)

5.2.4 Process of Final Impact Assessment and Data Analysis

1. Composition of Field Research Team

Division level supervisors were recruited based on their technical and geographical experience. The recruitment of field survey supervisors and researchers for the assignment was completed after the finalization of tools.

Surveyors were selected from the sample divisions to ensure smooth functioning in interaction with households, familiarity with location of villages, local language and culture. An attempt was made to provide training to more researchers than actually needed so as to have replacements. Researchers were selected and assessed on the basis of their performance during the training sessions, both in the classroom and in the field. The trainings were conducted by core team members with the support of the supervisors.

Apart from Field Managers and Division supervisors, internal team members were also engaged in quality monitoring from the beginning of the survey. It was ensured that processes were adhered to and flow of activities was smooth along with quality monitoring.

2. Translation of Tools

The translation of tools was done in Hindi from English. It was a strict necessity to thoroughly comprehend the original (source) message and field test it before finalizing the translated versions of the questionnaire. The first draft translation was reviewed during the supervisors training and rectified after that. This second draft was again reviewed by bilingual individuals not connected with the survey, to verify the correctness of the translation – both words/phrases and structuring of the sentences. The third draft was reviewed during the training program of the supervisors and field researchers & from experience of the piloting of the tools.

3. Training of Supervisors and Surveyors

Training of supervisors and surveyors was conducted in Dehradun for a duration of 5 days followed by field exposure. The purpose of this training was to understand the purpose of the tools, technical concepts involved and to discuss with them strategies to be adopted to overcome challenges. Role play exercises were conducted for difficult sections in the questionnaire.

Trainings were composed of two major components – Classroom Training and Pilot Testing. The researchers were trained adequately on the context, techniques and use of survey tools. A short training manual was also designed for this purpose which includes conceptual issues on research, overview of the project processes and institutional arrangement, basics of field research, sample selection, field guides of dos and don’ts,

explanation on using various instruments, guidelines on taking field notes and other research planning and management issues.

4. Quality Assurance

Field supervisors along with the internal team member were responsible for data collection and quality assurance. All data collected during the survey was checked for consistency at the field level and necessary corrections were immediately incorporated. Each day, after completion of the field survey, the supervisors did a manual scrutiny to identify incomplete questionnaires and redundant observations and had them rectified. In addition, 5 percent of the questionnaires were checked by the internal project team members during monitoring visits to field locations.

In addition to this, the use of CAPI ensured that core team of Sutra was able to check the data on daily basis to ensure that the data quality is maintained at the highest standard.

5. Data Entry and Analysis

The CAPI software was designed with operator controlled mode based on the nature of questions in survey tools. The following activities have been done with regard to the preparatory phase of the software testing:

- Range and validation rules were decided and included in each applicable cell of the software.
- The range and validation rules were ratified by taking feedback from all supervisors.
- Multiple testing exercises were conducted on the software with a small set of completed questionnaires in order to check all validations at different points in the software.

Data entry operators and supervisors were trained before the data entry work started. Data from all the sectoral questionnaires was entered directly to MS-Excel. For the purpose of minimizing the scope of errors and to improve data quality, double data entry option was availed of in which the same data was entered twice by different data entry operators. Later, the two sets of similar data were compared to identify unmatched values. The final dataset has been produced after correction of all such unmatched errors.

6. Sample Description

From a topographical perspective 47.5 percent of total 80 project villages come under Middle category, while the share of Ridge and Valley is 17.5 percent and 35.0 percent respectively. However, within each districts the distribution is not uniform. For instance, while all the project villages in Dehradun-II (PMU-Model) come under Middle category, 40 percent of project villages in Almora come under Ridge category. So, it was decided to consider the topography of the project villages while selecting the sample project villages in each of the 9 districts. Topography wise distribution of the sample project villages is shown in the Table 4 below.

Table 4: Distribution of the Sample Project Villages by Topography

Districts	Middle	Ridge	Valley	Total
Almora	3	3	1	7
Bageshwar	1	0	7	8
Dehradun	1	3	3	7
Dehradun-II (PMU-Model)	1	0	0	1
Pauri	4	1	1	6
Pithoragarh	5	0	1	6
Rudraprayag	3	1	1	5
Thatyur (Thatyur)	5	2	4	11
Uttarkashi	1	1	1	3
Total	**24**	**11**	**19**	**54**

Sample Profile according to Topography

Middle topography accounts for the majority of the households in both the project and control areas. Moreover, it can be seen from the Table 5 below that the households within each district are spread across different topographies.

Table 5: Distribution of the Sample by Topography

	Project			Control		
District	**Ridge**	**Middle**	**Valley**	**Ridge**	**Middle**	**Valley**
Almora	46.9	40.8	12.3	2.8	79.8	17.3
Bageshwar	0.3	15.7	84.0	0.0	98.7	1.3
Dehradun	13.0	43.2	43.8	6.4	36.7	56.9
Dehradun-II (PMU Model)	3.4	96.6	0.0	2.8	80.6	16.7
Pauri	57.2	30.9	11.9	11.5	87.6	0.9
Pithoragarh	0.7	88.6	10.7	0.0	83.6	16.4
Rudraprayag	25.2	44.9	29.9	0.0	59.7	40.3
Thatyur	14.7	52.8	32.5	7.7	30.8	61.5
Uttarkashi	28.4	38.6	33.0	73.1	26.5	0.3
Grand Total	**24.8**	**42.3**	**32.9**	**23.5**	**60.7**	**15.9**

Sample Profile according to Farmer Category

On studying the distribution of the sample households according to the landholding pattern, it is seen that the distribution of the households in project and control areas is similar with small farmers accounting for more than half of the households followed by large farmers.

Table 6: Distribution of Sample by District and Farmer Category

	Project (%)				Control (%)			
District	**Landless**	**Marginal**	**Small**	**Large**	**Landless**	**Marginal**	**Small**	**Large**
Almora	1.2	2.6	56.1	40.1	2.0	4.4	62.1	31.5
Bageshwar	3.5	0.3	44.5	51.7	0.0	0.0	68.8	31.2
Dehradun	6.7	1.3	40.6	51.4	0.9	6.4	55.0	37.6

Table 6: Distribution of Sample by District and Farmer Category								
Dehradun (PMU)	0.0	0.0	35.6	64.4	0.0	0.0	30.6	69.4
Pauri	3.4	6.8	47.3	42.6	0.9	0.0	45.1	54.0
Pithoragarh	2.0	1.0	59.3	37.8	5.5	0.0	43.8	50.7
Rudraprayag	3.6	3.2	82.6	10.6	0.0	2.6	89.6	7.8
Thatyur	2.2	0.0	27.2	70.6	0.0	0.0	46.2	53.8
Uttarkashi	4.6	2.0	34.5	58.9	4.1	1.4	42.5	52.0
Grand Total	**3.1**	**2.3**	**53.0**	**41.6**	**2.2**	**2.3**	**53.9**	**41.5**

*Marginal farmer (Less than 1 nali), **Small farmer (1 nali to 5 nali), ***Large farmer (More than 5 nali) as per Hill context

Sample Profile according to Gender

Male headed households constitute the overwhelming share of the sample households with three-fourth households in project villages and more than 80 percent households in control villages being male headed. However, within the district the share is not uniform as a little more than 60 percent of the project households in Pithoragarh are male headed, while the share of male headed households among project households in Dehradun and Thatyur is more than 90 percent. Moreover, in Almora, Bageshwar, Pauri and Rudraprayag the share of female headed households is close to one-third. Similar, is the case in control villages more than 80 percent of the households are male headed.

Table 7: Distribution of Sample by Gender				
	Project (%)		**Control (%)**	
District	**Male**	**Female**	**Male**	**Female**
Almora	75.99	24.01	83.47	16.53
Bageshwar	73.39	26.61	90.91	9.09
Dehradun	90.48	9.52	93.58	6.42
Dehradun-II (PMU Model)	91.53	8.47	97.22	2.78
Pauri	71.17	28.83	76.99	23.01
Pithoragarh	64.17	35.83	71.23	28.77
Rudraprayag	77.99	22.01	80.52	19.48
Thatyur	90.94	9.06	84.62	15.38
Uttarkashi	82.23	17.77	83.67	16.33
Overall	**77.52**	**22.48**	**83.85**	**16.15**

Sample Profile according to Social Group

A little more than half of the total project households belonged to general category while in the case of control households general category accounted for half of the total households. However, while in project households scheduled caste (SC) accounted for the second highest share, other backward classes (OBC) accounted for the second highest share among the control households.

Table 8: Distribution of Sample by Social Group								
	Project (%)				**Control (%)**			
District	**SC**	**ST**	**OBC**	**General**	**SC**	**ST**	**OBC**	**General**
Almora	25.0	0.1	4.2	70.6	29.0	0.0	1.6	69.4
Bageshwar	21.2	0.0	0.8	78.0	28.6	7.8	35.1	28.6
Dehradun	23.8	50.5	5.1	20.6	12.8	85.3	0.0	1.8
Dehradun-II (PMU Model)	6.8	0.0	0.0	93.2	2.8	0.0	0.0	97.2
Pauri	15.3	0.0	5.4	79.3	15.9	2.7	0.9	80.5
Pithoragarh	18.9	1.3	30.9	48.9	41.1	2.7	11.0	45.2
Rudraprayag	17.8	0.4	0.6	81.2	13.0	2.6	2.6	81.8
Thatyur	17.5	0.3	73.8	8.4	23.1	0.0	76.9	0.0
Uttarkashi	45.7	0.0	52.8	1.5	23.8	0.0	69.7	6.5
Grand Total	**21.4**	**4.6**	**14.2**	**59.9**	**23.1**	**10.2**	**24.7**	**42.0**

Sample Profile according to Poverty Group

The share of below poverty line (BPL) households is almost similar among the project and control households, followed by above poverty line (APL) households. Antayodaya Anna Yojana (AAY) households accounted for the lowest share (below 10 percent) among both the control and project households.

Table 9: Distribution of Sample by Poverty Group

	Project (%)			Control (%)		
District	**BPL**	**AAY**	**APL**	**BPL**	**AAY**	**APL**
Almora	67.1	12.2	20.8	58.5	27.4	14.1
Bageshwar	56.5	11.4	32.1	84.4	0.0	15.6
Dehradun	74.0	5.1	21.0	90.8	0.9	8.3
Dehradun-II (PMU Model)	74.6	18.6	6.8	94.4	2.8	2.8
Pauri	65.3	4.7	30.0	64.6	1.8	33.6
Pithoragarh	57.0	14.0	29.0	64.4	16.4	19.2
Rudraprayag	61.4	4.9	33.7	64.9	7.8	27.3
Thatyur	61.3	2.8	35.9	84.6	7.7	7.7
Uttarkashi	69.5	12.7	17.8	75.9	2.7	21.4
Overall	**63.5**	**8.6**	**27.9**	**71.8**	**9.5**	**18.7**

7. Summary of Results Achieved

PDO Level Results Indicator	Project Target	Baseline		Endline	
		Project	Control	Project	Control
PDO 1. ***Increase in water discharge (%)***	25%	0	-	Pre-Monsoon[3]- 13.3% to 25.0% Post Monsoon[4]- 13.8% to 33.7%	-
PDO 2. ***Increase in Bio Mass (%)***	20%	0	-	21.2%	-
PDO 3. ***Increased ha of rainfed area under irrigation (ha)***	7,800 ha[5]	5,262 ha	-	10,621.3 ha	-
PDO 4. ***Increase in productivity*** ***Irrigated crops (%)*** ***Rainfed crops (%)***	50% 20%	0 0	-	60.2% 33.1%	18.3% 11.8%
PDO 5. ***Direct project beneficiaries (Number)*** ***% of females***	45,000	0	-	50,866[6] 17.3%	-

Intermediate Indicators	Project Target	Baseline		Endline		DiD
		Project	Control	Project	Control	
Intermediate Indicator 1: **(i) Percent** ***of participating households in Gram Sabha meetings (%)***	80%	67.2%	58%	53.9%[7]	32.5%	12.2
(ii) ***% of which are female***	50%	62.4%	54.3%	32.2%[8]	12.9%	10.1
Intermediate Indicator 2: ***Hydrological monitoring systems fully installed and functional in sample MWS (No.)***	8	0	-	8	-	-

[3] Water discharge data recorded in 2,054 structures during the Pre-monsoon period (April-May) and increase evaluated from 2015 to 2021

[4] Water discharge data recorded in 2,054 structures during the Post-monsoon period (Dec-Jan) and increase evaluated from 2014 to 2021

[5] The net target for increase in area under irrigation was 2,538 ha and the cumulative target (including baseline) is 7,800 ha

[6] The net number of total beneficiaries from agriculture demonstrations, animal husbandry activities, institutional members excluding beneficiaries from vulnerable group income generating activities

[7] Due to the Covid-19 pandemic, GP meeting have not been conducted in majority of villages and also participation levels are low owing to restrictions on number of people. Thus, the percentage participation in gram sabha meetings has reduced from 88.5 percent in midterm to 53.9 percent at final impact evaluation.

[8] Percentage participation of female members in GP meeting was 63.4 percent at midterm evaluation.

Intermediate Indicators	Project	Baseline		Endline		DiD
	Target	Project	Control	Project	Control	
Intermediate Indicator 3: ***Targeted traditional natural water sources rejuvenated (%)***	30%	0	-	99.0%[9]	-	-
Intermediate Indicator 4: ***Natural resource conservation techniques adopted in the targeted area (%)***	70%	0	-	93.7%[10]	65.8%	27.9
Intermediate Indicator 5: ***Targeted farmers adopting Soil moisture conservation practices Crop production technologies (%)***	60%	28.4% 13.3%	27.0% 11.7%	65.7%[11]	49.8%	14.5
Intermediate Indicator 6: ***Farmers organized into FIGs (No.)***	10,660	0	-	17,488	-	-
Intermediate Indicator 7: ***Self-sustained FF (%)***	30%	0	-	85.7%[12]	-	-
Intermediate Indicator 8: ***Vulnerable HHs covered by the Vulnerable group activities under GPWDP (No.)***	8,895	0	-	14,148	-	-
Intermediate Indicator 9: ***Targeted GPs with satisfactory social audit using PME (%)***	80%	0	-	100%	-	-
Intermediate Indicator 10: ***Targeted GPs with satisfactory financial audit report (%)***	100%	0	-	100%	-	-

As seen from the summary of results above, the project has not only successfully achieved the component wise targets set in PAD but has exceeded them in multiple components. Due to the flexibility of design, the project was able to undertake more and varied activities, than planned in GPWDP, as per the changing needs and requirements of the communities. This additional achievement of physical targets contributed to the attainment and surpassing of the PAD targets.

The project achievements have led to the improvement of biophysical environment of the arable as well as non-arable lands and thus had positive effects on the socio-economic characteristics of the farmers. Rainwater conservation and soil erosion prevention measures that are vital for the economic sustainability of dry land agriculture have been undertaken helping to increase crop yield and demonstrating a sustainable integrated farming system to increase production as well as productivity. The increase in area under irrigation is one of the significant achievement of the project which was possible due to the various source sustainability measures making water available and water harvesting, conveyance and distributions systems helping bring more land under irrigation. The project interventions have helped increase the water discharge of sources by 13.8 percent to 33.7 percent in the post monsoon period and bring an additional 13 percent of rainfed land under irrigation making the total net irrigated area 25 percent of arable area. The increase in soil moisture and water availability coupled with improved crop production technologies especially seed replacement have helped to increase the productivity multi-fold in both rainfed and irrigated agriculture.

[9] Out of 2054 sources treated, 2034 sources are showing constant or positive discharge when measured during pre-monsoon period (April-May)

[10] Percentage of farmers adopting natural resource conservation techniques such as vegetative boundaries, terrace repair and napier border plantation.

[11] Percentage of farmers adopting the demonstrated practices for soil moisture conservation (zero tillage, poly mulching, mix cropping, organic mulch) and crop production technologies (seed treatment, line sowing, vermi-compost, bio fertilizer, insect trap, bio-compost, yellow strip, bio pesticides) in at least two cropping seasons

[12] Percentage of federations that are self-sustained

Although the project had not envisaged agribusiness as a major component in its interventions, this multitudinous increase in production brought forth the need of creating market linkages. This was done through aggregation of farmers into FIGs and Federations and establishment of Agribusiness Growth Centers to provide farmers with pre and post-harvest services in a decentralized manner. The agribusiness component has thus emerged as an important one in the Gramya II project which will need further handholding support through various convergence measures to ensure that the positive results of the integrated watershed management activities are directed to sustainable economic and financial gain of the farmers. Another significant impact of the project has been on the vulnerable groups wherein over 14,000 individuals from vulnerable groups (such as widows, single women, handicapped, SC/ST and lower income group) have been supported through various individual and group income generating activities in both farm and non-farm based categories.

As the project has followed a grassroots approach with community led planning and implementation, it is expected that the treatment and rejuvenation activities undertaken during the project period will continue and impact the catchment area in the time to come. This in turn will also add to the agriculture improvement benefits the farmers have accrued with seed replacement and adoption of new and improved technologies as well as the agribusiness benefits will multiply for the farmers.

7.1 Project Development Objectives

PDO 1: Increase in Water Discharge

The target for the PDO 1 was set at 25% in the PAD. The result for the indicator was divided into two parts per the strategy adopted by the PMU and the hydrological monitoring agency, WAPCOS. Accordingly, water discharge for the sources was measured at two stages in a year- one at pre-monsoon (Apr-May) and secondly at post-monsoon (Dec-Jan).

Although the project interventions have impacted the discharge rate for many sources, for the measurement of this PDO, the project identified 2054 depleting water sources particularly natural streams and springs (those that are dried up by 50 percent or more) throughout the micro watersheds and source sustainability measures were undertaken for their rejuvenation. These sources were being regularly monitored by the project for changes in discharge. The water discharge was measured in litres per minute (LPM) for the water sources treated as well as those identified downstream to the treated sources.

WAPCOS analysed this discharge data collected twice a year over the last 7 years and reported the findings on change in water discharge for the final impact assessment. It was observed that the increase in water discharge during pre-monsoon period was in the range of 13.3 percent to 25.0 percent and the increase in post-monsoon period was in the range of 13.8 percent to 33.7 percent.

Table 10: Summary of change in water discharge

Pre-monsoon increase in water discharge (%)	13.3% to 25.0%
Post-monsoon increase in water discharge (%)	13.8% to 33.7%

The increase in discharge given in Table 10 is a cumulative effective of comprehensive wastershed interventions and catchment area treatment. The change in water discharge has also been confirmed by the beneficiaries in the catchment areas treated and corroborated with the fact that water scarcity has reduced for almost 38 percent of the households in the project area as observed from the sample survey.

The tables below (Table 11 and 12) show the changes in water discharge in water sources treated division-wise both in pre-monsoon and post monsoon between Year 1 and Year 7 of the project. This data has been recorded for 2054 structures and categorised as per the 9 project divisions.

Table 11: Change in water discharge rate (Pre monsoon)

Division	Water discharge (lpm) Year 1	Water discharge (lpm) Year 7	Variation	% Variation from Y1 to Y7

Dehradun	0.48	0.56	0.075	15.6
Pithoragarh	2.65	3.21	0.56	21.1
Bageshwar	10.1	12.1	2	19.8
Pauri	1.06	1.26	0.2	18.9
Thatyur	3.97	4.59	0.62	15.6
Uttarkashi	6.9	7.82	0.92	13.3
Almora	0.36	0.45	0.09	25.0
Rudraprayag	4.1	4.92	0.82	20.0

Table 12: Change in water discharge rate (Post monsoon)

Division	Water discharge (lpm) Year 1	Water discharge (lpm) Year 7	Variation	% Variation from Y1 to Y7
Dehradun	1.1	1.43	0.33	30.0
Pithoragarh	5.1	6	0.9	17.7
Bageshwar	17.5	20.4	2.9	16.6
Pauri	2.9	3.3	0.4	13.8
Thatyur	10.2	12.75	2.55	25.0
Uttarkashi	10.7	14.31	3.61	33.7
Almora	0.6	0.72	0.12	20.0
Rudraprayag	7.67	9.21	1.54	20.1

A time series analysis of water discharge data for all the sources is provided in annexure.

The sources have been categorised division wise as the discharge rate is highly influenced by local geographical and topographical factors such as evapotranspiration, gradient, infiltration, etc. It can be seen from the data in Tables 11 and 12 that the change in discharge is unequal through out the project area. The increase in water discharge during pre-monsoon period (Table 11) was in the range of 13.3% to 25.0%.

Closer analysis shows that about 30% of the sources treated have shown 25% increase in water discharge, while majority sources show 18 to 25% increase. Water discharge is a dynamic feature, heavily dependent on climatic variations. Also, pre-monsoon discharge rate dividends, with such comprehensive treatment takes place over a long period of time. The comprehensive rejuvenation of the water sources also has long term impacts and it is envisaged that the increase in discharge will continue for the next few years and be effective for a long period resulting long term advantages for the households in the area.

However, climate change, weather patterns, changes in topography and geological factors play an important role in the changes in water discharge. The state has experienced many weather disparities in the recent years such as heavy rains, landslides and degradation of land resources. It will be thus be important that the rejuvenation & maintenance activities are responsibly continued by the local institutions in order to continue the benefit in the future.

PDO 2: Increase in Bio Mass

The biomass estimation has been done through analysis of the NDVI maps and corroborated with ground truthing exercises in the identified micro watersheds. The results of final impact assessment for biomass estimation, has shown that the biomass in the target micro-watersheds has increased by 21.2 percent. The factors that have contributed to the increase in biomass are

a. Increase in vegetation cover due to new plantations (afforestation, fodder, timber, etc.)
b. Natural regeneration of grasses, shrubs and tree seedlings due to the reduction in grazing and over usage
c. Increase in area under agriculture through conversion of fallow land for agriculture, horticulture & fodder
d. Biomass accumulation through protection of forest/non-arable areas

The contribution of soil conservation structures and drainage line treatment (DLT) has been an important project intervention which contributed to the increase in biomass by preventing soil erosion and conserving

the moisture regime not only in and around agricultural land but also around the water harvesting structures such as water channels and irrigation tanks. In addition, land which was previously fallow was brought under cultivation through orchard planation, fodder plantation as well agriculture and coupled with the increase in cropping intensity to 195 percent, the bio mass throughout the treated areas has considerably increased.

Table 13: Biomass estimation Baseline vs Endline

Sectors	Baseline 2014-2015 (tons)	Endline 2020-2021 (Tons)	% increment
1. Biomass from catchment areas (as per NDVI maps)*	40,98,995	47,59,931.96	16.1
2. Biomass from agriculture land			
a. Biomass from agricultural production in converted fallow land	NA	15,226.1	0.4
b. Biomass from increased Cropping intensity in agriculture land	NA	17,967.8	0.4
3. Biomass from Pasture (Napier & other fodder cultivation)	NA	1,54,512.0	
Total Biomass	40,98,995	49,67,121.06	**21.2**
Biomass MT/ha	**27.69**	**33.55**	

*details of biomass data for 38 micro-watersheds using NDVI is available in Annexure

Of the total project area of 2,63,837 Ha, an estimated 2,00,902 Ha is non-arable and covered under multiple species and remaining is arable land (including agriculture, fallow and barren). The biomass of this catchment area has been estimated using NDVI maps (#1) in Table 13. Additional dry and wet biomass from the arable lands (#2) i.e. agriculture in converted fallow lands and biomass from agriculture activities and pasture lands (#3) has been estimated using a biomass coefficient for the crops and the area coverage. The biomass in estimated through NDVI maps is for a particular time and does not take into account agriculture activities done during the rest of the year and therefore these are additionally added to the NDVI estimation.

As shown in Table 13, the total biomass in the treated areas has increased from 40,98,995 tons i.e., 27.69 MT/ha in baseline to 49,67,121.06 tons i.e., 33.55 MT/ha at the time of Final impact assessment. A 21.2 percent increase from the inception of the project against a project target of 20%.

PDO 3: Increase in Rainfed Area under Irrigation

Along with source sustainability and rejuvenation, the project has taken steps for creating water harvesting potential and improving irrigation availability for the farmers in the project area. The water harvesting structures built through the project include construction and rehabilitation of rain water harvesting tanks, irrigation tanks, LDPE tanks, irrigation channel, irrigation pipeline, water lifting with solar pumps, village ponds and geo membrane tanks. This has resulted in increased irrigation availability and enabled farmers to bring rainfed area under irrigation.

As a result of the water harvesting and conveyance measures, an estimated 5,359.8 ha of net area has been brought under irrigation by the project which makes the total land irrigated as 10,621.3 ha (baseline 5262 ha) against the target of 7,800 ha. The PAD indicates the target to be cumulative additional area of 7800 ha by end of project with a baseline of 5262 Ha. The net area to be achieved during the project period was 2538 Ha against which the project resulted in an increase in irrigated area of over 5,359 ha over baseline by converting from rainfed and previously fallow arable areas. The achievement was 211% over the targeted net area of 2538 Hs. The project achieved a cumulative 10,621 ha against targeted cumulative area of 7800 Ha including area during baseline, which was over 200 percent achievement against the target (increased Ha of rainfed area under irrigation)

The estimation has been done based on the analysis of physical progress of water harvesting structures and their size and cobined with geo spatial analysis and walkthrough survey of the project area.

Table 14: Increase in rainfed area brought under irrigation in Gramya II	
Irrigation Structure	**Estimated Area Irrigated (ha.)**
Irrigation Channel	2,217.1.5
Irrigation Tank	1,373.6
Solar Energy Powered Water Lifting Pumps	241.7
Irrigation Pond/Dugout Ponds	442.4
LDPE Tanks	712.0
Pre-Fabricated Geo Membrane Water Tanks	129.6
Rainwater/Roof Water Harvesting Tanks	242.9
Total Additional Irrigated Area (ha)	**5,359.8**

While the project has adopted many innovative structures for water conveyance and harvesting such as the pre-fabricated geo-membrane water tanks and solar energy powered water lifting pumps, conventional measures such as the irrigation channels, and irrigation tanks have helped bring maximum area under irrigation.

PDO 4: Increase in Productivity

PDO 4 of the PAD focuses on the productivity increase in irrigated and rainfed agriculture. The target productivity increase was 50% for irrigated crops and 30% for rainfed crops in comparison to the productivity assessed at Baseline stage. Productivity of the selected crops has been assessed through a sample survey of farmers as well as crop cutting exercises done during the project implementation period.

The selection of crops for providing impetus through the project and increasing productivity was done based on their propensity in the project area. The selection was also done to align the thrust given to their production and marketing by the GoUK. These crops are also those that are grown in all elevations i.e. coverage throughout the project districts, have high market demand and a huge potential to give farmers high net gains. However, they were lacking in input support and technology support for reaching the optimum production potential.

Accordingly, under irrigated agriculture 5 crops were selected including garlic, cauliflower, cabbage, green pea and tomato. The area share of these main crops in the state has been observed to be:

Table 15: Propensity of selected irrigated crops in the projectarea	
Crop	**Percentage share in the state (2016)***
Peas	19%
Cauliflower	4%
Cabbage	9%
Garlic	14%
Tomato	13%

*As per Uttarakhand State Horticulture board data

As given in Table 16 below, the final impact assessment showed an overall 60.2 percent average increase in the productivity of the selected Irrigated crops against a project target of 50 percent.

Table 16: Productivity of Irrigated Crops			
Crops	**Baseline Productivity (qtls/Ha)**	**Endline Productivity (qtls/Ha)**	**Change in productivity in project area (%)**
Garlic	40.2	72.0	79.1
Cauliflower	99.5	138.0	38.7
Cabbage	86.4	133.6	54.6
Peas	51.8	86.2	66.4
Tomato	105.4	171.67	62.9

Overall			**60.2**

The increase in yield of irrigated crops is mainly attributed to the promotion of climate resilient, high yielding varieties that are suitable for local conditions and the extensive field demonstrations of improved crop management practices. The seed replacement with high yielding vegetable crop varieties has effectively demonstrated their benefits over traditional varieties and methods of cultivation. The availability of assured irrigation has also encouraged people to undertake cultivation in more area and following of proper package of practices suitable for the crop. The demonstration of raising seed and seedlings of high value crops, especially off-season vegetables under poly tunnel, protected cultivation in polyhouses, has encouraged the farmers to undertake large scale cultivation of high value crops. The high yielding crop varieties being utilized for Irrigated crops include the following;

Table 17: High yielding varieties introduced in irrigated crops

Crop	**High Yielding Variety utilized**
Cabbage	Varun, NSC Longyard
Cauliflower (I)	Snow crown, Snow white, Moti
Garlic (I)	Agri found Parvati, VL-Lehsun,
Pea	GS 10, Arkel, NSC P 10, Greenwoods, AP 3
Tomato	Himraja, Swarna Baibhav

A Difference-in-Difference (DiD) calculated for the comparison of productivity in project and control areas and to establish attribution is given below in Table 18. The DiD (qtls/ha) is the absolute productivity change for project and control areas during baseline and endline assessment. The DiD percentage shows an average achievement of 41.7% increase in productivity which can be directly attributed to the project interventions.

Table 18: Productivity Difference-in-Difference (DiD) for Irrigated Crops

Crops	**Baseline Productivity (qtls/ha)**		**Endline Productivity (qtls/ha)**		**DiD (qtls/ha)**	**DiD (%)**
	Project	**Control**	**Project**	**Control**		
Garlic	40.2	39.9	72.0	47.7	24.0	59.7
Cauliflower	99.5	98.5	138.0	109.5	27.5	27.7
Cabbage	86.4	85.3	133.6	103.0	29.5	34.2
Peas	51.8	51	86.2	62.0	23.4	45.1
Tomato	105.4	105.2	171.67	117.9	53.6	50.8
Overall						**41.7**

In rainfed agriculture, crops have been selected under all the main categories; spices, cereals, nutri-crops, vegetables, oilseeds and pulses. There has been a 33.1 percent increase in productivity against a project target of 20 percent. The detailed crop yields of the select rainfed crops are shown in the Table 19 below.

Table 19: Productivity of Rainfed Crops

	Baseline Productivity (qtls/ha)		**Endline Productivity (qtls/ha)**		**Change in productivity in project area (%)**
Crops	**Kharif**	**Rabi**	**Kharif**	**Rabi**	
Spices					
Ginger	84.7	-	117.7		38.9
Turmeric	76.1	-	91.7		20.6
Onion	-	44		62.8	42.8
Garlic	-	40.2		62.3	55.0
Cereals					
Maize	13	-	16.9		29.7
Wheat	-	12.6		18.1	43.4

Rice	11.2	-	15.2		36.1
Nutricrops					
Finger Millet (Mandua)	12.1	-	15.4	-	26.9
Barnyard Millet (Madira, Jhangora)	11.7	-	13.9	-	18.6
Amaranthus (Ramdana)	6.1	-	7.9	-	28.8
Vegetables					
Potato	90.1	-	110.5		22.7
Tomato	105.4	-	141.7		34.4
French Bean	55.6	-	82		47.5
Capsicum	58.5	-	86.2		47.3
Cauliflower	-	99.5		117.3	17.9
Oilseeds					
Mustard/ Rapeseed	-	5.6		7.6	35.7
Pulses					
Lentils (Masoor)	-	7.3		8.7	19.2
Black Soybean	8.9	-	13.1		47.2
Horse gram	-	6.8		8.1	19.0
Overall					**33.1**

The increase in productivity of rainfed agriculture can be attributed to the introduction of varieties suited for hill areas and promotion of climate resilient varieties developed for the hills by VPKAS especially for cereals and millets. This combined with the increased soil moisture retention and improved crop management along with integrated nutrient management has helped to improve production from the existing farmlands. The project has also introduced short duration, high yielding varieties as in case of maize, rice, mustard, soybean, french beans, green peas, capsicum, tomato, etc. which has helped farmers to reduce input costs and get higher benefits in a shorter time.

Field surveys have corroborated the fact that farmers have become more aware of the use of fertilizers and pesticides and instead of the previous broad spectrum use, now follow a more scientifically recommended schedule for crop management. The extensive adoption of improved crop production technologies and soil moisture conservation practices has also helped considerably in the manifestation of the genetic potentials of HYV in enhanced productivity at the demonstration and adoption plots. Continuous support through extension services that helped create awareness, adoption support and capacity building of the farmers resulting in farmers largely following the recommended package of practices and a judicial use of pesticides and fertilizers.

The following high yielding varieties of crops have led to the increased productivity of rainfed agriculture under Gramya II;

Table 20: High yielding varieties introduced in rainfed crops

Crop	Recommended High Yielding Variety
Amaranthus	VL Chua 44
Barnyard millets	VL Madira 207
Finger millet	VL 324, 347, 315, 352
Garlic	Agri found Parvati
Ginger	Rio de Janeiro
Maize	Kanchan, TATA Ril 009, DMH-849, African tall, Vivek Sankul Makka 31, K 65, DMN 849
Mustard	8501, PT 303, PPS-1
Onion	Nasik red, Sarik Red
Potato	Kufri Badshah, Kufri Jyoti, Chandramukhi
Rice	PB 1509, VL 85, 86, 62
Soybean	PS 1225, PS 1092
Turmeric	Swarna
Wheat	VL 953, HS 507, VL 892, HS 507, HD 2967, UP 2572, UP 2526, PBW-550, VL 824, VL 832, VL 907

The DiD assessment as given in Table 21, shows that 20.8% of the productivity increase can be attributed to the project activities.

Table 21: Difference in Difference for Productivity of Rainfed Crops

Crops	Baseline Productivity (qtls/ha)				Endline Productivity (qtls/ha)				DiD (qtls/ha)	DiD (%)
	Project		Control		Project		Control			
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi		
Ginger	84.7	-	84.2	-	117.7		100.3		16.9	19.9
Turmeric	76.1	-	75.9	-	91.7		83.7		7.8	10.3
Onion	-	44	-	43		62.8		50.0	11.8	26.9
Garlic	-	40.2	-	39.9		62.3		51.2	10.8	27.0
Maize	13	-	12.3	-	16.9		13.2		3.0	22.8
Wheat	-	12.6	-	12		18.1		14.1	3.4	26.8
Rice	11.2	-	11.1	-	15.2		11.5		3.6	32.5
Finger Millet (Mandua)	12.1	-	11.5	-	15.4	-	13.2	-	1.6	12.9
Barnyard Millet (Madira, Jhangora)	11.7	-	11.5	-	13.9	-	12.8	-	0.9	7.5
Amaranthus (Ramdana)	6.1	-	5.8	-	7.9	-	6.1	-	1.5	23.8
Potato	90.1	-	89.8	-	110.5		100.0		10.3	11.4
Tomato	105.4	-	105.2	-	141.7		127.8		13.6	12.9
French Bean	55.6	-	55.2	-	82.0		70.3		11.3	20.4
Capsicum	58.5	-	58.1	-	86.2		65.2		20.5	35.1
Cauliflower	-	99.5	-	98.8		117.3		107.9	8.7	8.7
Mustard/ Rapeseed	-	5.6	-	5.4		7.6		6.0	1.4	25.0
Lentils (Masoor)	-	7.3	-	7.1		8.7		7.5	1.0	13.7
Black Soybean	8.9	-	8.6	-	13.1		9.0		3.8	42.7
Horse gram	-	6.8	-	6.7		8.1		7.0	1.0	14.6
Overall										**20.8%**

PDO 5: Direct Project Beneficiaries

The project through its 7 year project period has directly benefitted a total of 50,866 beneficiaries against a project target of 45,000 (113 percent target achievement). This number is excluding the beneficiaries from vulnerable groups who have benefitted through income generating activities. Additionally, the project has also benefitted 1351 families of transhumant population that pass through the project areas in the winter months.

The beneficiaries have been documented through the project MIS and include the unique beneficiaries of agriculture and horticulture demonstration & adoption support activities, beneficiaries of animal husbandry interventions, farmers that have received support for irrigation and other natural resource conservation activities, members of the various community based institutions created by the project such women aam sabhas, farmer interest groups, farmer federations, user groups, and individuals benefited under the income generation activities for the vulnerable groups.

Table 22: Details of direct project beneficiaries

Intervention details	Total beneficiaries	Female beneficiaries
Direct beneficiaries under different project interventions	50,866	8,817
Percentage of female beneficiaries		17.3%

The percentage of female beneficiaries among the project beneficiaries is 17.3 percent, target for female beneficiaries was not specified in PAD.

7.2 Intermediate Indicators

Intermediate Indicator 1: Percent of participating households in gram sabha meetings

Intermediate Result	Project Target	Baseline		Endline		DiD
		Project	**Control**	**Project**	**Control**	
Intermediate Indicator 1: (i) Percent *of participating households in Gram Sabha meetings (%)*	80%	67.2	58	53.9	32.5	12.2
(ii) *% of which are female*	50%	62.4	54.3	32.2	12.9	10.1

The percentage of households participating in Gram Sabha meetings was 53.9 percent for the last year. With 32.2 percent participation of women. The achievement under this indicator is very low, as the data collected here corresponds to year 2020-21. During this time, there were restrictions on meetings and gatherings due to the pandemic which are still prevalent in some of the areas. Almost 37 percent of the respondents stated that there has been no gram sabha meeting held in their village in the last one year and 17 percent have not had a meeting for two years. Due to Covid-19 related concerns, very few meetings were taking place, with only a limited number of people as people were also reluctant to attend the meetings.

However, during the midterm it was observed that 88 percent of households participated in gram sabha meetings. This achievement was above the project target of 80 percent. It can thus be fairly assumed that the project has been able to change the attitude of people toward participation in gram sabha and that if meetings resumed the participation levels of pre-covid time would also resume. It was also reported through the field survey that if proper precautionary measures for Covid-19 were in place or if the spread of Covid-19 reduced, members would be comfortable in attending meetings and participate in village development activities. Members have also stated that although official meeting are not taking place, the gram sabhas have been continuing with the village development activities.

Intermediate Indicator 2: Hydrological monitoring systems fully installed and functional in sample MWS

Micro Watershed (MWS) is a small hydrological unit generated to create water balance in the regions of acute water shortage like remote hilly regions where water availability is scarce. To reverse the trend of environmental degradation and ensure sustainable livelihood to the people, Gramya II has introduced the active and effective participation of community as a major stakeholder in conservation, regeneration and the judicious use of all the natural resources - land, water, plants and animals within a watershed. WAPCOS, the technical consulting firm has installed hydrological monitoring systems in eight micro-watersheds.

Intermediate Result	Project Target	Baseline		Endline	
		Project	**Control**	**Project**	**Control**
Intermediate Indicator 2: *Hydrological monitoring systems fully installed and functional in sample MWS (No.)*	8	0	NA	8	NA

The area and Gram Panchayat details of the eight micro watersheds is as follows;

Table 23: Area Details of 8 MWS

District	No. of Micro Watersheds	Area (ha)	Gram Panchayat	Revenue Villages
Almora	9	28,396	85	186
Uttarkashi	17	45,103	67	119
Dehradun	9	29,242	49	74
Thatyur	13	31,730	72	151
Rudraprayag	6	19,201	65	119
Pithoragarh	9	25,739	59	137

Bageshwar	11	55,296	48	82
Pauri	7	26,713	57	185
Total	**81**	**261,420**	**502**	**1053**

Intermediate Indicator 3: Targeted traditional natural water sources rejuvenated

Intermediate Result	Project Target	Baseline		Endline	
		Project	Control	Project	Control
Intermediate Indicator 3: *Targeted traditional natural water sources rejuvenated (%)*	30%	0	NA	99.0	NA

The project had identified over 2500 traditional water sources that has dried up 50 percent or more. Throughout project period, treatment and rejuvenation was done for 2054 of these sources and they were being monitoring for their water discharge. At the time of final impact assessment, 2034 of the identified and treated sources have shown constant of positive discharge in water flow when rate of discharge was measured in eth pre-monsoon period. For this result indicator, the results framework target was set at 30 percent. However, the project has seen a rejuvenation in 99 percent of the sources treated. A target achievement of 300 percent.

Table 24: Traditional water sources rejuvenated in Gramya II

District	No. of sources treated	No. of sources with positive discharge
Dehradun (PMU)	261	261
Pithoragarh	279	279
Bageshwar	96	96
Pauri	196	193
Thatyur	381	381
Uttarkashi	144	144
Almora	550	533
Rudraprayag	147	147
Total	**2054**	**2034**

Intermediate Indicator 4: Natural resource conservation techniques adopted in the targeted area

The adoption of natural resource conservation techniques among farmers / households is measured based on the responses of the beneficiaries in adopting measures of planting vegetative field boundaries, napier border plantation and terrace repairs as soil conservation measures to conserve natural resources. The baseline value of the indicator was zero and control values were not applicable.

Intermediate Result	Project Target	Baseline		Endline	
		Project	Control	Project	Control
Intermediate Indicator 4: *Natural resource conservation techniques adopted in the targeted area (%)*	70%	-	-	93.7	65.8

As per the field survey, an aggregate 93.7 percent farmers are adopting the natural resource conservation techniques in the targeted area against 65.8 percent farmers in control area. The adoption of terrace repair and napier border plantation is higher than vegetative boundaries. Terrace repair is undertaken by majority farmers with and without project support. Napier plantation is however an activity promoted by the project and has received good response from the farmers as it also provides much needed fodder for the livestock thus reducing the time and effort of procuring fodder from the forests and other common land.

	Baseline		Endline	
	Project	Control	Project	Control
Vegetative boundaries	-	-	86.7	67.4
Napier border plantation	-	-	95.9	61.0

Terrace Repair	-	-	98.6	69.1
Overall			**93.73**	**65.83**

Along with the terrace repair, the project has undertaken improved watershed services and ecological functions through comprehensive conservation of natural resources. Multiple activities have been undertaken in arable as well as non-arable lands by the project as well as through convergence with the forest department in the Reserved Forest areas.

The progress under construction of each structure has been detailed in Table 25 below.

Table 25: Area impacted through natural resource conservation techniques

Natural resource conservation techniques	Units	Project Achievement
Terrace repair/vegetative field boundary	cum	46,773.0
Construction of vegetative check dam	no.	16,052.0
Construction of dry stone check dam	cum	2,50,272.0
Construction of crate wire check dam	cum	4,32,357.0
Construction of spur (river training work)	cum	1,331.0
Construction of cross barrier	cum	481.0
Vegetative treatment	ha	6.9
Road side erosion control & other soil conservation work	cum	96,243.0
Recharge pit	cum	1,10,736.0
Digging of trenches	no.	8,79,284.0
Renovation of existing tal/khal	no.	10,830.0
Landslide treatment	cum	76,921.4
Diversion drain	km	30.0
Dugout ponds	no.	1,186.0
Retaining wall	cum	2,89,610.2
Afforestation	ha	3,897.0
ANR of oak	ha	552.0
Napier and forage plantation	ha	4,667.0
Orchard development & homestead	ha	4,946.2

Many techniques are being promoted by the project and farmers have been provided information about many natural resource conservation techniques. It was found that construction of dry stone check dams and crate wire check dams along with river bank protection was adopted on a large scale to check soil erosion**.** The most significant plantation activity was undertaken in the district of Thatyur division 2268**.**6 ha of land has been brought under plantation, which the highest among all districts**.** Additionally, over 1,000 water harvesting structures including farm ponds and community ponds have been constructed for water storage and retention**.**

Intermediate Indicator 5: Targeted farmers adopting soil moisture conservation and crop production technology

This indicator is a composite indicator that measures the percentage of farmers adopting soil moisture conservation practices and crop production technologies together.

The various soil conservation and crop production technologies demonstrated through the project include seed treatment, bio-compost, vermi-compost, mulching, IPNM (bio pesticides, yellow strip, insect traps, organic manure, cow urine, bio fertilizer), deep ploughing, zero tillage, and line sowing. The demonstrations have encouraged farmers to a great extent and adoption by farmers / households showed that 65.7 percent farmers have adopted a minimum of five techniques from those listed. A target achievement of 109.5 percent

Intermediate Result	Project Target	Baseline		Endline		DiD
		Project	Control	Project	Control	

Intermediate Indicator 5: ***Targeted farmers adopting soil moisture conservation and crop production technology (%)***	60%	28.4	27	65.7*	49.8	14.5

*Farmers using at least five soil moisture conservation technologies

Seed treatment, deep ploughing, and line sowing are the most adopted techniques due to their easy application and little to no cost to the farmers. Mulching has also been adopted greatly in some reasons due to its benefits in conserving soil moisture and reducing the labour requirements of hoeing and weeding. Practices that require higher investment such as use of insect traps and yellow sticky traps is lower as farmers are either unable to source them or find the practice of using spray pesticides more convenient. The use of these measures is seen more in vegetable and other cash crops as compared to cereal crops.

The Table 26 presented below shows the percentage of households practicing different soil moisture conservation techniques in project and control area.

Table 26: Soil moisture conservation measures & crop production technologies adopted

	Baseline (%)	Endline (%)
Soil moisture conservation measures		
Organic Mulch	0.1	48.1
Poly Mulching	1.8	44.7
Mix Cropping	11.1	41.8
Crop production technologies		
Bio Pesticides/Natural Pesticides (made of botanical extracts/organic materials)	0.1	72.2
Seed Treatment	0.1	67.3
Line Sowing	20.1	56.4
Vermi-compost	1.1	47.8
Bio Fertilizer	2.1	28.9
Insect Trap	0	26.5
Yellow Strip	0.7	18.4
Bio-compost	3.1	11.3
Zero Tillage	0.8	10.4

Intermediate Indicator 6: Farmers organized into FIGs

Intermediate Result	Project Target	Baseline		Endline	
		Project	Control	Project	Control
Intermediate Indicator 6: ***Farmers organized into FIGs (No.)***	10,660	0	NA	17,488	NA

Formation of FIGs is a significant part of the institution building to streamline distribution of services and promote agribusiness activities for the benefit of farmers. The project has helped establish a total of 1,488 FIGs with 17,488 members. A target achievement of 164 percent. The Table 27 below illustrates the membership details of the FIGs

Table 27: Composition of FIG members (gender wise)

Type of FIG	Total Number	No. of Members		
		Male	Female	Total
Female FIGs	727	0	8032	8032
Mixed FIGs (with Male and Female Members	594	3078	4094	7172

Male FIGs	167	2284	0	2284
Total	**1488**	**5362**	**12126**	**17488**

As seen above, 48 percent of the FIGs are solely constituted of women members showing high inclusivity. The FIGs are engaged in collective production and sale of fresh produce, mainly vegetables, as well as post-harvest activities such as sorting, grading and packaging of produce, and value addition through processing such as making of jams, pickles, squash, flours and other food items. The percentage of women members is 69 percent in the total membership thus showing a high percentage of gender inclusion in the FIGs. Women have through this and other institutional initiatives of the project been provided exposure to outside activities thus giving them opportunities for social recognition and financial independence.

The project has undertaken capacity building from time to time, to enable the FIG members to carry out their operations as per the group governance norms. The FIGs have their own bank account and bye-laws have been constituted to self-regulate their activities and to control the actions of its members. Elections are held annually for the selection of office bearers and all the members participate in the decision-making. All the members (male and female) are participating regularly in the meetings and their respective points are taken into consideration. Activities of the group are well documented and known to all the members and all information regarding business and finances freely available when demanded. Members are also aware of their responsibilities.
However, the groups need to be more diligent with giving leadership opportunities to members as it was observed that the same person has been the office bearer for multiple terms in many groups. The group rules do not stipulate for how long a leader can hold the position and therefore owing to no opposition from other members and/or the lack of replacement candidates there was no change in leadership for many years. There were also a few FIGs where some members have dropped-out of the group however, new members have joined the group in place or the group is continuing with reduced number of members.

Intermediate Indicator 7: Self-sustained FF

A Farmers' Federation (FF) is the institutional amalgamation of FIGs at the cluster or block level. It plays an important role for strengthening FIGs, provide them a forum for participation, understand the issues, and come up with their own solutions for the functioning of their groups. The FF also act as a social and economic support system for FIGs through which learning opportunities are provided via trainings and exposure visits and undertaking of processing and value addition activities to support assured buying for the FIGs' produce.

A self-sustained FF under Gramya II has been defined as one which,

1. is functioning, i.e.
    a. maintaining proper records and documentation
    b. members and Managing Committee are conducting regular meetings (minimum two/year- one for each crop season)
    c. Business operations- buying and selling of produce- is on going
2. has made profit in at least last two business cycles
    a. Where profit is equivalent to the savings made by the federation from business operations and deposited in their bank accounts

Federations that are conforming to all of the above 4 criteria are deemed as self-sustainable under this objective. With this parameter in mind, the assessment of the FFs created under Gramya II shows that 18 federations out of 21 have currently achieved self-sustainability.

As per the self-sustainability parameters listed here, the federations have shown a more than acceptable progress. All, except three, of the federations have been deemed self-sustainable under the listed criteria. The three federations have become inactive due to some leadership issues. The project has intervened here and taking steps to resolve the issues and resume operations for these three federations.

Intermediate Result	Project Target	Baseline		Endline	
		Project	Control	Project	Control
Intermediate Indicator 7: *Self-sustained FF (%)*	30%	0	NA	85.7	NA

The federation wise compliance with each of the criterion identified above in given in Table 28 below.

Table 28: Self-sustainability of Farmer Federations

Name of FF constituted	Records Maintained	Regular Meetings	Ongoing business	Profit made	Score on self-sustainability (Out of 4)
Jagnath Krishi Beej Utdpadak Sangh, Almora	√	√	√	√	4
Dhauladevi Gramyashree Swayatta Sahakarita Sangh, Almora	√	√	√	√	4
Danpur Kisan Ekta Swayatta Sahakarita, Bageshwar	√	√	√	√	4
Saryu Ghati Swayatta Sahakarita, Bageshwar	√	√	√	√	4
Teelu Rauteli Swayatta Sahakarita,	√	√	√	√	4
Chaundkot Navjyoti Swayatta Sahakarita, Pauri	√	√	√	√	4
Kshetragarh Bahuddesheeya Swayatta Sahakarita, Pauri	√	√	√	x	3
Triveni Sangam Swayatta Sahakarita Kisan Sangh, Nachni, Pithoragarh	√	√	√	√	4
Unnati Swayatta Sahakarita, Thal, Pithoragarh	√	√	√	√	4
Kalika Devi Swayatta Sahakarita Kisan Sangh, Pithoragarh	√	√	√	√	4
Malkoti Swayatta Sahakarita, Thano (Dehradun)	√	√	√	√	4
Mandakini Swayatta Sahakarita, Rudraprayag	√	√	√	√	4
Jay Kedar Baba Swayatta Sahakarita, Rudraprayag	√	√	√	√	4
Jay Bhagwan Vasudev Swayatta Sahakarita, Rudraprayag	√	√	√	√	4
Gramya Kirshak Swayat Sahakarita, Thatyur	√	√	√	√	4
Kamal Ghati Gramya Swayatta Sahakarita, Uttarkashi	√	√	√	√	4
Yamuna Ghati Gramya Swayatta Sahakarita, Uttarkashi	√	√	√	x	3
Kedar Ganga Gramya Swayatta Sahakarita, Uttarkashi	√	√	√	√	4
Athgaon Fal Evam Sabji Utpadak Swayat Sahakarita, Vikasnagar	√	√	√	√	4
Jonsar Fal Evam Sabji Utpadak Swayat Sahakarita, Vikasnagar	√	√	√	x	3
Vangaon Mankhat Fal Evam Sabji Utpadak Swayat Sahakarita, Vikasnagar	√	√	√	√	4

The PAD description of the indicator states that it is calculated as the percentage increase in the production volumes marketed by the FFs. Since the Federations have been established as part of the project, there is no baseline for comparison, however a comparison of the year 3 and year 7 volumes of the produce marketed shows a 4314 percent increase. The total marketed volume for all 21 FFs for year 3 (2016-17) was 218.7 qtls and that for year 7 (2021-22) was 9,651.9 qtls.

The high achievement under this objective can be attributed to the increased focus of activities on agribusiness component. The increase in production and expansive aggregation of farmers into FIGs made it necessary to establish a larger level institution to meet the knowledge and capacity building needs of the farmers and also to provide an avenue to absorb the surplus production due to increased adoption of agriculture and increased productivity. The strengthening of FFs came as a necessity for the forward growth of the project activities and was thus dedicatedly implemented at the project level. The project design did not have provision for extending financial support to the federations in terms of loans, however, support is provided in terms of technical guidance and capacity building, exposure visits for members, input support for adoption, developing of value chains and marketing facilities.

During field visits, the status of the current activities of the federations has been evaluated and the project plan for exit was also evaluated. The FFs are engaged in the providing processing services as well themselves processing and selling of products. The profit margin from the sale of processed products has been observed to be 20-30. In addition to the profits from sale, funds have been collected through membership fees and shareholder fees. To ensure fund availability for future functioning, purchase of raw materials, processing

and marketing of products, the FF members have unanimously decided to not distribute the savings of the FFs just yet.

The project has undertaken capacity building from time to time, to enable the FF members to carry out their operations as per the society norms. The FFs have their own bank account and bye-laws have been constituted to self-regulate their activities and to control the actions of its members. Elections are held annually for the selection of office bearers. All the members (male and female) regularly participate in the meetings and their respective points are taken into consideration. Activities of the FF are shared with all the members, information is properly documented and all information regarding business and finances is freely available when demanded. All members are aware of their responsibilities, and collectively discuss and take decisions during meetings. At the time of discussion, the federations confirmed that they are all aware of the operations and management of their FF. Each federation also has independent staff employed by them for the provision of services as well for maintaining records and book keeping.

However, the FFs need to be more diligent with giving leadership opportunities to members as it was observed that the same person has been the office bearer for multiple terms in many FFs. The FF bye-laws do not stipulate for how long a leader can hold the position and therefore owing to no opposition from other members and/or the lack of replacement candidates there was no change in leadership.

Intermediate Indicator 8: Vulnerable HHs covered by the vulnerable group activities under GPWDP

The project allocated Vulnerable Group Funds (VGF) to the WWMC for supporting livelihood enhancement of vulnerable groups in order to ensure equity amongst the vulnerable individual households. These funds were used to finance small income generating activities for vulnerable individuals/groups. The vulnerable group funds have been distributed equitably keeping in mind various parameters. The beneficiaries are identified from the 'C'- category households through a 'Wealth Ranking Exercise' carried out as part of participatory planning for preparation of Gram Panchayat Watershed Development Plans. Due care was also taken to include divorcee women, widows and specially-abled individuals for income generating activities. Proposals were developed by the FNGO in consultation with concerned individual/group and funds disbursed to the vulnerable individuals/groups, through the GPs after signing of an agreement with GP. Trainings were also provided to the beneficiaries where required and they were also connected with other line departments for extended support.

Intermediate Result	Project Target	Baseline		Endline	
		Project	Control	Project	Control
Intermediate Indicator 8: ***Vulnerable HHs covered by the Vulnerable group activities under GPWDP (No.)***	8895	0	NA	14,148	NA

Throughout the duration of the project, 1,040 group and 8,615 income generating activities have been funded for vulnerable individuals totalling to 14,148 individuals. The project has over achieved the target of vulnerable household by benefiting 1.5 times the target number of beneficiaries. The total number of female beneficiaries is 5,447, a 39 percent proportion of the total beneficiaries.

Table 29: Composition of vulnerable group beneficiaries

	Male				Female				Total
Social category	**SC**	**ST**	**OBC**	**Gen**	**SC**	**ST**	**OBC**	**Gen**	
Individual Activities	2210	254	635	2260	905	142	519	1690	**8,615**
Group activities	1456	165	652	1036	558	98	400	1135	5**,533**

Intermediate Indicator 9: Targeted GPs with satisfactory social audit using PME

Intermediate Result	Baseline	Endline

		Project	Control	Project	Control
Intermediate Indicator 9: ***Targeted GPs with satisfactory social audit using PME (%)***	80%	0	NA	100	NA

The PME round is conducted every six months. The project has conducted 7 rounds of PME exercise and out of 527 GPs, 522 GPs were audited in the last round completed in January 2022. Some of the GPs were not included in the audit due to pandemic related restrictions.

Table 30: No. of GPs audited

Division	GPs	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7
PMU	07	07	07	07	07	07	07	07
Dehradun	56	56	54	53	53	53	53	53
Thatyur	78	78	78	78	78	78	75	78
Pauri	62	62	62	62	62	62	59	60
Almora	87	87	87	87	87	87	87	87
Bageshwar	44	43	43	43	43	43	44	44
Pithoragarh	64	62	61	61	61	61	62	64
Rudraprayag	61	61	61	61	61	34	61	61
Uttarkashi	68	66	25	-	-	-	66	68
Total	**527**	**522**	**478**	**452**	**452**	**425**	**514**	**522**

All the GPs audited in the 7th round have displayed satisfactory performance in the audit. The detailed result of PME will be annexed in the Withdrawal Document of the GPs.

Intermediate Indicator 10: Targeted GPs with satisfactory financial audit report

Financial audit as per requirement of the PRI Act and the State Accountant General and a Social audit through Participatory Monitoring & Evaluation of Gram Panchayats is an integral part of Gramya II. It is mandatory for all GPs to submit their monthly and annual financial audit reports to WMD in accordance to statutory norms. The audit has aided to review operations in the Gram Panchayats to ensure that the internal control systems are operating satisfactorily across the programs. The timely auditing has ensured transparency in financial transactions and expenditure done on project activities by the GP. Transparent operations increase trust of the village members in the institution and strengthen participatory governance.

Intermediate Result	Project Target	Baseline		Endline	
		Project	Control	Project	Control
Intermediate Indicator 10: ***Targeted GPs with satisfactory financial audit report (%)***	100%	0	NA	100	NA

Out of the total targeted Gram panchayat for financial audit, the Project has been able to achieve a completion rate of 100 percent by March 2021. The number of GPs with satisfactory financial audit stands at 100 percent.

8. Social Mobilization and Building Social Capital

The Gramya II project by its design has given specific emphasis to community inclusive approaches and utmost importance to people's involvement. Gramya II draws from the learnings of the previous project giving greater emphasis to community participation and community ownership and a greater focus on the involvement of women. The project is built to develop greater ownership, planning and management by community through participatory approach involving all stake holders at Gram Panchayat (GP) level. The project staff and project partners (Facilitating NGOs, Partner NGOs) have a facilitating role to support the community for planning, implementation and management of the project.

Institution building for creating various community based groups, aggregation of beneficiaries for collective working and smooth implementation of the activities, and building social capital has been the focus area of the project. For this purpose, 18 percent of the project IDA fund are allocated for social mobilization activities (Component 1) in order to make the project approach more decentralized and encourage community ownership. The project has adopted the following strategies to have an inclusive approach:

8.1 Institution Development and Capacity Building

Institutions at various levels have been created to promote the above fundamental principles. The FNGO and PNGO field staff have facilitated in the formation of various institutions and groups, such as Water and Watershed Management Committees (WWMC), Revenue Village Committee (RVC) and Farmers' Interest Groups (FIGs) across the divisions. These institutions were strengthened by building the capacities on variety of thrust areas such as natural resources management, agriculture systems development, skill development, livelihood enterprise development, gender sensitization, governance, legal issues and general awareness building.

The design of Gramya II was based on learnings from Gramya 1 as new approaches for promoting decentralized watershed management was included while implementing the GPWDP. The participatory approach in GPWDP preparation and implementation also ensured ownership of the institution over the infrastructure created under the project. The existing institutions were strengthened and the newly formed institutions were capacitated. The project has ensured sustainability of the investments by ensuring that the community groups take responsibility of the various activities under their responsibility.

Gram Sabha-Approves key decisions related to GPWDP, ensure inclusion of disadvantaged groups; women, poor, SC/ST, transhumant and monitors the working of GP and implementers.

Gram Panchayat-Organizes Gram Sabha meetings, gets all necessary project agreements signed by WMD. It supports NGOs in mobilization of village communities, initiates and completes the preparation of GPWDP as per project guidelines, manages project funds and expenditure as per AWPs of GPWDP, ensures transparency and accountability by all GP level institutions and individuals involved in the project and ensures the beneficiary contribution.

Water and Watershed Management Committee (WWMC) - It comprises of a committee of GP headed by the Gram Pradhan. The committee supports NGOs in mobilization of village communities, lead the process of planning, preparation and implementation of GPWDP, manage fund of vulnerable groups, delegates responsibility for implementation of Village Watershed Development Plans to RVC, submits timely monthly and annual financial reports to WMD and ensures timely audit of GP annual accounts and submission of the audit report to the WMD.

Revenue Village Committee (RVC) - The committee is headed by Gram Pradhan/Ward Members and it consists of the remaining ward members of that revenue village, members of SHG, Mahila/Yuvak Mangal Dal and other village level institution. At least 50 percent of the committee members are women. It is responsible to lead the process of preparing RVC proposals, implement GPWDP activities at the village level when GP gives them a contract and ensures equity for all, especially the disadvantaged groups.

Mahila Aam Sabha (or Women Aam Sabha- WAS) - It is constituted of all adult women voters of GP and is responsible to ensure that proposals of Mahila Aam Sabha are included into the GPWDP. It is envisaged as an Institution responsible for the empowerment of the women in the Project area

Van Panchayat (VP)-It is constituted as per provisions of Uttarakhand Van Panchayat Act 2005. The committee develops inter GP space plan, implements all plantation related activities under the project and coordinates with concerned Forest Department office for technical and management issues.

User groups- It comprises of village members who are the beneficiaries of the water harvesting structures created as part of the GPWDP & UDWDP. Their role is to maintain the structures and look after its keep.

FIGs & FFs- The project has also enabled the formation and strengthening of farmer interest groups (FIGs) at village level to allow easy delivery of services and project benefits as well as effective dissemination of knowledge to the farmers.

Table 31: Local Institutions Built for Project Implementation

	Institutions Formed	Total Members
User groups	1381	10827
Water & Watershed Management Committees	527	3201
Revenue village committees	999	7293
Farmer Interest Groups	1488	17488
Farmer Federations	21	13938
	4416	

A total of 4416 different types of community level institutions have been formed in the project area. During the survey it was found that 12 percent of the sample households were part of the project created institution. If projected across the number of direct beneficiary reached out by the project, about every 8th household is a part of one or the other project created institution which is an encouraging effort towards building social capital.

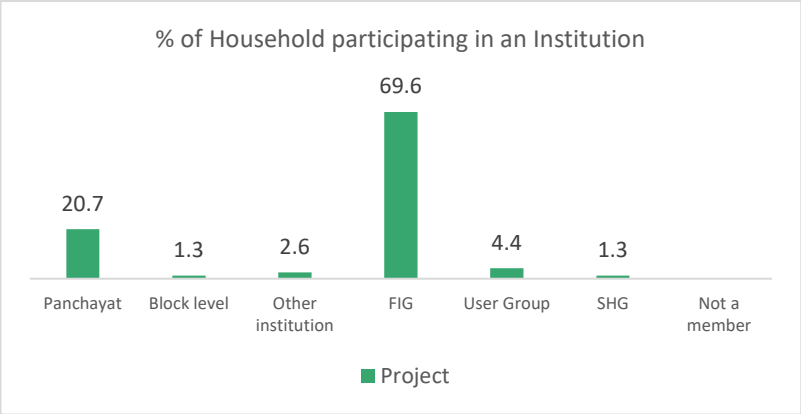


Figure 2: Percentage of households participating in an institution

8.2 Building Social Capital

Social Capital remains a contested concept till this time as there is no standard definition. The World Bank defines Social Capital as 'Institutions, relationships, and norms that shape the quality and quantity of a society's social interactions. Social capital is not just the sum of the institutions which underpin a society – it is the glue that holds them together' (Hans). It is an important impact indicator to capture as it broadly defines the capacity of the community to co-operate, resolve conflicts, ease transactions and dealings and facilitate upliftment and inclusion. The project has taken various steps for institutional building and for inclusion of the different groups through focused interventions. The impact of these interventions is bound to change the fabric of the society towards the positive as benefits are being gained by all. The Social Capital score was calculated for all the households covered under treatment and control separately both in baseline

and endline. A total of 9 parameters were considered under dimensions of 'Togetherness and Trust' and 'Social Cohesion'.

Social capital is believed to increase efficiency of social exchange and build new forms of information exchange. The five critical elements considered as building blocks of togetherness and trust for building socially resilient communities are positive perceptions towards general trust prevailing within the community, positive attributes to think about welfare of the community, prevailing trust for sharing resources within community, willingness to help and positive perception about a cohesive society. A comparison between the controls groups indicate that project sites show relatively higher percentages of household agreeing to the positive attributes of community which has trust and togetherness. This means that communities in the project site consult each other for critical developmental decisions, share resources and will also share profits if any gained from collective interventions. There were several instance when community has gradually got involved in WWMC and Aam Sabha bestowing greater trust in the institution created under project and collective action.

In the beginning the community took the WWMC meeting and GPWDP simply as the Gram Sabha meeting only, where they felt they have least role in participation at planning, decision making and implementation. But after attending few meetings of GPWDP and MSW Plan, a confidence has come in particularly the women who seldom participated in Gram Sabha meetings. Now they show their positive attitude towards Local Self Governance because they know that during WWMC meetings as well as GPWDP meetings their voice will be heard.

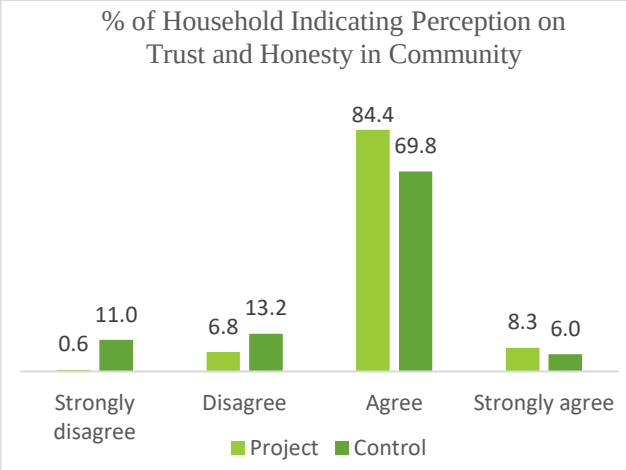


Figure 3: Household Perception on Trust and Honesty in Community

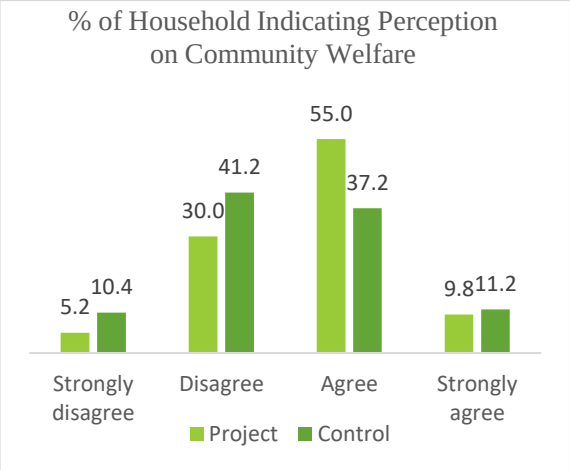


Figure 4: Household Perception on Community welfare

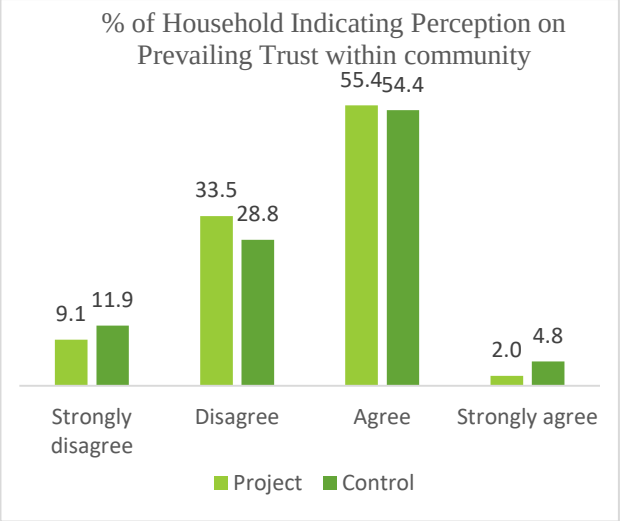


Figure 5: Household Perception on Prevailing Trust in Community

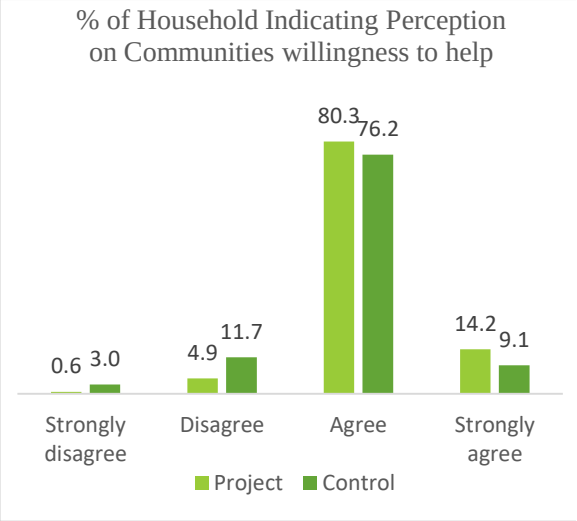


Figure 6: Household Perception on Community's willingness to help

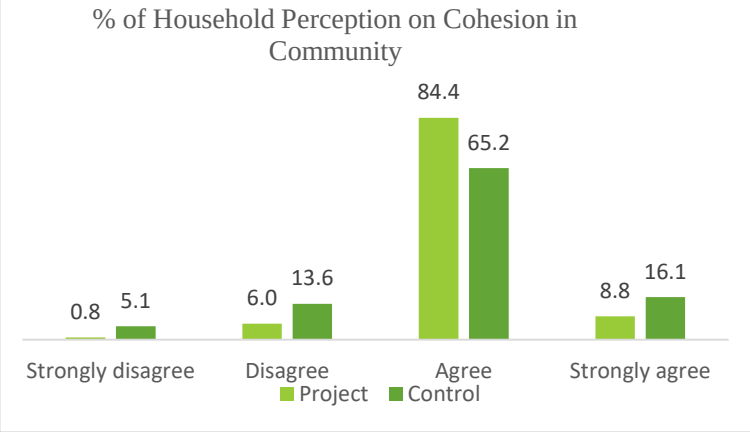


Figure 7: Household Perception on Cohesion in Community

Likewise social cohesion is reflected from four critical parameters such as attitude towards usage of common property, managing occurrence of crisis in the situation, conflict resolution and other safety issues. It is believed that communities with greater trust have lower incidence of crime making the community a safe space to reside. Qualitative consultations indicate that community is vocal about several forums that have been created such as Women Aam Sabha, RVC Meetings, FIG meetings for sharing community dialogues which has instilled greater belongingness and trust over collective decision making.

Case: Gram Panchayat Digoti (Consultation during Women Aam Sabha Meetings)

The community knows about the Project as Watershed project. They know about Budget envelop also. Though the participation of women is lesser as compared to men, yet they have participate at the time of GPWDP planning.

> *"When we realized that this (GPWDP Planning Process) is not a regular panchayat meeting individual as well as Group's came forward to give proposals which was needed and would help us fetch an additional income. We felt very happy that all our requests were included and supported through the Panchayat Budget"-Vimla Devi (VGA Member)*

Almost 100 of the proposal given by community were approved. The community knew about the different activities carried out in the village. Less knowledge about the expenditure, although it has been clearly displayed on the walls of the Panchayat. There are no of institutions at village level, repeating the same members which would mean every individual has been connected through one or the other group formed

under the project. The Group meetings are organized on monthly basis on fixed date, but sometimes changed for local reasons. Women participation in trainings and meetings is more as compared to man. Community has received individual as well as groups support from the project like Polyhouse, cow shed, Goat, cow etc. Participation in agriculture interventions such as grading and marketing of crop. The project activities have given an exposure to the community particularly the women. The group members are contributing in group account as they have gathered trust in the collective activity. Time to time trainings has been provided to groups. The women showed keen interest in participating in exposure visits.

Figure 8: Social Capital Dimensions and Parameters

There parameters have been combined together to an index to explain the social capital score. Scores are divided into four quartiles where Quartile I represent percentage of households who perceive all attributes of the index to be Excellent, Quartile II represents households scoring those attributes to be Good and not Excellent, Quartile III represents the attributes to be just Adequate and may need still improvement and Quartile IV represents households that have scored poorly on the social capital front which means the community is poorly placed in terms of mutual trust, collectivisation and all such attributes that may lead to a resilient community. It can be seen from the chart below that the score in the highest quadrant has slightly increased during the Final impact assessment as compared to that of the baseline results.

Apart from project led interventions, social issues, such as, girls' education, employment, sanitation, widow / old age / handicapped pension, rural road connectivity, etc. were raised and were resolved through convergence with different social welfare schemes, skill development programmes of Rural and Social Welfare Departments. The holistic development approach has led to greater confidence among community on the project.

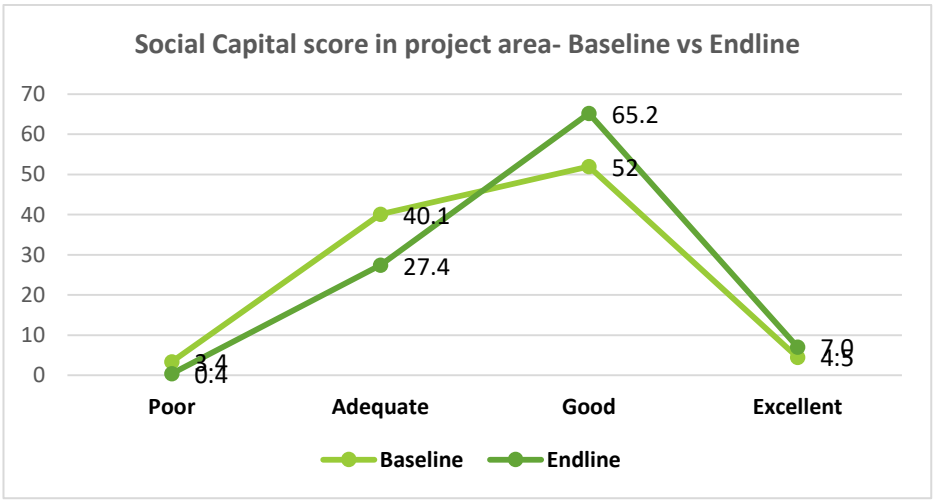


Figure 9: Social Capital score in project area

The difference-in difference from the above graphs shows that there has been a positive change in one of the quartiles in category of "Good" from Baseline to Endline indicating projects contribution.

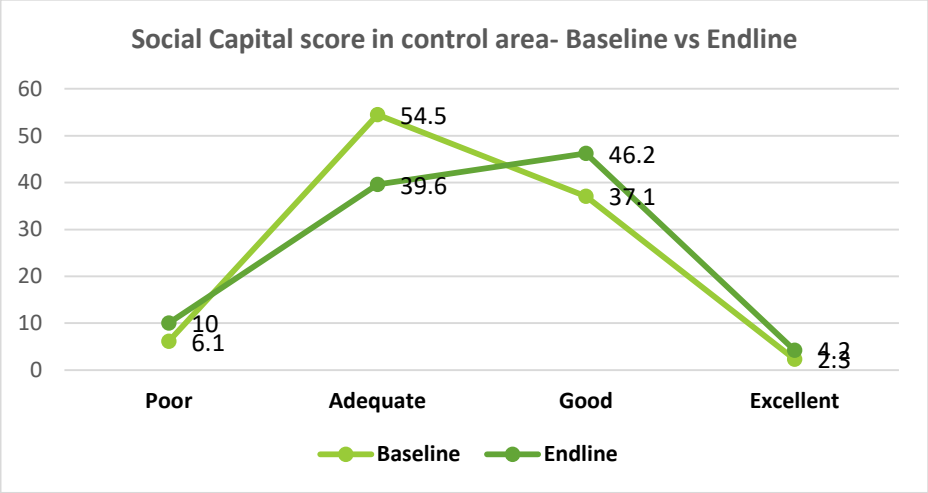


Figure 10: Social Capital score in project area

Women's opinions were captured to calculate the women empowerment score. The score was calculated for all the households covered under treatment and control separately both during baseline and MTR study based on various parameters grouped under multiple dimensions. A total of 24 parameters were considered under dimensions of 'Mobility', 'Women's role in agriculture', 'Decision making', 'Access to services' and 'Safety' as shown in the Figure 11 below.

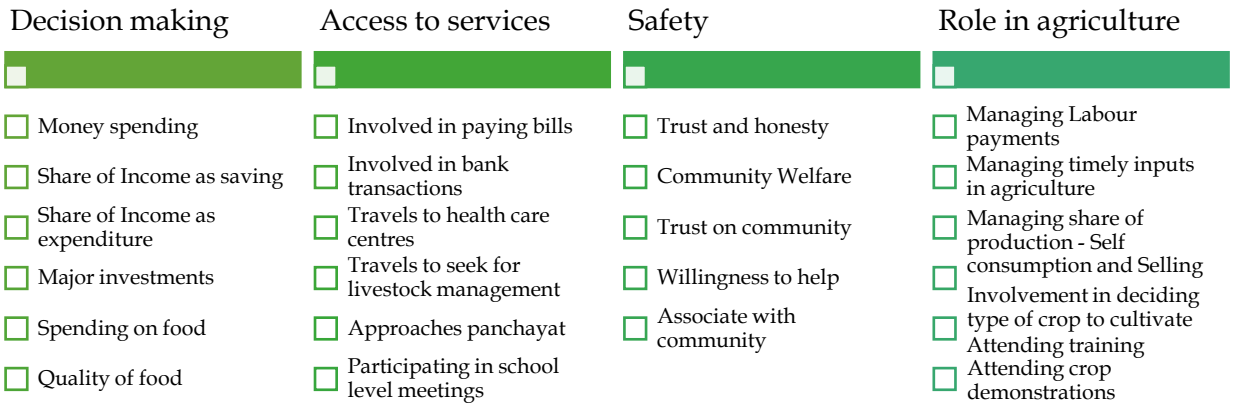


Figure 11: Parameters of Women Empowerment

Perceptions of women are reflected in the Women Empowerment Score. The graph below shows that women in project areas feel more empowered post project interventions and over 16 percent change is seen in the highest (excellent) quadrant. Women's ease of mobility in visiting markets and other areas outside the village is significantly better that control area and also women's role in making household decisions has increased.

During qualitative consultations it emerged that the most prominent strength for women through the project livelihood interventions was the 'ability to have savings in cash or in account'. Women were more vocal about feeling independent as a result of income earned through various activities. They were encouraged to participate in various trainings and meeting as a result of which men often consulted them for crucial decisions in family as well.

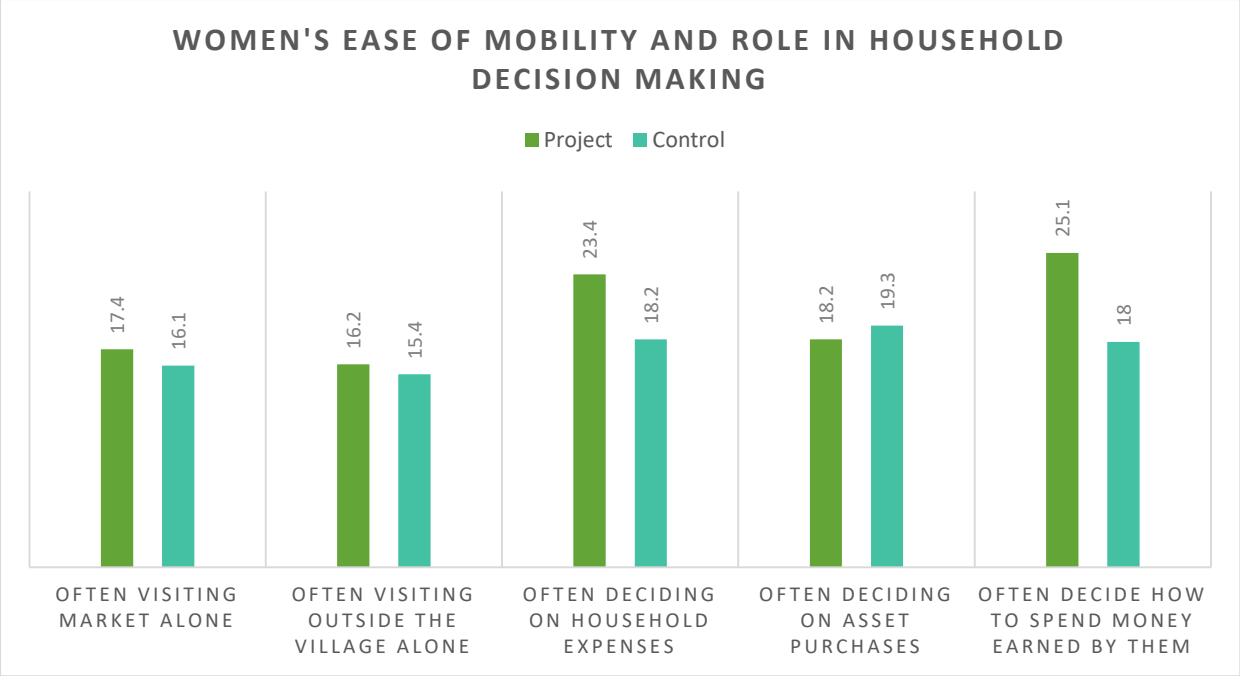


Figure 12: Women's Ease of mobility and role in household decision-making

Women's role in agriculture and economic decisions at home is also more often than that in the control areas and the change can be attributed to project activities which encourage participation of women in through different interventions.

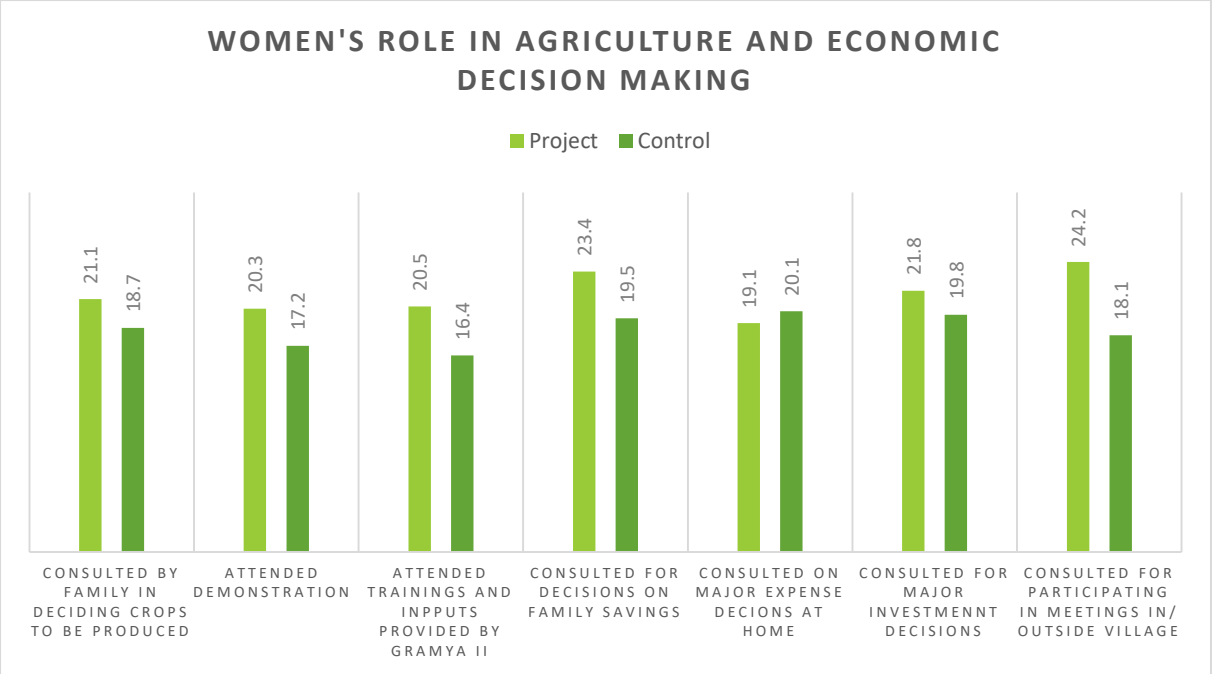


Figure 13: Women's Role in agriculture and economic decision-making

Women's perception on ease in accessing the different services as well as safety while participating in the different community forums is good to fairly good showing that the women regard the interventions undertaken in the project important in changing the gender dynamics. Women's participation in demonstrations and trainings is 18 percent higher compared to that of control.

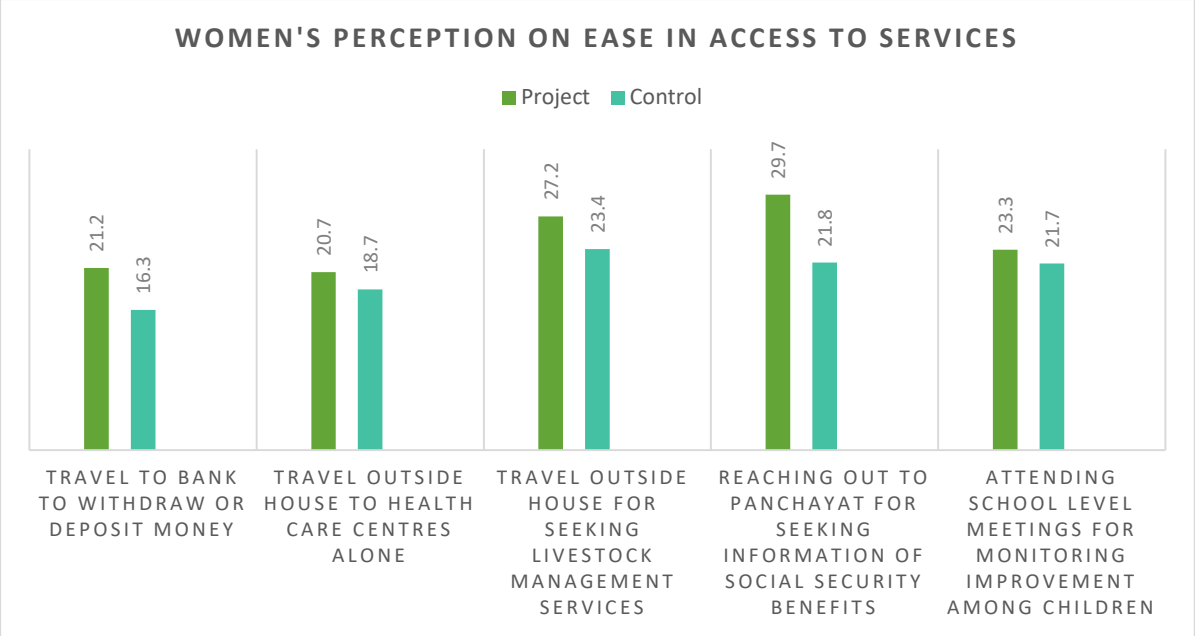


Figure 14: Women's Perception on ease in access to services

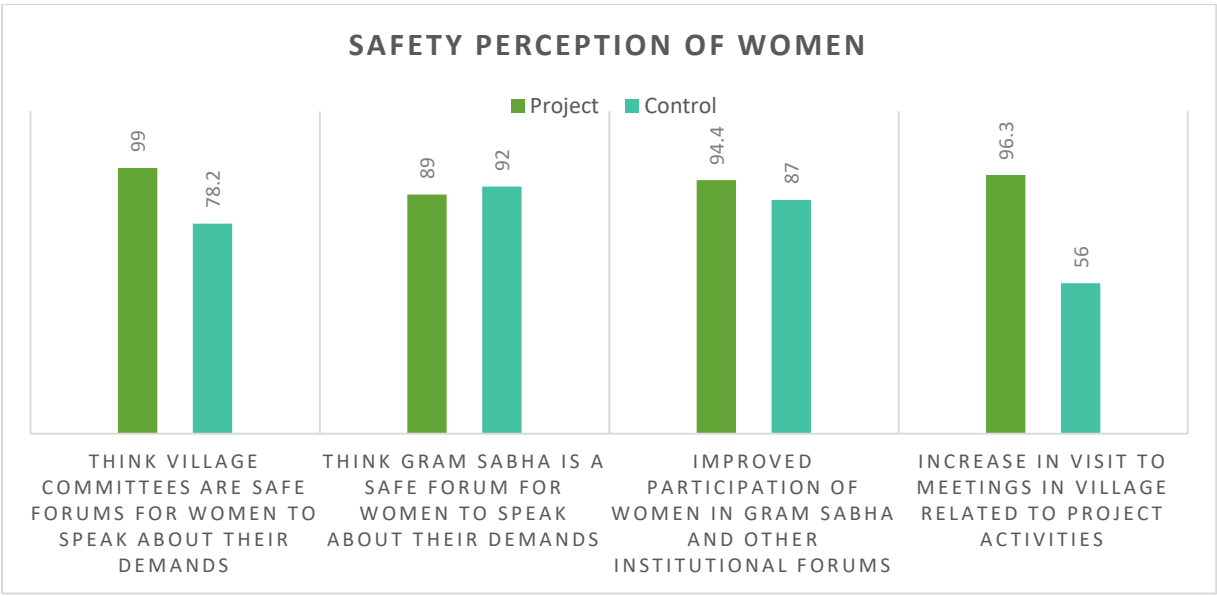


Figure 15: Safety Perception of women

The difference-in-difference of scores of each quartile indicates a positive progression in each of the groups. The above charts in each category indicates how exposure to various trainings, participation in demonstrations, participation in Women Aam Sabha, taking up independent IGA activities have helped in improving mobility of women and providing financial independence.

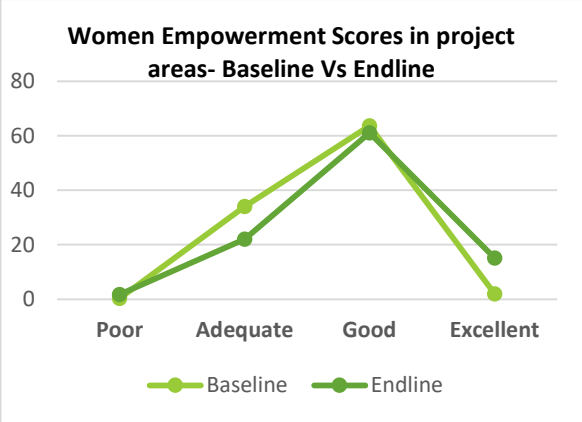


Figure 16: Women Empowerment Scores in project areas- Baseline Vs Endline

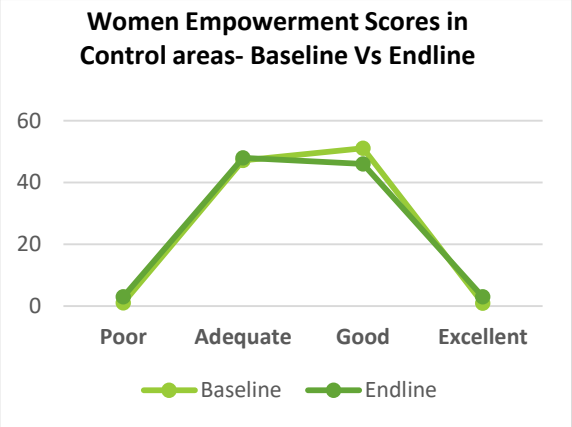


Figure 17: Women Empowerment Scores in control areas- Baseline Vs Endline

Emerging women leadership in the region

The project created forums have facilitated both men and women to come forward and undertake activities which was earlier not done by them such as managing books of accounts of Growth Centres, handling business activities, maintaining profit and loss details of businesses etc. This has pushed them to become more mobile and confident in representing themselves in many forums. Though women seats have been reserved in the PRIs, but the leaders emerging post project interventions are leaders and have been responsible in decision making, etc. The regular interaction of the motivators and facilitators with the community for understanding the need of community and implementing interventions accordingly have resulted not only in building trust but has enhanced confidence and leadership skills. The various capacity building programs and awareness sessions have provided information to the project beneficiaries regarding various sources of development and opportunities to take responsibilities and ownership for various activities and then relating it to the representation in PRIs

The platform provided by the project helped instil a great deal of confidence in the rural women. Their experiences in WAS, gram sabha, FIGs and other institutions where they were taking the lead and voicing out their needs helped them in going a step further and participating in the PRI institution elections and other administrative processes. There was high number of women participation in elections and their interest in leadership roles from all communities including the ST and SC. This made the reserved seats for women in elections de facto which were earlier filled with proxy candidates (where women are only token office bearers and a male relative is the actual decision maker) or left unfilled.

About 311 men & women members who were part different institutions across the 9 divisions have been elected in various positions in the PRI institution demonstrating remarkable leadership abilities which is certainly and unintended impact of the project.

Table 32: Emerging women leadership in the region

Representation of Project Beneficiaries in Panchayati Raj Institutions)		Women in elected positions			
		Gram Pradhan	Ward member	BDC & Jila panchayat members	Total
Male	Female				
115	196	34	155	7	196

8.3 Trainings and Capacity Building

The project has been largely multidisciplinary in nature and a multi-stakeholder project involving communities, implementers, policymakers, resource organizations, institutions functionaries and so on. The capacity building strategy of the project has attempted to address concerns of all stakeholders such as Policy makers and executives of PRIs, Project staff/MDT/Field Functionaries, Partner NGOs, Field NGOs/Social

mobilisers, Gram Panchayat as PIA, RVC, User Groups, Vulnerable Groups, Farmer Interest Groups, Farmer Federations, Other Associated Groups, Panchayat secretaries/Assistant accountants, Paraprofessional, Master Trainers, Transhumant communities etc.

Project followed extensive approaches to ensure that training and capacity building initiatives percolates to extensive knowledge development among the stakeholders. The significance of these approaches were also evident during the endline assessment:

1. **Focus on "Learning by doing" approach:**

The project has created ample opportunities to push various stakeholders particularly farmers to learn by themselves. Facilitation support through exposure visits, participation in demonstration and trainings were provided to various stakeholder. The project has also established collaborations with research institutions and universities for enhancing exposure of stakeholders such as Soil Conservation Research Institute, KVK Dhakrani, Green Foundation, G.B.P. Agri. & Tech. University Pantnagar/Rishikesh, Kotdwar, Indian Veterinary Research Institute Bareilly, Y.S. Parmar University, Potato Research Institute, Watershed Project Solan and Nahan, HP, Biodiversity conservation Kotamalla, Srinagar University etc. Total demonstrations conducted under the project 60,962 Minikit, Adoption support 92.725, Green Technology demonstration 6,761 (Bio compost and Vermicompost), 11,118 (Polyhouse and Polytunnels)

A total of 25,560 trainings and 777 exposure visits have been conducted altogether for farmers and staff. The training and exposure visits have created awareness and enabled farmers to physically witness improved technologies in agriculture, horticulture, livestock and agribusiness and also given them a proven example of success.

The overall percentage of SC and ST participants have decreased in the trainings over the years, however, the number of trainings conducted has also proportionally decreased as the number of participants. Much of an impact was due to Covid-19 pandemic especially in the last two years.

Table 33: Trainings/ Workshops/Exposure visits organized

Year	Total Trainings/Workshops/Exposure Visits	Participants			
		SC	ST	OBC/General	Total
FY 14-15	2295	20576	36247	48205	104828
FY 15-16	3310	22198	22513	55144	99855
FY 16-17	2783	29781	14238	86148	130167
FY 17-18	3789	27917	30792	100496	159205
FY 18-19	3823	30722	32540	97844	161106
FY 19-20	3395	20775	12943	87622	121340
FY 20-21	3236	19012	12025	81124	112161
FY 21-22	2929	18047	13535	81212	112794
Total	**25560**	**189028**	**174833**	**637795**	**1001456**

During the endline survey 170 beneficiaries were surveyed across specific intervention sectors. They expressed their satisfaction against the trainings provided and support provided during demonstration and the accrued benefits.

Table 34: Satisfaction on Training and Demonstration Suport (n=130)

	% of Household
% Household satisfied with assistance provided	92.9%
Reason of Satisfaction	
Timely Support	58.5
Technical Know-how	17.7
Resource support	20.8
Others	3.1
Benefits from Training/ Demonstration	
Increase in production	90.7
Less input requirement	20.9

Less incidence of disease	23.2
Less incidence of pest	23.2
Better management of disease and pest	13.9
Better rate received for produce	27.9
Any other	11.6

2. Capacity building inputs along with Project Management Cycle

The capacity building initiatives were well planned in line with the project management cycle. The training themes were decided and implemented based on the ongoing phases of the project and were not ad hoc in nature.

Table 35: Phase wise details of capacity building iniiatives

Initial Project Phase	**Focus: Social Mobilisation** - PRA Exercises - Institution Building Workshops (Formation of Committees and Groups) - Orientation of Project and ESMF Guidelines (Includes GP Proposals and Budgets) - Financial Trainings at GP Level
Early Implementation Phase	**Focus: Social Mobilisation, Agriculture, Animal Husbandry, FIG and Finance** - Farm Demonstrations and Introduction of New Techniques and High Yield Varieties - Formation and Orientation of FIGs - Trainings on Entrepreneurship Development Programme (EDP) for Vulnerable Households - Accounting and Book Keeping - Refresher Trainings on ESMF Guidelines - Gender Inclusion Trainings and Workshops - Soil And Water Conservation Trainings - Workshop on Participatory Monitoring and Evaluation (PME) - Training on Animal Husbandry (Paravets, establishing Breeding Centres, etc.)
Mid Implementation Phase	**Focus: Social Mobilisation, Agriculture, Animal Husbandry, FIG and Finance** - Farm Demonstrations and Introduction of New Techniques and High Yield Varieties - Crop protection (IPM/IPNM) and Post-harvest Management of Specific Crops - Agribusiness Promotion - Technical Training on Composting - Moisture Conservation (Mulching) - Marketing and Management of Farm Surplus - Financial Literacy and Account Keeping - Training on Food Processing and value Addition - Specific EDP Trainings - Refresher Trainings on Accounting and Book Keeping - Refresher Training of MDT Staff - Training and Pruning of Fruit Plants

	- Insect pest management (Crop Protection) - Training on Vegetable Cultivation Practices - Formation and Orientation of Farmer Federations - Workshops on Roles and Responsibilities of BODs - Trainings/ Workshops on Farmer Federation Organisational Structure and Functions - Financial Literacy and Account Keeping of Federations - Training on Equipment Handling and Operations - Gender Inclusion Trainings and Workshops - Soil And Water Conservation Trainings - Workshop on Participatory Monitoring and Evaluation (PME) - Training on Animal Husbandry
Late Implementation Phase	**Focus: FIG, Marketing and Quality Management** - Refresher Trainings on Financial Literacy and Account Keeping of Federations - Marketing Skills and Entrepreneurship Development - Training on Food Processing and value Addition - Product Quality Management - Supply Chain and Value Chain Management - Logistics, Packaging and Labelling - Business Plans - Training on Store Management - Accounting, Book keeping and Financial Management - Training and Pruning of Fruit Plants - Insect pest management (Crop Protection) - Training on Vegetable Cultivation Practices - Specific EDP Trainings - Refresher Training of MDT Staff - Refresher Trainings on ESMF Guidelines - Training on Animal Husbandry
Withdrawal Phase	**Focus: Withdrawal** - Trainings and Workshops on Exit Strategy and Withdrawal Plans - Sustainability of the Assets created and systems established - Way Forward for the sustainability of FIGs and FFs

8.4 Social and Gender Inclusive Focus

Gramya II activities are focused on an inclusion strategy which covers all the social groups including vulnerable groups and therefore have targeted interventions for promoting the same. It is mandatory for Revenue village Committee (RVC) formed at the Revenue Village level comprises at least 50 percent women voters. To ensure fair representation of SC/ST category, at least one male and one female member must be from SC/ST category. The Secretary of the RVC should necessarily be women and in case Chairperson of the RVC is a female, in that case Secretary can be a male. The Bank account of the RVC is operated jointly by the Chairperson and Secretary. The Gender and Social Category-wise Distribution of RVC members is reflected in the following Table 36 which clearly shows that RVC have more than 50 percent woman members. This is a testimony to empowerment of women through Gramya-II and speaks how women have been mobilized to participate in project institutions and activities.

Table 36: Composition of Membership of RVC								
Total no. of Revenue Villages	Total no. of RVC Formed	Total members in RVC	Total no. of woman member					
			SC	ST	OBC	Gen	Total	% of women
1057	**999***	7293	1035	209	846	1992	4082	56%

*Pauri division has smaller RVs hence RVC are formed by combining adjacent RVs together.

The Water & Watershed Management Committees (WWMC) comprises of six members which include at least one woman, one OBC and one SC/ST member. One female ward member of WWMC is nominated as a co-signatory to the project account along with the Gram Pradhan. In case of Gram Pradhan being a female, male co-signatory to the project account can be nominated at the discretion of the WWMC. From the Table 37 below, it can be seen that 63 percent of the WWMC members are women, which clearly indicates that project has been conscious about the inclusion strategy and have included members in leadership position. Across the social class there is equitable distribution as well in proportion to the population.

Table 37: Composition of Membership of WWMC								
Total number of GPs	Total no. of WWMC Formed	Total members in WWMC	Total no. of woman member					
			SC	ST	OBC	Gen	Total	% of women
527	**527**	**3201**	**557**	**135**	**445**	**894**	**2031**	**63**

Women Aam Sabhas

Mobilizing women for ensuring their participation in project activities was one of the major objectives of the project. The project envisaged empowering women by enabling them to draw maximum benefits from the project and help reduce their drudgery. The concept of WAS was introduced in the project to provide suitable platform to women to express and share their experiences and have their say without any gender based hesitation.

Women Aam Sabha have helped in greater participation of women in governance forums and voice out their concerns about the need for work in the village. Due to WAS women are getting a platform to discuss and formulate need based proposals which is then placed in Gram Sabha for approval. During these meetings, proposals highlighting need of women and vulnerable were invited for being incorporated into GPWDP of respective Gram Panchayats. A total of 9,780 WAS meeting have been conducted till date. The participation of women in Aam Sabhas was at 70 percent from the total women population which is a good representation of women involvement. Subsequent to 2019-20, due to the Covid-19 pandemic, the number of WAS meeting organized has reduced to half and also the percentage of women participation has decreased. The Table 38 below represents the year wise participation of women in Aam Sabha.

Table 38: Women Aam Sabha Participation and				
Financial Year	WAS Conducted	Total Female Population	Female Participation in WAS	Percentage participation
2014-15	148	40630	9841	24.2
2015-16	808	112969	37367	33.1
2016-17	948	112969	49833	44.1
2017-18	1756	112969	80658	71.4
2018-19	1922	112969	80271	71.1
2019-20	1308	112969	53717	47.6
2020-21	1279	112969	48422	42.9
2021-22	1611	112969	47366	41.9
Total	**9780**			

Cumulatively, till date the Women Aam Sabhas have placed 15,911 proposal to be implemented from GP Fund out of which 55 percent proposals (8741) are directly taken up under GPWDP and 3192 were addressed through convergence and other sources such as funds from public representative.

NRM proposals included –	Other proposals raised by women included -
Fodder development	IGA for Vulnerable households
Water resource rejuvenation	Training and exposure visits
Plantation work	Mushroom cultivation
Orchard Development	Exposure visits for IGA activities
Pipelines	Flour/ spice mills,
Construction of Irrigation Channels	Goatery, Poultry, dairy units
Irrigation tank	Improved variety of seeds
Roof water harvesting tank s	Agricultural tools
Biogas plants	Construction of animal shelters, mangers, compost pits and animal chari, etc.
Construction of Check Dams	Solar lights
Solar water lifting pumps	Weaving, Sowing and Computer Training
Terrace repair	Fencing of agricultural land to protect crops
Crate wire and Vegetative check dams	Repair of School Building
Protection walls	Construction of Link roads, connecting paths
Bio composting pits	
Poly houses	
Fencing of Forest Land	

Table 39: WAS proposals raised and completed

Division	Total Issues Raised in WAS	Activities Accepted	Proposals Completed through		
			GPWDP	Convergence	Other Sources
Dehradun	727	647	452	16	179
Pauri	937	937	598	147	192
PMU (MWS)	220	209	155	0	54
Tehri	1517	1455	1340	34	81
Almora	6996	4503	3120	373	1010
Bageshwar	2126	1076	721	188	167
Pithoragarh	2032	1890	1201	331	358
Rudraprayag	780	640	580	20	40
Total	**15911**	**11933**	**8741**	**1109**	**2083**

Increased participation of women in Gram sabha meetings because of WAS has also been observed. WAS has brought a significant change among women in the space where they had limited role to play. The suggestions of WAS are getting due importance, there has been open discussions on the suggestions of WAS and are incorporated in the plans. Women's participation in Gram Sabha has also eventually improved over a period of time as the DiD gives a positive result proving the outcome to be significantly positively attributed by the project led initiatives.

Table 40: Gram Sabha Participation

	Project Target	Baseline		Midline		Endline	
		Project	Control	Project	Control	Project	Control
Intermediate Indicator 1: (i) *Percent of participating households in Gram Sabha meetings (%)*	80%	67.2	58	95.6	94.6	53.90	32.50
(ii) *% of which are female*	50%	62.4	54.3	57.0	54.6	32.20	12.90

Gramya interventions focuses on encouraging the participation of women as well as other vulnerable groups in the training and exposure visits organized. It has been observed that participation of women has increased. Participation of women in trainings/workshops and exposure visits has increased from 43 percent in 2014-15 to 46 percent in 2021-22. There has been a decrease in participation since 2018-19 from 59 percent in 2018-19 because of restrictions due to Covid-19 pandemic.

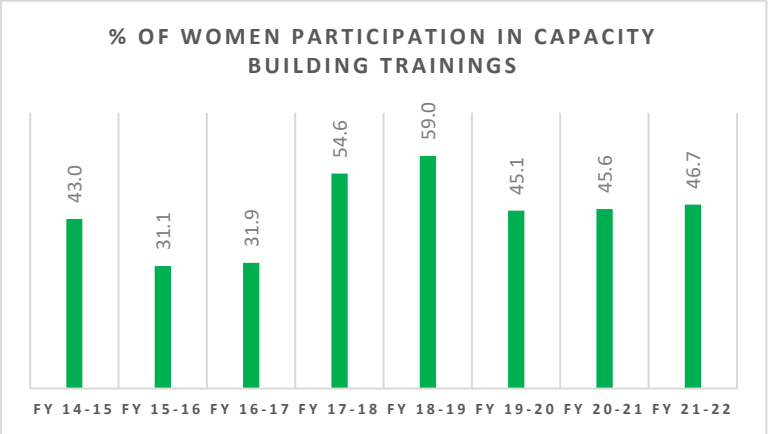


Figure 18: Percentage of women participation in capacity building

The greatest impact of Gramya II in the project region is on building gender responsive strategies and encouraging women leadership and their representation in governance. The WAS formation has enabled women to voice their opinions and given a platform to present their issues. Community women reported that the concerns of women were given priority after the WAS formation. There has been a change in terms of understanding the women issues and problems at the panchayat level. The issues and problems are being discussed in details and efforts are made to address them. The positive change in the community due to WAS and its work has also encouraged women to take up leadership positions and there is a supportive environment, the family members and the community at large. The suggestions of WAS are getting due importance, there has been open discussions on the suggestions of WAS and are incorporated in the plans. Women of the community are much aware about the schemes because of mobility and active participation in governance forums their knowledge about the schemes have increased many folds.

8.5 Inclusive focus for Vulnerable and Transhumant

a. Vulnerable groups

In the project, the ‘C’- category households were identified through 'Wealth Ranking Exercise' carried out as part of participatory planning for preparation of Gram Panchayat Watershed Development Plans. The features characterizing these ‘C’ category/ vulnerable group households may vary from one Gram Panchayat to another depending upon the proximity of GP to the connecting road, availability of irrigated area, proximity to market place and other amenities, which are generally characterized by the following features:

- Kuccha House
- Households having fallow/uncultivated land /landless and marginalized farmers having less than 0.1 ha land.
- Reduced Livelihood opportunities
- Less Number / absence of livestock
- Living under debt or have very less income
- Socially Vulnerable (widow, especially abled, SC/ST, women etc.)

Households fulfilling above 2 to 3 criteria qualify as members of vulnerable group. Similarly, due care was taken to see that Divorcee women, widows and specially-abled are included as members of groups for income generating activities.

The overall rating of quality and distribution of Individual Assets across the divisions appears too satisfactory. The Table 41 shows that there has been equitable distribution among various categories of project beneficiaries. As can be seen from the Table 41 below, allocation of assets among ‘C’ category of

beneficiaries is the highest with 42 percent of assets provided to this category, followed by category 'B' (37 percent) and category 'A' 19 percent.

Table 41: Distribution of Individual Assets across categories

Region	Total No. of units (person)	Category 'A'			Category 'B'			Category 'C'		
		No.	% Units	Female	No.	% Units	Female	No.	% Units	Female
Kumaon	20709	3983	19	1975	7895	38	3915	8831	43	4630
Garhwal	14793	3100	21	675	5478	37	1351	6215	42	1795
Total	**35501**	**7083**	**20**	**2650**	**13373**	**38**	**5266**	**15046**	**42**	**6425**

The WWMC is also responsible for managing the Vulnerable Group Fund (VGF) supporting livelihood enhancement of vulnerable groups to ensure equity amongst vulnerable households. These Funds are used to finance small income generating activities for vulnerable individuals/groups. The vulnerable group funds have been distributed equitably keeping in mind various parameters. Due care was also taken to include divorcee women, widows and specially-abled individuals for income generating activities. IGA proposals are developed by the FNGO in consultation with concerned individual/group and funds are disbursed to the vulnerable individuals/groups, through the GPs after signing of an agreement with GP. Endorsement of each proposal by the MDT to ensure that it is in accordance with the ESMF is mandatory. Trainings were also provided to the beneficiaries where required and they were also connected with other line departments for extended support.

Throughout the duration of the project, 1,040 group and 8,615 income generating activities have been funded for vulnerable individuals totalling to 14,148 individuals. The total number of female beneficiaries is 5,447, a 39 percent proportion of the total beneficiaries.

Table 42: Composition of vulnerable group beneficiaries

	Male				Female				Total
Social category	**SC**	**ST**	**OBC**	**Gen**	**SC**	**ST**	**OBC**	**Gen**	
Individual Activities	2210	254	635	2260	905	142	519	1690	**8,615**
Group activities	1456	165	652	1036	558	98	400	1135	5**,533**

Women Cholia Nritya-An amazing Initiative

Cholia Nritya, is a traditional dance form from the Kumaon region of Uttarakhand and is part of all special celebrations such marriages, pujas and other events. Traditionally the dance is performed by men and a dance earns Rs. 15,000 to Rs. 30,000/- per event. A group of women from GP Hokra have stepped forward to become a part of this tradition and formed the first women Choliya dancers group. Under the vulnerable group fund, Gramya provided the group of 9 members financial support for their costumes, props and instruments.

The dance group is being promoted via project and has demand in various events being organized locally and at State Level. Women of the group are performing at marriages of the village and local area and at other festivals, cultural functions and competitions. At the Munsyari Mahotsav where 30 groups participated, the Hokra group received first prize for their performance. The group has also participated in *Parvat Divas* celebration in GP Liti of Kapkot block where they received the second prize there. They also performed at the Republic Day's Bharat Uday Program organized by the Department of Tourism in Dehradun. . The group has come forward as a change maker and overcome the gender bias.The group has earned Rs. 1,25,229/- till now

Ringal- Medium of prosperity

Ringal is a natural fiber found in the topical forest of Himalaya's. Due to the softness and flexibility of the fiber, it is used for knitting storage baskets and other decorative items. Ringal work is a traditional occupation of Uttarakhand but was slowly disappearing with the advent of plastic products. Under the vulnerable group income generating activity, ringal work has been started. People were traditionally making baskets using ringal for their own use but through the project they have now started making these in a commercial scale for sale to tourists as well as local markets.

As part of the project, skill training in ringal work has been provided to 22 Individuals (7 women and 15 men) and 14 groups of 72 members(22 women and 50 men) who have now adopted this as entrepreneurial activity. The skill training has helped the craftsmen to improve the quality and finish of the traditional baskets that they were making as well they have been able to add more innovation and utility based products to their list such as Lamp shades, Hand Basket, Pen Stand, Service Basket, Paper Dustbin, Flower Pot, Fruit Basket etc. The products are sold in the local markets and in local fairs, SARAS market (organized by Rural Development Department) and Vikas Pradarshinis and to other bigger resellers such as Himgiri Swayatt Sahkarita, Empower Society, Dehradun Dishang Enterprises; Village Charitable Trust, Faridabad, Taleriya Export Company, Delhi; Gramyashree store; Dehradun. Now they are producing festival centric season products i.e., small basket to grow harela (mix grain growing up to 10 days) for Harela Festival, Ringal made Rakhis for Rakshabandhan, etc.

They have earned Rs. 16,37,380 /- and Rs. 16880/- per person till March 2019. The earnings of groups and individuals till December 2021 is Rs. 46,08,642 and Rs. 32,42,524 respectively. The members are recovering from the effect of COVID-19 as their business was greatly affected during the lockdown. However, the group has received demand from government offices for paper dust bins and other items and in order to expand their business, they have also established two display and sale centers in Industry Department Bageshwar and Anashakti Aashram in Kausani.

b. Transhumant Action Plan

The project also has a special component focused on transhumant population which has helped in providing day to day items of need to this population helping improve their quality of life. Transhumant groups such as Gujjars and Bhotiyas are nomadic tribes who are primarily engaged in animal husbandry. They migrate from higher altitudes to lower altitudes during the peak winter months along with their cattle and/or flocks of sheep and goats in search of green pastures. Many such groups camp in the project areas during winters for short durations. These groups live with limited resources and often have to face hardships during transit.

Under the Transhumant Action Plan, various utility items have been provided to these groups every year along with other benefits. Health camps were organized for both the humans as well as their livestock consisting of 1103 individuals and over 51,368 livestock which has impacted in improving their health by identifying and addressing the disease and administering curative as well as preventive measures.

Table 43: Families And Livestock Census Of Transhumant Population									
SN	**District**	**Transhumant**	**No. of families staying/ passing through project area**	**Details of livestock**					
				Cow	**Buffalo**	**Sheep/ goat**	**Mule/ horse**	**Other (calves, Dog etc.)**	**Total**
1	Rudraprayag	Gujjars	200	0	80	4100	60	41	**4281**
2	Tehri	Gujjars	112	135	1418	240	45	103	**1941**
3		Gaddi	85	0	0	6218	28	48	**6294**
4	Uttarkashi	Gujjars	88	494	992	383	98	140	**2107**
5		Bhotiyas	73	75	10	867	15	30	**997**
6	Dehradun	Gujjars	148	253	1791	242	351	651	**3288**
7	Almora	Bhotiyas	47	0	0	5693	38	21	**5752**
8	Bageshwar	Gujjars	210	0	0	10200	60	60	**10320**
9	Pithoragarh	Bhotiyas	140	0	0	16139	124	125	**16388**
	Total		**1103**	**957**	**4291**	**44082**	**819**	**1219**	**51368**

Almost 30,000 units of items such as tarpaulin/poly sheets, tents, feed tubs, blankets, concentrated feed for the cattle, torches/solar lanterns, daris/cow mats, raincoats, umbrellas, buckets, milk/ water cans, shearing scissors, bells for cattle, shoes, socks, pitthu bags, tarpaulin canvas, cookers, cotton mats, first aid kits, etc. were distributed over the project period. These activities have helped to benefit over 1103 humans and above 50000 livestock population during the entire project period.

The broad activities carried out for the Transhumant were veterinary and human health camps, distribution of first aid kits, distribution of warm clothing and camping equipment, distribution of daily utility articles and for livestock, distribution of concentrate. As a result of the interventions laid out for the Transhumant through the Transhumant action plan, their routes were tracked in order to have a control over grazing and loping from where they passed. Other than that some communities were also market linked such as wool being purchased directly from Bhotiyas/Anwal communities, milk purchase from Gujjars to be able to directly benefit them.

9. Watershed Treatment and Source Sustainability

The state of Uttarakhand is characterized by its undulating topography comprising mostly of hills with fragile soils and steep to very steep slopes. Coupled with medium to heavy rainfall, weak geological formations, active seismicity and increasing deforestation for human habitation has resulted in extensive soil erosion. The increased vulnerability of the topsoil being washed away and accumulation into the natural drainage channels occasionally blocking it and breaching/altering the channel morphology and spilling the silt load onto the village lands and human habitations threaten the entire natural ecosystem. The traditional drinking and irrigation water systems like *Naula* (subsurface water harvesting), *Dhara* (springs), *Gadhera* (small river tributaries), *Gul* (traditional irrigation canals), *Chal* and *Khal* (artificial ponds on hilltops), also come under immense stress due to the erosion and water run-off. The magnitude of the problem is compounded by the increasing degradation of the natural environment that has reached a stage that is now beyond the natural resiliency of nature and requires human interventions to arrest further damage to the natural ecosystem.

In order to address various challenges due to topographic vulnerability, a strategic approach has been adopted to address command area treatment through Command Area Treatment Plans and catchment areas through Micro-watershed Plans. MWS Plans and focussed spring shed plans were made in which the activities were planned for sustaining the existing water sources, rejuvenating of water sources, improving water availability and improving soil moisture regime.

Since soil and water conservation is of critical importance, the main intervention of Gramya II is watershed treatment using various soil and water conservation measures and forestry activities in micro watersheds selected in project districts to enhance the productivity of natural resources through the protection of fertile soil, improved availability of water and moisture and enhanced agricultural yield consequently. The Gramya II project area focuses on 527 GP with 82 micro watersheds covering 2,63,837 ha. 83 percent of the land accounts for non-arable land i.e., 2,18,985 ha and arable lands cover only 17 percent of the area (45,050 ha). The Inter GP area accounts for 44 percent of the project area. MWS Plans have been developed by the project to address the inter GP area treatment activities by following a prioritized ridge-to-valley approach. Through various watershed treatment measures the key outcomes of increasing water discharge, improving area under irrigation and enhanced productivity have been achieved.

9.1 Interventions Undertaken

The project prepared comprehensive treatment plans for both GP areas and non-GP areas part of the micro watersheds. The GPWDP consists of activities which are to be implemented in the areas which fall in the jurisdiction of GP. For areas which are out of the jurisdiction of the GP but lie in the MWS (primarily reserve forest areas), comprehensive MWS plans were prepared by WWMC and Van Panchayat with help, coordination and consultation of project team and concerned Forest Division in a manner that complements the GPWDPs. MWS plans following a ridge to valley approach for undertaking sustainable springshed management in the inter GP areas ensuring reduced soil erosion and enhanced source sustainability of water and drainage line treatment.

The preparation of Gram Panchayat Watershed Development Plan (GPWDP) is participatory undertaken with the involvement of GP members, community and women village members through Women Aam Sabhas (WAS). A Water & Watershed Management Committee (WWMC) has been constituted at the GP level which is headed by the Gram Pradhan to assist FNGOs in the mobilization of village communities, lead the process of planning, preparation & implementation of GPWDP, to manage the Vulnerable Groups

Fund, to delegate responsibility for implementation of Village Watershed Development Plans to Revenue Village Committee (RVC) and ensure the audit of GP annual accounts, etc. The Revenue Village Committees are responsible for identifying treatments on arable and non-arable lands and preparation of RVC proposals, which are integrated into Gram Panchayat Watershed Development Plans (GPWDPs). The Multidisciplinary Team built under the project provides technical guidance to GP & village communities for planning and preparing GPWDP and Inter GP space plans, their consolidation into MWS plans and implementation of these plans.

The 'Watershed Treatment and Rainfed Area Development' component under Gramya II focuses on the implementation of the GPWDP prepared with community participation. The watershed treatment and water source sustainability interventions aimed to increase the efficient use of natural resources on about 220,000 ha of non-arable land and expand irrigation from 5262 ha to 7,800 ha of arable rainfed land in the project area.
The key watershed treatment activities include:

i. Construction and rehabilitation of check dams, recharge pits, ponds, irrigation channels and tanks, and roof water harvesting structures;
ii. Reparation of agriculture terraces and vegetative field boundaries;
iii. Implementation of water source sustainability activities like:
    a) Construction and rehabilitation of soil conservation structures and vegetative structures;
    b) Border plantation of Napier and other grasses;
    c) Implementation of forestry activities; and
    d) Promotion of alternative energy source practices.

The soil and water conservation efforts have increased the total cultivable area as well as improved the irrigation and drainage facilities in the micro-watershed units, thereby increasing the acreage and productivity of crops.

Water Balance Studies
WAPCOS, the technical consulting firm has been entrusted with the installation and functionality of hydrological monitoring systems in eight micro-watersheds. WAPCOS is responsible for using the hydrological monitoring system to undertake real-time data analysis of runoff, sedimentation and water discharge. For the purpose of hydrological monitoring, 14 automated rain gauges, 4 automated weather stations, 8 weirs for stage discharge measurement through currents meters etc were established in the eight representative micro watersheds.


9.2 Impacts

Changes in water discharge due to source treatment

Source sustainability construction measures of developing recharge pits, digging of trenches, renovation of existing Tal/Naula/ Khaula and village pond / Dugout pond was executed and the targets set for the same were achieved for more than 2 times of what was envisaged for the project. 8,17,864 (140 percent) numbers of Village dugout pond, trenches and renovation of existing Tal/Naula/ Khaula against a target of 5,81,131 was constructed. 10,29,89 (407 percent) Cum. recharge pits have been constructed against a target of 25,254 Cum. recharge pits.

Due to catchment area treatment by the mid-term stage, 76 percent (1522) sources were rejuvenated. At the time of the final impact assessment, 99 percent of the treated water sources have shown positive discharge. Some sources had not shown any increase in discharge but had shown a constant rate of discharge without any declination. Considering the principle of rejuvenation of water sources, the rehabilitation is not only impacting the treated sources but is also positively impacting other second and third order structures.

Table 44: Targeted traditional natural water sources rejuvenated

District	No of sources treated	No of sources with positive discharge
Dehradun (PMU)	261	254
Pithoragarh	279	279
Bageshwar	96	96
Pauri	196	195
Tehri	381	381
Uttarkashi	144	144
Almora	550	549
Rudraprayag	147	138
Total	**2054**	**2036**

Throughout the project, 2054 streams and springs were identified which had depleted by 50 percent or more and selected to be treated. Through the project, these sources were monitored, treated and rehabilitated to improve their discharge. The increase in water discharge measured through flow change in litres per minute (LPM) in water sources treated or under treatment in the project show encouraging improvement. The water discharge rate during mid-term was in the range of 12.3- 22.2 percent in pre-monsoon and 13.8 - 27.0 percent increase in post-monsoon on an aggregate basis. It is very encouraging to see that the discharge ratio has changed from 13.3- 25.0 percent pre-monsoon and 13.0 - 33.7 percent post-monsoon. The percentage increase in water discharge for water sources treated or under treatment division-wise both in pre-monsoon and post-monsoon between midterm and endline. The change in discharge has been monitored over a period of time and analysed for its sustainability over time and flow. A year on year difference and its average have been considered to give a better understanding of the change in discharge due to project activities.

The data on discharge has been recorded for 2054 structures across the 9 project divisions. Overall, it can be said that there was a 19 percent increase in pre-monsoon water discharge and a 24 percent increase in post-monsoon discharge as compared to the water discharge in Year 1. THe discharge rate is a result of comprehensive catchment area treatment and as such takes time to manifest and give results. Also, source augmentation activities have long term impacts and it is estimated that the positive discharge achieved during the project period will continue during the next few years and be effective for a longer period. Source augmentation activities plan for the post-project period to sustain positive discharge will ensure that the treatment is sustainable and effective for a longer period.

The tables 45 and 46 shows the changes in water discharge in water sources treated division-wise both in pre-monsoon and post-monsoon between Year 1 and Year 7 of the project.

Table 45: Average Pre-monsoon Discharge of water sources in lpm

District	No of sources	2015	2016	2017	2018	2019	2020	2021	Variation	% variation
Dehradun	187	0.48	0.5	0.505	0.515	0.55	0.56	0.56	0.075	15.63
Pithoragarh	381	2.65	2.8	3.05	3.1	3.2	3.2	3.21	0.56	21.13

Bageshwar	98	10.1	11.32	11.35	11.38	11.9	12	12.1	2	19.80
Pauri	196	1.06	1.09	1.15	1.23	1.27	1.30	1.26	0.2	18.87
Tehri	381	3.97	3.98	4.13	4.36	4.54	4.50	4.59	0.62	15.62
Uttarkashi	144	6.9	7.32	7.32	7.40	7.80	7.80	7.82	0.92	13.33
Almora	362	0.36	0.37	0.36	0.40	0.44	0.44	0.45	0.09	25.00
Rudraprayag	550	4.1	4.18	4.28	4.55	4.86	4.90	4.92	0.82	20.00
Total	**2299**	3.70	3.95	4.02	4.12	4.32	4.34	4.36		

Table 46: Average Post monsoon Discharge of water sources in lpm

District	No of sources	2014	2015	2016	2017	2018	2019	2020	2021	Variations	% variations
		Dec	Dec	Dec	Dec	Dec	Dec	Dec	Dec		
Dehradun	187	1.1	1.05	1.39	1.4	1.41	1.41	1.42	1.43	0.33	30.00
Pithoragarh	381	5.1	5.19	5.5	5.9	5.92	6	5.8	6	0.9	17.65
Bageshwar	98	17.5	19.4	19.45	19.5	20.5	20.12	20.2	20.4	2.9	16.57
Pauri	196	2.9	2.98	2.9	2.9	3.3	3.3	3.2	3.3	0.4	13.79
Tehri	381	10.2	11.01	11.24	11.67	11.9	12	12.2	12.75	2.55	25.00
Uttarkashi	144	10.7	10.77	12.59	13.50	14.10	14.15	14.30	14.31	3.61	33.74
Almora	362	0.6	0.65	0.65	0.70	0.72	0.72	0.71	0.72	0.12	20.00
Rudraprayag	550	7.67	8.2	8.35	8.54	9.165	9.16	9.2	9.21	1.54	20.08
Total	2299	6.97	7.41	7.76	8.01	8.38	8.36	8.38	8.52		

The positive change in improved discharge was due to various soil and water conservation measures in treated MWS

The implementation of soil and water conservation measures in treated MWS covered i) Drainage line treatment & River / Nala training work; ii) Soil conservation measures; iii) Terrace repair/Vegetative field boundary, and iv) Water harvesting and source sustainability measures. The progress of this implementation is presented below with regards to the end of project targets to be achieved in Gramya II.

Drainage Line Treatment & River / Nala training work

Robust measures were taken under the project in the implementation of drainage line treatment & River / Nala training work by the end-term with an exception of progress made in the construction of spur. However, considering the fact that the construction of the spur is a need-based intervention, it is expected to be taken care till the end term of the project as per the GPWDP plan.

Table 47: Progress of Drainage line treatment and river / Nala training work

Project Intervention	Unit	Progress till End Term
Drainage Line Treatment		
Construction of dry-stone check dam	Cum	2,50,272.0
Construction of crate wire check dam	Cum	4,32,357.0
River / Nala training work		
Construction of spur	Cum	1331.0
Retaining Wall	Cum	2,89,610.2
Construction of Cross Barrier	Cum	481.0
Construction of Protection Walls	Cum	7257.0

Soil Conservation measures

The soil conservation measures have been widely adopted by the project and in implementation of roadside erosion control measures and landslide treatment till mid-term, while construction of vegetative check dam, vegetative treatment and implementation of diversions drains was accelerated to meet the needs of different community demands.

Table 48: Progress in the implementation of Soil Conservation Measures		
Soil Conservation Measures	**Unit**	**Progress Till End term**
Construction of vegetative check dam	No.	16052.0
Vegetative treatment	Sqm	69227.0
Road-Side erosion control & other soil conservation work	Cum	96243.1
Land Slide Treatment	Cum	76921.2
Diversion drain	km	30

Terrace repair / Vegetative field boundaries for natural resource conservation

The progress in implementation of terrace repair / vegetative field boundaries till mid-term is presented below and it is evident that the project would have to focus more on the implementation of this activity in the remaining project period.

Water Harvesting & Source Sustainability Measures

Water harvesting and source sustainability measures have been satisfactorily covered by the end term stage. The project had made efforts in expediting the implementation of LDP tank, Village irrigation pond and renovation of existing Naula compared to midterm stage.

Solar water lifting pump with solar panel and Pre-Fabricated Geo Membrane Water Harvesting Tank has been overachieved as it is one of the most important needs based and community demand-driven initiatives. Farmers have shown greater interest and participation in implementation.

Table 49: Progress in the implementation of Water Harvesting & Source Sustainability measures		
Project Intervention	**Unit**	**Progress till End Term**
Irrigation Channel	Km.	281.07
Irrigation Tank	No.	1717
Roof Water Harvesting Tank	No.	12145
LDPE Tank	No.	890
Solar water-lifting Pump with solar panels	No.	24
HDPE Irrigation Pipeline	Km.	676.432
Pre-Fabricated Geo Membrane Water Harvesting Tank	No	288
Village Irrigation Pond	No	80
Demonstration of water conservation through Pond Construction along with peripheral activities	No	90
Source Sustainability		
Village Pond/Dugout ponds	No.	1186
Recharge pit	Cum.	110736
Digging of trenches	No.	879284
Renovation of existing Tal/Naula/Khaula	No.	10830

Implementation of Inter GP Fund Activities as per MWS Plans in Reserve Forest Areas

Progress in the implementation of Inter GP Fund Activities as per MWS Plans in Reserve Forest Areas is presented below. There are no targets (end of the project) for activities undertaken under GP fund as per MWS plan; however, the progress till end-term most of the planned activities have been achieved

Table 50: Progress in the implementation of Inter GP Fund Activities as per MWS Plans in RF Areas		
Soil and Water conservation	**Unit**	**Progress till Endline**
Construction of dugout Pond	No.	25
Recharge pits	cum	4226
Digging of trenches	No.	17337
Drainage Line Treatment		
Construction of vegetative check dam	No.	0
Construction of dry-stone check dam	Cum	8366
Construction of crate wire check dam	Cum	3868
Protection wall	Cum	610
Diversion drain	Km.	0

Changes in sedimentation and runoff losses

About 15 percent of the total micro watershed area is categorized as moderately erodible (E-1) and 85 percent as a medium to highly erodible (E-2 and E-3, respectively). Annual soil loss ranges from 11 t/ha (moderate) to 65 t/ha (high). Project interventions are designed to reduce overall sedimentation and runoff losses and to ensure source sustainability by rejuvenating all the affected traditional natural water sources. The project has achieved the targets of soil conservation measures, roadside erosion control measures and landslide treatment as per targeted targets.

The final impact assessment by WAPCOS to quantify all the hydrological information using various weather and thematic parameters have been done using the Soil and Water Assessment Tool (SWAT) as a tool for the water budgeting activity. The report indicates that the average sediment yield of the representative micro watersheds was 71.6 tons per ha per year and this has reduced to 69.3 tons per ha per year. Holistically, a 17 percent reduction in sediment load is happening in the watersheds. The results of water budgeting studies indicate that the average water yield of the 8-micro watershed during the baseline period was 42.4 million cum whereas during the final impact assessment was to increase to 44.47 million cum. The difference of about 2.07 million cum is an average gain for the watersheds while contributing towards moisture retention.

Almost all watersheds show a reduction in surface runoff. More than 60 percent of the watersheds shows an increase in lateral flows. Wherever reduction in lateral flows is noticed, it is marginal only to a range of 0.3 to 0.4 percent. 75 percent of the watersheds are showing an increase in aquifer recharge which directly contribute to water sources as well as soil moisture. It is indicative that conservation, harvesting and augmentation in the catchment area and is largely helping to percolate water to subsurface routes. 75 percent of the watersheds shows an increase in final impact assessment which shows a markable increase in biomass. This may be due to the efficient use of water in agricultural activities such as mulching, drip and sprinkler irrigation, and overall land and water management. Water budgeting analysis shows that overall surface runoff has increased 1.5 percent, lateral flow decreased 0.7 percent, evapotranspiration decreased 4.3

percent, yield increased 4.9 percent, aquifer recharge increased 3.3 percent, storage increased 0.5 percent with respect to the baseline period.

The results in sedimentation yield and surface run-off are not as envisaged in the PAD (30% reduction in sedimentation yield and surface run-off). Gramya 2 is one of the first projects in the country to use SWAT model for hydrology assessment. The SWAT model is a comprehensive, semi-distributed river basin model that requires a large number of input parameters, uses time series data and calibration of water discharge and sedimentation/run-off to provide the results based on parameterization and calibration. The automated weather stations (AWS) were established after the mid-term stage of the project. Water discharge data has been calibrated but calibration of sedimentation and run off has not been possible due to insufficient data.

Given the drastic fragility of the state of Uttarakhand, a monitoring period of 2-3 years without comprehensive information is insufficient to make clear conlusion on the reduction of sedimentation yield and surface run-off. An average 3 percent reduction in surface run-off has been estimated by the WAPCOS study which is not representative of the complete project area. For a more accurate measurement, multiple AWS in all of the MWS need to be established and caliberated.

Table 51: Summary of SWAT output during final impact assessment

MWS	District	Endline Results (mm)				
		Surface Flow	Lateral Flow	Aquifer Recharge	Return Flow	Evapotranspiration
Dewangad	Dehradun	333	167	417	343	693
Lathiyagad	Pithoragarh	58	78	247	210	469
Loharkhet	Bageshwar	247	248	565	490	708
Paligad	Tehri	273	149	338	286	684
Saintoligad	Pauri	265	84	252	206	551
Sarugad	Uttarkashi	108	117	294	244	664
Sindhiyagad	Almora	305	183	577	521	630
Uttarsu	Rudraprayag	475	136	446	400	413

The evaluation indicates that a few of the critical impacts due to the improved water discharge and restraining runoff losses are seen in improved soil moisture content and increased availability of water for domestic purposes.

Improvement in soil moisture content

A soil testing procedure was followed to check the current soil moisture content in project and control sites. The soil samples have been collected from different field areas and the laboratory results show that the soil moisture content has doubled as compared to control sites. Sufficient levels of soil moisture are an important condition for proper plant formation and high crop yields and the increase in soil moisture is also reflective of the improvement in agriculture production in subsequent sections.

Table 52: Soil Moisture Content

	Type of Sites Selected	Project sites	Control sites
1.	Agricultural field irrigated	26 to 32%	11-14%
2.	Agricultural rainfed field	11 to 14 %	-
3.	Trenching area	17 to 22%	7-9%
4.	Drainage lines	8 to 11%	5-6%

Changes in water availability

Increased water availability through increased stream discharge indicates that the scarcity period of water available for irrigation and domestic use has reduced. A baseline study indicated that 73 percent of the households in the project area and 83 percent of the control area faced water scarcity at least for the duration of one to three months. The percentage of households reporting water scarcity has reduced from 73 percent to 48 percent during the Final impact assessment.

WAPCOS's water need assessment for domestic, livestock and crop water requirement shows that all watersheds are water surplus and much more water is available than the requirement.

Table 53: Water requirements cum/year						
Micro Watershed	**District**	**Livestock**	**Population**	**Crop**	**Total in requirement million cum/yr.**	**Availability in million cum/year**
Dewangad	Dehradun	116732	12697	7897230	8	56.6
Lathiyagad	Pithoragarh	387449	46767	204500	0.6	13.2
Loharkhet	Bageshwar	575187	9128	42630820	43.2	126.8
Paligad	Tehri	362122	33753	7442820	7.8	40.3
Saintoligad	Audi	470182	107015	686400	1.3	20.7
Sarugad	Uttarkashi	167436	9300	4817365	5	32.3
Sindhiyagad	Almora	917648	87653	29255495	30.3	74.3
Uttarsu	Rudraprayag	684528	6282	6566832	7.3	30.9

9.3 Conclusion

The watershed treatment and water source sustainability interventions aimed to increase the efficient use of natural resources on about 220,000 ha of non-arable land and expand irrigation from 5262 ha to 7,800 ha of arable rainfed land in the project area. The soil and water conservation efforts have increased the total cultivable area as well as improved the irrigation and drainage facilities in the micro-watershed units, thereby increasing the acreage and productivity of crops. The project has done watershed treatment in 3429.59 ha of reserved forest area as part of the MWS plans. The project has satisfactorily achieved the demands raised by community and the targeted soil and water source sustainability measures in order to achieve mandated project objectives.

Over the course of the project, 2054 streams were identified which had depleted more than 50 percent and selected to be treated. Source sustainability construction measures of developing recharge pits, digging of trenches, renovation of existing Tal/Naula/ Khaula and village pond / Dug out pond was executed and the targets sets for the same were achieved for more than 2 times of what was envisaged for the project. 99 percent of the treated water sources have shown positive discharge by the end term stage. The increase in water discharge measured through flow change in litres per minute (LPM) in water sources treated or under treatment in project shows encouraging improvement. The water discharge rate during mid-term was in the range of 12.3- 22.2 percent in pre-monsoon and 13.8 - 27.0 percent increase in post-monsoon on an aggregate basis. It is very encouraging to see that the discharge ratio has changed from 13.3- 25.0 percent pre monsoon and 13.0 - 33.7 percent post monsoon.

Almost all watersheds show reduction in surface runoff. More than 60 percent of the watersheds shows increase in lateral flows. Wherever reduction in lateral flows notices, it is marginal only to a range of 0.3 to 0.4 percent. 75 percent of the watersheds are showing increase in aquifer recharge which directly contribute to water sources as well as soil moisture. A soil testing procedure was followed to check the current soil moisture content in project and control sites. The test reports indicate an increase in soil moisture content as compared to control sites. Water availability in the region has increased and percentage of households reporting water scarcity has reduced from 73 percent to 48 percent during the Final impact assessment.

10. Forestry

Uttarakhand has 24,295 sq. km of forest, which is approximately 45.43 percent of the total geographical area (India State of Forest Report, 2019). According to the land use classification, 63.42 percent of the total land in the State is classified under forest. The Gramya II project area comprises of 0.142 million ha of forest which is 53.9 percent of the total geographical area under the project. The project area under agriculture is 0.071 million ha (26.9 percent), while the remaining 0.05 (19.2 percent) is classified as fallow barren land.

The forest area in the state is classified as reserved forest, civil-soyam forest and van Panchayats which falls under the middle Himalayan range with altitudes varying from 1000 m to 2000 m. This comprises of subtropical pine forest (below 1500 m) and Himalayan broadleaf forest (between 1500 m to 2600 m) consisting of Chir pine (*Pinus roxburghii*) and Oak (*Quercus leucotrichophora*) as either pure stands or mixed with other species.

The emphasis of the forestry interventions under the project has been primarily aimed at improving soil and water conservation, watershed treatment and land reclamation, and improving soil moisture content. However, the needs of the community for fodder, fuelwood, minor forest produce, timber, fruits and other edibles were given preference in the selection of the species and types of plantations encouraged under the project. A majority of the forestry plantation was undertaken through the van panchayats with funds received by project gram panchayats. As a result of the consultation process in the community and based on their demand, need-based activities were incorporated through the GPWDP plan. While both the Van Panchayat and community were responsible to implement the forestry works proposed in the GPWDP, the works undertaken in Inter GP areas was the sole responsibility of Van panchayat only. The works were implemented in the Inter GP areas after prior approval of a plan by the forest department.

10.1 Interventions Undertaken

The project, based on the requirement of Gramya II and local needs, has undertaken the following forestry and vegetative regeneration interventions.

i) Afforestation

The afforestation plantation was planned through direct project interventions as well as through investments in inter GP plans in reserve forest (RF) and gram panchayat area. Some of the main species that have been planted under afforestation/reforestation are devdar/deodar/cedar (*Cedrus deodara*), oak (*Quercus leucotrichophora*), kachnar (*Bauhinia variegate*) or orchid, chir pine (*Pinus roxburghii*), sal (*Shorea robusta*), sagun/teak (*Tectona grandis*), bakain (*Melia azedarach*), bheemal (*Grewia optiva*), shisham (*Dalbergia sissoo*), ringal (*Arundinaria falcata*), kesia (*Cassia fistula*), etc.

ii) Assisted Natural Regeneration (ANR) of oak trees

A total of 255 ha of assisted natural regeneration of oak trees has been planted under the project as one of the supportive reforestation activities.

iii) Horticulture plantation

The horticulture plantations implemented by the project was aimed at orchard development, homestead plantation, and seed & seedling for orchard cluster development which ensures twin benefit of improving bio-mass and ensuring food and nutritional benefits to communities. Some of the common horticulture species planted during the project are mango (*Mangifera indica*), lemon (*Citrus limon*), *malta* (*Citrus sinensis*), Apple (*Malus domestica*), Walnut (*Juglans regia*), Guava (*Psidium guajava*), Kiwi (*Actinidia deliciosa*), etc.

iv) Fodder plantation

The fodder plantation undertaken by the project was primarily through napier grass border plantation and Forage row plantation, besides plantation of several multipurpose species like banj oak (*Quercus leucotrichophora*), bheemal (*Grewia optiva*), etc. Supplementary agave plantation to check soil erosion along slopes was also undertaken in various treated micro watersheds. The project has promoted the improved variety of Napier (hybrid Napier, IGFRI-7, 10 etc.) and the tufts were planted in the agriculture

terraces and abandoned lands in the villages. The grass tufts were procured from the forest department nurseries, ULDB centres, or KVK nurseries.

v) Fuel Wood Plantation

Fuelwood plantation was undertaken as an interspersed plantation activity to enhance the availability of fuelwood for the local communities. The project consciously did not demarcate dedicated fuelwood plantation area but it was mixed with other plantation activities to enhance species diversity while reducing pressure on natural forests for fuelwood requirement. Species like Banj Oak (*Quercus leucotrichophora*), Bheemal (*Grewia optiva*), Khaural (*Bauhinia variegasa*), Bakain (*Melia azedarach*), Khair (*Acacia catechu*), Angu (*Fraxinus micrantha*), etc. were planted. Some of the species planted for timber under afforestation interventions such as Oak (*Quercus leucotrichophora*), Deodar (*Cedrus deodara*), Sal (*Shorea robusta*), Sagun / Teak (*Tectona grandis*), Kachnar (*Bauhinia purpurea*), Chir Pine (*Pinus roxburghii*), etc. also supports local fuelwood requirement.

The project has shown very good progress of plantation activities and achieved the area target over and above the project target. The Table 54 below gives the details of the area covered under the plantation activities.

Table 54: Area covered under the plantation activities

Plantation activity	Unit	Progress till Endline
Afforestation (1000 plants/ ha.)	ha	**3897**
ANR of Oak Trees	ha	**552**
Horticulture plantation		
Homestead plantation (250 Plant)	ha	1713.17
Orchard development (250 Plant/ha.)	ha	3233
Total		**4946.17**
Fodder plantation		
Napier crop border plantation	ha	907.5
Forage row plantation	ha	171
Total		**1078.5**

Against the initial planning of 9332 ha by end of the project, the project has achieved 14062 ha of plantation till endline. The project has completed 91.4 percent of the afforestation plantation. The area covered under afforestation plantation also included plantation undertaken through inter GP fund, both in Gram Panchayat and Reserve Forest area. Very high progress of horticulture plantation has been achieved by the project due to the cluster plantations of orchards done to reclaim fallow lands and for diversifying from mainstream agriculture.

Survival percentage

Survival percentage was also calculated based on the survey of plantation sites in the project area. In each surveyed site, around 3 to 6 quadrants were laid depending upon the plantation area. In each quadrat, the total number of planted saplings, plant species and number of dead and live saplings were counted separately. Further, the percentage of existing plants and dead plants were derived separately for each quadrat and then extrapolated for the individual project site.

It was assessed that the average survival percentage varies from 60 percent (Dangi) to 85 percent (Kalsi) within the twelve surveyed sites. In Dudhau, Khatwagad, Pali, Kyari, Chargad, Patisen, Bhanwargad, Loharkhet, Saran Gadhera, and Gogina sites the survival percentage was recorded as 82, 82, 80, 65, 75, 75, 70, 70, 65, and 72 percent respectively. The overall average survival percentage within the surveyed sites was around 73 percent.

Table 55: Survival Rate			
Division	**Micro-watershed**	**Block**	**Survival rate (percent)**
Dehradun	Kalsi	Kalsi	85
	Aragad	Kalsi	82
	Khatwagad	Kalsi	82
Thatyur	Paligad	Jaunpur	80
	Kyarigad	Jaunpur	65
Rudraprayag	Dangi	Agastmuni	60
Pauri	Chargad	Pokhra	75
	Patisen	Ekeshwer	75
Almora	Bhanwargad	Dhauladevi	70
Bageshwar	Loharkhet	Kapkot	70
	Saran Gadhera	Kapkot	65
	Gogina	Kapkot	72

10.2 Impacts

Improvement in biomass

The biomass of the treated areas has increased by 21.2 percent from 2014-2015 to 2021. These changes were on account of an increase in vegetation cover due to new plantations under the project, natural regeneration of grasses, shrubs and tree seedlings owing to the protection against grazing and over usage as well as the increased area (both net and gross) under agriculture.

In this regard, the contribution of soil conservation structures and drainage line treatment (DLT) is acknowledged as an important project intervention that has led to an increase in biomass by preventing soil erosion and conserving the moisture regime not only in and around agriculture and forest land but also around structures such as water channels and irrigation tanks. The biomass accumulation through natural regeneration has also contributed to the overall biomass increase. In addition, bringing of additional land under irrigation (land which was previously fallow), increase in cropping intensity and fodder cultivation are some of the other contributing factors to the added in biomass throughout the treated areas.

Table 56: Biomass estimation Baseline vs Endline			
Sectors	**Baseline 2014-2015 (tons)**	**Endline 2020-2021 (Tons)**	**% increment**
4. Biomass from catchment areas (as per NDVI maps)*	40,98,995	47,59,931.96	16.1
5. Biomass from agriculture land			
c. Biomass from agricultural production in converted fallow land	NA	15,226.1	0.4
d. Biomass from increased Cropping intensity in agriculture land	NA	17,967.8	0.4
6. Biomass from Pasture (Napier & other fodder cultivation)	NA	1,54,512.0	
Total Biomass	40,98,995	49,67,121.06	**21.2**
Biomass MT/ha	**27.69**	**33.55**	

*details of biomass data for 38 micro-watersheds using NDVI is available in Annexure

The biomass of this catchment area has been estimated using NDVI maps (#1) in Table 56. Additional dry and wet biomass from the arable lands (#2) i.e. agriculture in converted fallow lands and biomass from agriculture activities and from pasture lands (#3) has been estimated using a biomass coefficient for the crops and the area coverage. The biomass in estimated through NDVI maps is for a particular time and does not take into account agriculture activities done during the rest of the year and therefore these are additionally added to the NDVI estimation.

The total biomass in the treated areas has increased from 4098995 tons (27.69 MT/ha) in Baseline to 4967121.06 tons (33.40 MT/ha) at the time of final assessment. The biomass conserved in the forests due to the non-utilization for fodder and fuelwood is not included here. This biomass could be equivalent to the biomass of fodder that was cultivated in the fields instead of being procured from the forests. Additionally, the biomass from the agricultural residues is also excluded here which is equivalent to 20-60 percent of the total agriculture production biomass (differing from crop to crop). This conserved biomass can be calculated only with a more in-depth study of the area and the population habits.

The Table 57 below provides information on the change in biomass in each of the divisions of the project. A micro watersheds wise bio mass change has been provided in annexure. The biomass increase. Has been highest in the Bageshwar division and this is also the largest division area wise. Other divisions such as Rudraprayag, Pauri and Pithoragad divisions show a considerable increase.

Table 57: Division wise change in total Biomass as per NDVI maps

Division	Area (Ha)	Baseline Biomass (t)	Endline Biomass (t)	% change
Dehradun	21003	504422	511883	1.48
Tehri (Thatyur)	20796	558529	578517	3.58
Pauri	16543	551876	602454	9.16
Uttarkashi	9301	256203	264271	3.15
Rudraprayag	10712	373696	411259	10.05
Pithoragarh	13314	392103	427594	9.05
Almora	13277	366212	391835	7.00
Bageshwar	43035	1095955	1572119	43.45
Total	**147980**	**4098995**	**4759932**	**16.12**

As of January 2022, almost 2530.88 ha of previously fallow land has been brought under the cultivation of different crops (agriculture and horticulture). The contribution of fallow land under cultivation of different crops in Rabi, as well as Zaid in the project area too, is considered crucial to assess the overall biomass increment.

Table 58: Crop Wise Contribution to Biomass of Fallow Land

Crop	Area (ha)	Production Biomass (tons/ha)	Biomass from Production
Bottle Gourds	3.3798	45	152.1
Brinjal	2.6462	12	31.8
Radish	63.2468	8	506.0
Lentil	6.55	0.713	4.7
Potato	125.1443	22.14	2770.7
Pea	135.978	13.53	1839.8
Onion	37.8721	11.46	434.0
Broccoli	92.4074	3	277.2
Cabbage	161.3789	11.65	1880.1

Cauliflower	79.5956	1.872	149.0
Cucurbits	87.115	3	261.3
French Bean	15.5104	5.98	92.8
Garlic	96.678	15	1450.2
Tomato	162.9771	17.27	2814.6
Chilli	9.1176	0.5	4.6
Cucumber	1.31	3	3.9
Lady's Finger	10.349	7.1	73.5
Pumpkin	2.62	3	7.9
Capsicum	18.34	3	55.0
Radish	11.2136	3	33.6
Leafy (Rai, Spinach, Fenugreek, Coriander)	21.9032	3	65.7
Wheat	829.6492	2.376	1971.2
Toria/Rape Seed/Mustard	372.0007	0.579	215.4
Lentil	183.8971	0.713	131.1
Total	**2530.88**	**196.88**	**15226.1**

The increment in biomass due to project interventions owing to increased soil moisture leading to enhanced contribution from herb and shrub can be exemplified by biomass growth in agroforestry, plantation and open forest. In the sampled micro-watersheds, the highest per ha increase in biomass of 15.65 percent has been observed in Saran Gadhera, block Kapkot in Bageshwar Division.

Species Diversity

A vegetation survey was conducted following the vegetation sampling process and methodology as described earlier in the report. The diversity index for different vegetation classes was assessed using the total number of tree, shrubs and herbs and their abundance. The diversity index is an effort to integrate both affluence and abundance into a single value. Here Shannon-Weiner diversity index was used to calculate the species diversity. This index is based on the relationship between the number of individuals of a species to the total number of plants within a sample.

$$H' = -\sum pi \ln pi$$

Here pi is the number of individuals of one species divided by the total number of plants and 'ln' is the natural logarithm to base e.

In the present study estimation of Species diversity and richness was done separately for tree, shrub and herb. Details of the diversity index and species richness are provided in the following Table 59.

Table 59: Biodiversity and Species Richness

Division	Micro-watershed	Block	Vegetation Type	Diversity Index			Species Richness		
				2014	2019	2022	2014	2019	2022
Dehradun	Kalsi	Kalsi	Tree	1.46	1.51	1.42	6	7	7
			Shrub	1.73	1.69	1.81	10	10	10
			Herb	1.54	1.52	1.58	13	11	13
	Aragad	Kalsi	Tree	0.29	1.20	1.29	2	9	10
			Shrub	1.22	0.60	1.13	6	5	6
			Herb	1.37	1.40	1.40	7	11	11
	Khatwagad	Kalsi	Tree	0.92	0.76	1.01	4	3	4
			Shrub	0.64	0.59	0.79	2	2	2
			Herb	1.19	1.12	1.42	4	3	3
Thatyur	Paligad	Jaunpur	Tree	1.38	1.14	1.39	5	5	5
			Shrub	0.93	0.97	1.00	4	**5**	5
			Herb	0.41	0.53	0.53	4	5	5
		Jaunpur	Tree	1.32	1.53	1.50	5	11	10

Table 59: Biodiversity and Species Richness									
	Kyarigad		Shrub	1.17	1.06	1.11	4	3	3
			Herb	2.02	1.92	2.00	9	4	9
Rudraprayag	Dangi	Augustmuni	Tree	1.51	1.43	1.82	10	9	10
			Shrub	1.05	0.99	1.21	6	5	6
			Herb	1.70	1.52	1.73	7	4	7
Pauri	Chargad	Pokhra	Tree	0.91	0.99	0.98	4	5	5
			Shrub	1.09	0.99	1.09	5	4	5
			Herb	1.55	1.33	1.65	5	5	5
	Patisen	Ekeshwar	Tree	0.84	0.78	1.32	7	6	7
			Shrub	0.84	0.82	0.98	4	4	5
			Herb	0.64	1.21	1.35	3	5	5
Almora	Bhanwargad	Dhauladevi	Tree	0.83	0.89	0.91	5	6	6
			Shrub	1.47	1.39	1.53	10	8	10
			Herb	1.83	1.82	1.80	9	7	10
Bageshwar	Loharkhet	Kapkot	Tree	1.48	1.42	1.45	8	7	8
			Shrub	1.20	0.91	1.30	6	5	6
			Herb	1.48	1.31	1.50	5	4	5
	Gogina	Kapkot	Tree	1.62	1.10	1.43	6	6	7
			Shrub	1.18	1.19	1.29	4	7	7
			Herb	1.60	1.59	1.61	7	5	6
	Saran Gadhera	Kapkot	Tree	1.04	0.98	1.11	4	4	5
			Shrub	0.18	0.39	0.38	3	6	6
			Herb	1.05	1.12	1.12	3	3	3

The project interventions have resulted in the protection and conservation of biodiversity and the richness of tree species. In addition, species richness in the region is strengthened with a reduced disturbance in the nearby forest in terms of the collection of forest resources. The treated plantation sites have higher values of diversity and species richness as compared to the control sites. It may be concluded that conservation and protection activities have created a conducive environment for various other local species to grow and survive better. The increase in the species richness and diversity index was largely due to an increase in the moisture content through the various soil and water conservation structures.

Change in Land Use Land Cover (LULC)

The land use and land cover in the model MWS areas has been assessed by WAPCOS and changes have been reported. The analysis of the data shows that there is a total of 5.1 percent increase in area under agriculture throughout the 8 micro watersheds along with a 0.4 percent increase in the forest cover. There LULC also shows a 1.77 percent reduction in the area with or without scrubs. These achievements are directly linked to the project interventions of bringing fallow as well as rainfed land under irrigation and afforestation efforts undertaken in the different parts of the watershed.

The increase in land under forest is showing very little change as the forest is very vast in the region. The other aspect of bringing fallow land under cultivation is seen, both through the increase in land under agriculture as well as the decrease in land under scrubs.

Table 60: Land Use Category			
MWS	**Agriculture**	**Forest**	**Land with or without scrub**
Dewangad	10.02	0.93	-1.53
Lathiyagad	8.68	-3.23	6.21
Loharkhet	6.66	0.42	-2.58
Paligad	2.87	0.05	-2.28
Saintoligad	1.98	0.13	-0.93
Sarugad	9.27	0.61	-9.2
Sindhiyagad	0.79	2.26	-1.21
Uttarsu	0.55	1.77	-2.68

Average	**5.1**	**0.37**	**-1.77**

Fodder availability and production

Gramya II has endeavoured to link forest conservation and rural development under a single umbrella to create synergies in watershed development, conservation of water and sustainable livelihoods. The project has provided ideal opportunities for providing water conservation, water harvesting and drought proofing, reforestation, and tree plantations in an integrated manner for conservation of natural resources and for strengthening local livelihoods. Economic returns from the investments in the project are an important aspect of the evaluation but it may be premature to assign productivity to the unirrigated tree plantations in the formative years (2 to 5 years).

The following impacts were reported by the community as a result of afforestation and plantation activities undertaken in Gramya II. A greater percentage of households have access to fodder and grass now from their own land, while a substantial decrease in grazing has been reported. Fodder and fuelwood stress on the natural forest has reduced with lesser households collecting them from the forest and also reduced quantity of collection as the same is available in own and common land in the village.

Table 61: Impact on fuelwood and fodder due to forestry activities in Gramya II

	Before Project	**After Project**
Households using fodder and grasses from their own agricultural, barren and other lands	69%	95%
Households purchasing feed from the market	10%	7%
Households procuring fodder and fuelwood from forest	66%	48%
Households allowing cattle to graze in fallow lands/pastures	29%	9%

Institutional, social and gender impacts

The forestry interventions have several positive social and gender impacts on women beneficiaries. The time spent on fodder collection has reduced and now a lesser number of family members are involved in fodder collection indicating reducing drudgery. Women have greater involvement now in local development planning with a positive impact on their empowerment. Employment opportunities for women have also expanded due to forestry activities undertaken in the project.

Table 62: Impact on women due to forestry activities in Gramya II

	Before Project	**Presently after Project**
Time spent for collection of fodder	Average 2.5 hours	Average 1.0 hours
Members involved in collection of fodder	2 or 3	1 or 2
Employment opportunities created for women in plantation activities	Low	Medium
Involvement of women in planning activities of plantation	Low	High

85.7 percent of respondents indicate that new plantation activities have led to a decrease in time spent in the collection of fodder. 100 percent respondents also reported higher impact on income generation activities for women due to plantation activities as a result it has also led to their greater involvement in other institutional activities such as Gram Panchayat planning meetings, Women Aam Sabha, School committee, etc. 85 percent GPs also reported that women were involved during planning activities of plantation execution.

Impacts of plantation on the community

a) Species Selection

The main species selected for plantation were deodar (*Cedrus deodara*), oak (*Quercus leucotrichophora*), kachnar (*Bauhinia variegate*), chir pine (*Pinus roxburghii*), sal (*Shorea robusta*), bakain (*Melia azedarach*), bheemal (*Grewia optiva*), shisham (*Dalbergia sissoo*), kesia (*Cassia fistula*), khaural (*Bauhinia variegasa*),

khair (*Acacia catechu*), angu (*Fraxinus micrantha*), etc. Selection of species for plantation as per the altitude was reported to be good in all of the GPs visited

b) Plantation activities
Across locations, the GP members and beneficiaries were satisfied with the appropriateness of the site selected for afforestation and silvipasture and the site development activities undertaken. The community were overall satisfied with the site development activities undertaken in the project such as clearance, demarcation of boundary, retaining indigenous varieties in pasture development, etc. Among several activities' GP members are particularly satisfied with the boundary and fencing of sites whether it was vegetative boundary or stone and/or wire boundary.

In 90 percent of the sites visited, the GP members reported that digging of pits was appropriately undertaken and in the remaining GPs the activity was considered to be of acceptable quality but could have been done better. In 94.6 percent of the GPs visited the employment of local villagers in the digging of pits was reported and in 80.0 percent of the sites, the mulching and trench system was reportedly ensured. In all the sites the filling of pits was considered to have been done properly. The timing of planting and size of sapling selected for planting was considered to be have been done properly in all the sites visited.

In almost all the gram panchayats, the maintenance of plantations and aftercare, soil work and weeding post plantation was considered to be of average quality and needs to be improved further. The need for systematic planning with a clear timeline for maintenance and aftercare of the plantation was suggested during the consultations.

c) Survival Rate
The community during consultations shared the survival rate of species planted, which varies across Gram Panchayats visited. The overall average survival percentage within the surveyed sites was around 73 percent with the lowest in Dangi MWS (60 percent) and highest in Kalsi MWS (85 percent). Among all the surveyed GPs, 57 percent have reported a plantation survival rate between 70-75 percent. 64 percent of GPs (out of 42) where fuelwood plantations were undertaken the overall survival rate is higher at 72 percent compared to fodder plantations which is at 65 percent. Wherever there was low survival the primary reason was because of grazing, frost and lack of desired rainfall.

Replacement of dead saplings/plants was reported in two-thirds of the GPs, which ideally should be ensured in all the GPs. The main reason cited for poor survival of plantation in some GPs was lack of proper attention during planting, weeding and other works. Other factors reported for low survival in some GPs were planting of weak and damaged saplings, untimely planting of saplings, carelessness in the cartage of plants, lack of supervision at the time of planting, and issues related to shifting, grading and root cutting of plants.

d) Plantation of shrubs and grass
In 92 percent of the GPs, the GP members were reportedly satisfied with the planting of shrubs and grass in the watershed treatment area. 4 percent of the GP members were not satisfied with the coverage of shrubs and grass plantation and in the remaining GPs, the plantation of shrubs and grass was considered average or acceptable. In all the GPs, the members were satisfied with the maintenance of shrubs and grass plantations undertaken.

10.3 Conclusion
The biomass of the treated areas has increased due to an increase in vegetation cover as a result of plantation initiatives, the increased area under agriculture and protection against grazing. The treated plantation sites have higher values of diversity & species richness as compared to the control sites. The reduction of LULC in the area with or without scrubs can be attributed to the project interventions of bringing fallow & rainfed land under irrigation and afforestation.

A greater percentage of households now have access to fodder and grass from their own land, while a substantial decrease in grazing has been reported. Fodder and fuelwood stress on the natural forest has reduced with a lesser number of households collecting them from the forest. There has been a reduction in the quantity of collection of fuel and fodder as the same is available now in own and common land in the

village. New plantation activities have led to a decrease in time spent in the collection of fodder. Community reported a major impact on income generation activities for women due to plantation activities which have led to their greater involvement in institutional activities.

The project encompassed activities that aimed at managing natural resources along with improvement in the overall condition of the people residing in the project area through the participation of the local village community in afforestation and plantation activities. Proper selection of local and endemic species suitable for different zones played a very important part in the success of the plantation programme as climatic conditions vary with the altitude and other environmental aspects. The process of plantation i.e. selection and preparation of the site, digging of pits, spacing between the pits, alignment and size of pits, planting of seedlings, protection of plantation sites, weeding and other maintenance operations have been effectively implemented by the community through proper capacity development initiatives.

The areas in the afforestation programme were taken up already had some existing plants, but the density of existing vegetation was less and there were open patches available for the plantation. Under the fuelwood plantation programme, blank patches were taken up for plantation and those species were preferred which provided a good source of fuelwood. In all these plantation models, plantation techniques which included site selection and development, digging and filling of pits, construction of protection wall or fence, plantation of saplings and its aftercare were similar. Plantations also offered important environmental benefits such as sustainable production and improved soil, water quality and salinity mitigation, carbon and biodiversity benefits.

It may be concluded that conservation and protection activities have created a conducive environment for various other local species to grow and survive better. The increase in the species richness and diversity index was largely due to an increase in the moisture content through the various soil and water conservation structures.

11. Agriculture and Horticulture

The state of Uttarakhand is approximately 90 percent covered by the hills with only 7448 sq. km area (10 percent) for plains. About 80 percent of the population living in the hills of Uttarakhand depends on agriculture. Thus, hill agriculture is practiced on a large scale in the state and an estimated 54 percent (415,000 ha) of the total cultivated area is located in the hill regions (Land Use Survey 2009-10). The hill farms are characterized by being very small and fragmented with an average farm size of 0.6 to 0.8 ha, often subdivided into a number of plots in different size, shape and locations.

At the beginning of the project in 2014, the project area had 66,400 farmers, cultivating 45,050 ha. of which, 77 percent was rainfed, 12 percent irrigated, and the remaining 11 percent under fallows. The rainfed cropping was dominated by cereal, millet, and pulse crops. Major crops being finger millet, wheat, paddy, pulses and mustard, which occupied 75 percent of the cropping area in the project villages. Use of chemical fertilizers was a minimum and mostly FYM and compost was used to fertilize the farms. Despite low to no use of chemicals, it was reported that the overall soil fertility was declining[13]. As a result, productivity for major crops like staple cereals, was as low as 10-12 qtls/ha in the hills- almost 50 percent lower than in the plains. This is evident from the below comparison of production averages with global and national scenarios.

Crop	Global average (qtls/ha)*	National average (qtls/ha)*	Project area average (qtls/ha) from baseline
Wheat	32.57	30.75	12.6
Rice	30.26	21.91	11.2
Pulses	8.90	8.41	7.6

*Economic Survey of India 2015-16

Actual crop yields being only 40 to 50 percent of the potential crop yields in rainfed agriculture, resource conservation-cum-improved production technology packages were critical to minimize the yield gap and stabilize productivity across diverse rainfall situations in the project area. Gramya II aimed to promote integrated resource conservation measures in the arable lands and support adoption of moisture conservation based efficient crop production management in cereals, coarse cereals, pulses, and oilseeds in about one million farming terraces, protected with vegetative (fodder) boundaries.

Enhancing rainfed agronomic practices and increasing agricultural productivity requires intensive soil management and conservation and also provision of irrigation to enable farmers to take crops all throughout the year. However, the past few years have seen a decline in the discharge rate of spring and stream water sources: about 10 percent of these water sources disappeared over the last decade. Heavy rainfall, of which more than 90 percent is received during the July-September monsoon months, resulting in severe soil erosion due to rapid water run-off from the undulating and steep slopes during monsoon months. In addition, the hill topography makes conventional irrigation practices unfeasible. The small farms, fragmented plots and lack of capital investment leave little scope for making staple crop cultivation an income-generating activity. These constraints combined result in low household incomes forcing people to migrate the region in search of jobs.

The project aimed to increase agriculture from a sustenance occupation to an income-generating one by changing the way agriculture is practiced in the hill regions. In addition, efforts have been made to develop crops for seed production, and encouraging farmers to grow aromatic plants, spices, tree nuts, etc. Uttarakhand, being a hilly state with varying agro-climatic zones possesses immense potential for production of off-season vegetable and there is tremendous scope to enhance their productivity. The relatively cooler temperatures compared to the plains also make Uttarakhand hill regions one of the few areas in India that can produce certain temperate vegetables such as potatoes, brassicas (e.g., cabbage, cauliflower) and legumes (e.g., peas, beans) and temperate fruits like apple, pear, plum, apricots and peaches. Vegetable cultivation is ideal for small and marginal farmers to get better returns if they can grow vegetables in the off seasons owing to higher market price during off season. The shorter duration of these crops also makes them

[13] Crop productivity and suitability analysis for land-use planning in Himalayan ecosystem of Uttarakhand, India, August 2018

more suitable and remunerative. Therefore, the promotion of high yielding vegetable crops through demonstration has been a crucial intervention of this project to substantially improve their incomes and livelihood security.

11.1 Interventions Undertaken

In order to achieve the desired outcomes, the project interventions focused on farm demonstrations (and farmer trainings linked with these demonstrations) for a wider dissemination of improved crop husbandry and natural resource management practices. The scope of demonstrations includes supplying subsidized inputs such as seed, fertilizers, bio-fertilizers, bio-pesticides, etc. to the beneficiary farmers. For enhancing rainfed crop productivity, the main thrust has been given for adoption of improved varieties of crops, quality seeds, low water-requiring crops like millets, and other nutri-cereals, as well as high market value crops like pulses, and oilseeds based on bio-physical and resource suitability. This is combined with improved crop husbandry and rainwater conservation practices, including life-saving irrigation with stored rainwater at critical stages of crop growth for maximizing productivity. Specific technologies and practices developed and/or recommended for Uttarakhand by GB Pant University of Agriculture and Technology (Pantnagar), the Central Soil and Water Conservation Research and Training Institute (Dehradun), Vivekananda Parvatiya Krishi Anusandhan Sansthan (Almora) and the Centre for Research in Dryland Areas are being promoted in the project area.

Development of production clusters

Small and fragmented land holdings result in low volume production giving farmers and cultivators little to no leverage when marketing their produce. Therefore, the project promoted a cluster based approach for cultivation of crops which could be marketing through farmer-based institutions such as FIGs and FF and give higher returns to producers. The project has helped form 165 agriculture clusters in 901 ha. area., 447 vegetable clusters in 1728 ha. area and 318 fruits clusters in 1496 ha. area. The clusters are focused on cultivating crops such as finger millet, maize, and vegetables and fruits like tomato, cabbage, malta, etc. as well as orchards.

Table 63: Clusters formed under the project

	No. of Clusters	Area (ha.)	Cumulative Production (qtls.) 2014-15 to Jan 2022	Cumulative Turnover (Rs. million) 2014-15 to Jan 2022
Agriculture	165	901.0	85320.7	91.48
Vegetable and Spices	447	1728.0	747975.2	1227.08
Fruit Crops	318	1496.0	374.1	4.35
Total	**930**	**4125.0**	**833670**	**1322.91**

Along with forming clusters the project has also enabled the formation and strengthening of farmer interest groups (FIGs) at village level to allow easy delivery of services and project benefits as well as effective dissemination of knowledge to the farmers. Details about FIGs formed are provided in the section on Agribusiness and Value Chains.

Promoting Soil moisture conservation practices

The main objective of soil moisture conservation is to minimize the amount of water loss from the soils through evaporation (water loss directly from the soil) and transpiration (water loss occurring through the plants) – or combined, the evapotranspiration. Soil moisture conservation is ensured through the initiatives such as deep/shallow ploughing, poly and organic mulching, seed treatment, IPM, INM, Intercropping, and providing irrigation facilities. The agricultural technologies and improved practices promoted by the project include;

i. Seed treatment,
ii. Bio-compost,
iii. Vermi-compost,
iv. Mulching,
v. IPM measures like bio-pesticides, yellow strip, insect trap
vi. Deep ploughing,

vii. Zero tillage,
viii. Line sowing, and
ix. INM measures like organic manure, cow urine, bio fertilizer

A farmers field survey conducted in the final impact assessment, has shown that the number of farmers practicing at least five soil conservation method or improved crop production methods in last cropping seasons was 65.7 percent. Adoption is defined as using the practice for a minimum of two seasons after demonstration under the project.

While the baseline data shows that farmers were already exposed to and also practicing some of the improved crop production and soil conservation technologies in both project and the control areas, their percentage has grown significantly after the commencement of the project. The Field demonstrations along with extension services played a major role in leveraging this awareness and encouraging the farmers in adopting the improved practices with providing essential technical know-how. Seed Treatment, mulching and use of bio-compost and vermicompost are most popular as the project has special focus on these activities.

Table 64: IPNM distribution

IPNM measure		Unit	Quantity distributed
Bio Fertilizers (Masterzime, Super Gold, Nutra Mx , Nutra Gold, Nutra Zyme)		qtls	4355.78
Phosphate rich Organic manure		qtls	40.58
Organic Foliar Spray		Lit	60
Beauveria Bassiana		qtls	17
Neem Khali		qtls	533.91
Neem Mix manure		qtls	543.77
Vermicompost		qtls	841.7
Manure Compost		qtls	188.14
Bio Pesticide	Neem oil	Lit	9639
	Trichoderma	qtls	1404
	Pseudomonas	qtls	15.05
	Caliber	Lit	1208
	Agromin	qtls	25
	Torment	Lit	982
Bio Agent	Plant Bio Agent	qtls	443.33
	Waste Decomposer	Lit	780
Solar light Trap		Nos.	436
Yellow Trap Sticker		Nos.	21609
Pheromone trap		Nos.	556

In addition the project has also promoted following appropriate nutrient management in the farms by promoting soil testing. Soil tests have been conducted through soil test laboratories in local Krishi vigyan kendras and other Agriculture departments run labs.

Table 65: Number of soil tests conducted through the project

	2017-18	2018-19	2019-20	2020-21
Number of tests	3202	4316	1868	4908

Promoting crops/products fetching maximum price and also providing nutritional advantage

The project has given considerable push for the production of millets and nutri-crops such as finger millet, barnyard millet, Amaranthus which as not only suited for the climate of Uttarakhand but also have good market value owing to their recent acceptance as a super food and have nutritional advantage for the cultivator as well. Additionally, promotion of pulses like kidney beans, horse gram, etc. and oilseeds like mustard and rapeseed which require low input support and give higher returns are also being promoted. The crops promoted also have greater opportunity for value addition which would help engage more people in the value chain and fetch higher returns. Some of the crops promoted include finger millet (processed into biscuits and cookies), kiwi (processed into jams, squash, juice), turmeric and ginger (processed into powders), etc.

Promoting region specific, improved, high yielding varieties

Traditional crops grown using traditional varieties provide very little profit to the producers due to high input requirement, low production and the high risk due to low tolerance of crops to climate and external adversities like drought, water logging, disease and pest infestation, etc. To overcome this limitation, the Gramya -2 has promoted crops that are suitable to be grown in the temperate and hilly environment on Uttarakhand as well as promoted improved varieties of crops which would provide higher returns as compared to local and traditional varieties. The project introduced short duration, high yielding varieties as in case of Maize, Rice, Mustard, Soybean, French Beans, Green Peas, Capsicum, Tomato, Introduction of varieties suited for hill areas and promotion of climate resilient varieties developed for the hills by VPKAS especially for cereals and millets.

a. Maize- High yielding and hybrid varieties Vivek Makka, TATA DMH-849 replacing composite variety. Also, the Chardham circuit is favorable for maize growth
b. Rice- Shifting to VPKAS recommended long strain variety PB 1509
c. Millets- Promotion of nutri cereal cultivation under National Mission for Sustainable Agriculture
d. Rapeseed/Mustard- Short duration high yielding varieties that are suitable for hill regions
e. Pulses (lentils, horsegram, soybean)- High yielding varieties, hill adaptive varieties like PS 1225 for Soybean

The following high yielding varieties of crops has led to the increased productivity of rainfed agriculture under Gramya II;

Table 66: Recommended high yielding crop varieties of irrigated crops	
Cabbage	Varun, Mohini 53, 55
Cauliflower (I)	Snow crown, Snow white
Garlic (I)	Agri found Parvati, VL-LEHSUN 2, Yamuna
Pea	GS 10, Arkel, Indo-American Hybrid Seeds, NSC P 10, AP 3, RS 10, Pahuja 1100
Tomato	Himraja, Swarna Baibhav

Table 67: Recommended High yielding crop varieties of rainfed crops	
Amaranthus	VL Chua 44
Barnyard millets	VL Madira 207
Finger millet	VL 324, 347, 315, 352, 379
Garlic	VL-Lehsun 2, Agri found Parvati, Yamuna Safed
Ginger	Rio de Janeiro, Himgiri, Maran
Maize	Kanchan, TATA Ril 009, DMH-849, African tall, Vivek Sankul Makka 31, K 65, DMN 849, Samrat, Vivek composite maize-31,35, RMH1899, DMH 489, DKC 7074, RDS 45, Monsanto 7074, Satya KSP 5284
Mustard	8501, PT 303, PPS-1, PM 30, Pant Sweta, PPS-1, Giriraj, RH749T
Onion	Naisk Red - 53, Red Stone, Sarik Red, Light Red, Saanwi, T 821, Gulmohar
Potato	Kufri Badshah, Kufri Jyoti, Chandramukhi, Kufri Himalini, Kufri Bahar
Rice	PB 1509, VL 85, 86, 62, VL 68
Soybean	PS 1225, PS 1092, Black Soyabean
Turmeric	Swarna, Pant Peetabh, Lakadong, Rajendra, Sonia
Wheat	VL 953, HS 507, VL 892, HS 507, HD 2967, UP 2572, UP 2526, PBW-550, VL 824, VL 832, VL 907, VL 829, VL 967

Increase in productivity

The final impact assessment shows that there is an overall 60.2 percent average increase in the productivity of selected Irrigated crops against a project target of 50 percent. About 41 percent of this increase can been attributed to project interventions when compared to the results of the control areas. In rainfed agriculture, there has been a 33.1 percent increase in productivity against a project target of 20 percent with more than 20 percent of the attribution to project activities.

The selected crops under irrigated agriculture include Garlic, Cauliflower, Cabbage, Tomato and Green Pea. The detailed crop yields of these crops is shown in Table 68 below.

Table 68: Productivity of Irrigated Crops						
Crops	**Baseline Productivity (qtls/ha)**		**Endline Productivity (qtls/ha)**		**Change in productivity in project area (%)**	**DiD (%)**
	Project	**Control**	**Project**	**Control**		
Garlic	40.2	39.9	72.0	47.7	79.1	59.7
Cauliflower	99.5	98.5	138.0	109.5	38.7	27.7
Cabbage	86.4	85.3	133.6	103.0	54.6	34.2
Peas	51.8	51	86.2	62.0	66.4	45.1
Tomato	105.4	105.2	171.67	117.9	62.9	50.8
Overall					**60.2**	**41.7**

Extensive field demonstrations of the high yielding vegetable crops have effectively demonstrated their benefits over traditional varieties and methods of cultivation. The main contributors for the increase in productivity under irrigated crops is the availability of assured irrigation which has encourage people to also undertake cultivation in more area, demonstration of raising seed and seedlings of high value crops, especially off-season vegetables under poly tunnel, protected cultivation in polyhouses, has encouraged the farmers to undertake large scale cultivation of high value crops.

A significant increase in productivity has been observed in rainfed agriculture with an overall increase of 33.1 percent increase in the project areas against 11.8 percent in control areas. The detailed crop yields of Irrigated Crops reported are shown in the Table 69 below.

Table 69: Productivity of Rainfed Crops										
	Baseline				**Endline**				**Change in productivity in project area (%)**	**DiD (%)**
	Project		**Control**		**Project**		**Control**			
Crops	**Kharif**	**Rabi**	**Kharif**	**Rabi**	**Kharif**	**Rabi**	**Kharif**	**Rabi**		
Spice Crops										
Ginger	84.7	-	84.2	-	117.7		100.3		**38.9**	**19.9**
Turmeric	76.1	-	75.9	-	91.7		83.7		20.6	10.3
Onion	-	44.0	-	43.0		62.8		50.0	42.8	26.9
Garlic	-	40.2	-	39.9		62.3		51.2	55.0	27
Cereal crops										
Maize	13.0	-	12.3	-	16.9		13.2		**29.7**	**22.8**
Wheat	-	12.6	-	12.0		18.1		14.1	43.4	26.8
Rice	11.2	-	11.1	-	15.2		11.5		36.1	32.5
Nutri Crops										
Finger Millet	12.1	-	11.5	-	15.4	-	13.2	-	**26.9**	**12.9**
Barnyard Millet	11.7	-	11.5	-	13.9	-	12.8	-	18.6	7.5
Amaranthus	6.1	-	5.8	-	7.9	-	6.1	-	28.8	23.8
Horticulture Crops/ Vegetable Crops										
Potato	90.1	-	89.8	-	110.5		100.0		**22.7**	**11.4**
Tomato	105.4	-	105.2	-	141.7		127.8		34.4	12.9
French Bean	55.6	-	55.2	-	82.0		70.3		47.5	20.4
Capsicum	58.5	-	58.1	-	86.2		65.2		47.3	35.1
Cauliflower	-	99.5	-	98.8		117.3		107.9	17.9	8.7
Oilseed crops										
Mustard/ Rapeseed	-	5.6	-	5.4		7.6		6.0	35.7	**25**
Pulse crop										
Lentils (Masoor)	-	7.3	-	7.1		8.7		7.5	**19.2**	**13.7**

Black Soybean	8.9	-	8.6	-	13.1		9.0		47.2	42.7
Horse gram	-	6.8	-	6.7		8.1		7.0	19.0	14.6
Overall									**33.1**	**20.8**

Along with high yielding and hill recommended crop varieties, yield increase is also attributed to appropriate crop husbandry, integrated nutrient management, and adoption of improved crop production technologies and soil moisture conservation practices as recommended under the project. Field visits have corroborated the fact that farmers have become more aware of the use of fertilizers and pesticides and instead of the previous broad-spectrum use, now follow a more scientifically recommended schedule for crop management. The extensive adoption of improved crop production technologies and soil moisture conservation practices has also helped considerably in the manifestation of the genetic potentials of HYV in enhanced productivity at the demonstration and adoption plots. Continuous support through extension services that helped create awareness, adoption support and capacity building of the farmers resulting in farmers largely following the recommended package of practices and a judicial use of pesticides and fertilizers.

Development of Knowledge Management documents and Package of Practices (PoP) for on Farm Demonstrations

Gramya II has prepared and released a number of knowledge management documents to spread awareness and educate the project beneficiaries as well as disseminate information of the project activities. The aim of the knowledge documents was to educate farmers about the benefits of growing short-duration crop varieties suitable for rainfed conditions, and adoption of critical package of practices like fertilizer application to the crop immediately after a rainfall event in early stages of crop growth, providing water at critical stages of growth, weeding and pest management, etc. Package of practices have been prepared for all the target crops under the project and disseminated to the demonstration farmers.

The knowledge management documents prepared and disseminated include package of practices for important rainfed and irrigated crops, brochures on improved crop production technologies such as nursery production, improved farm tools, etc., manuals on activities such as strawberry cultivation, aquaculture, animal feeding, mushroom cultivation, etc., catalogues of products produced by federations/growth centres, summary of trainings, workshops and other events. The details of the documents created are provided in Annexure.

As per the field survey, 100 percent farmers who receive the package of practices are satisfied with the production/results they received after following it. The main reasons for their satisfaction were increase in production as well as the requirement of less input, less incidence of pests and diseases and better quality of produce giving them better rates for the produce.

Along with sharing a package of practices, the project has provided continuous support to the farmers throughout the crop cycle. During the field survey, 70 percent of the farmers have said that they received support from the project during the adoption of the new technologies being demonstrated.

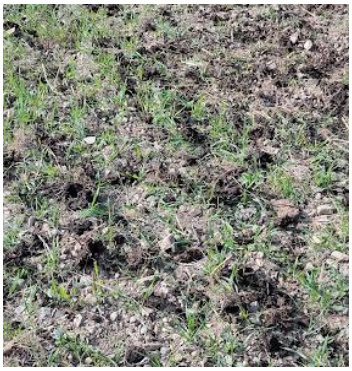
Table 69: Support from the project during the adoption of the new technologies			
	Satisfied	**Neutral**	**Not Satisfied**
Support from project officials during the adoption process	92.3%	3.8%	3.8%
	Timely Support	**Technical knowledge**	**Resource Support**
What is the reason for satisfaction?	58.5%	17.7%	20.8%

The package of practices includes improved practices for reducing inputs, better crop management, and efficient management of pests and diseases. These technologies are also more conducive to the environment and help reduce the use of chemicals by focusing on mechanical and other natural methods. Some of the recommended practices are:

- Use of soil test based nutrient application and proper method and stage of fertilizer application, including integrated nutrient management using organic manures, bio-fertilizers and chemical

fertilizers. Polyhouse production of seedlings and vegetable crops for reduced losses due to damage and disease/pest

- Use of good quality seed of improved variety/hybrid, which is recommended for cultivation in the area, especially rainfed areas.
- IPM using Bio agents developed by GB Pant University, cow urine, and other mechanical measure such as yellow sticky traps, light traps, etc.
- Certified Seed Production Program with Foundation and Breeder seeds from VPKAS, Almora & Uttarakhand State Organic Certification Agency
- Methods of in situ moisture conservation and reduced run off during crop growth, and minimizing evaporation by use of mulches and other appropriate practices.
- Recommended seed rate and optimum time of sowing to ensure proper plant population, particularly in rain fed areas.
- Line sowing of crops and proper placement of fertilizers for higher plant population, greater plant vigour and easy weed control.



USe of Farm Yard Manure

Use of polymulch in capsicum

Certified seeds for seed replacement

The complete recommended package of practices for select crops in both rainfed as well irrigated farms as well for all categories of crops has been demonstrated in the farmers' field. 'On Farm Demonstrations' (Method demonstration and Impact demonstration) have played an important role in demonstrating a practice/technology to farmers and to convince them for adoption, leading to wider and sustainable adoption.

Table 70: Agriculture & Horticulture demonstrations conducted

Component Activity	Unit	Project Target	Achievement	% Target achieved
Demo. of High Yielding agric. crops (0.2 ha. For rainfed ag)	No.	14300	29506	206.3
Adoption support for High yielding agric. crops (0.06 ha for rainfed area)	farmer	50500	92725	183.6
Demonstration for high yielding vegetable crops (0.08 ha. for irrigated area)	No.	18950	31456	166.0
Seeds and Seedlings (High value crop demonstration)	ha.	-	1062	-
Seeds and Seedlings (Orchard Cluster Development)	ha.	-	1558	-

Demonstration of High Yielding agriculture crops & adoption support

Demonstration of High Yielding agriculture crops was undertaken in 0.2 ha area for rainfed agriculture and adoption support provided for high yielding agriculture crops in 0.06 ha rainfed area. The project provided input support through HYV seeds and seedlings and technical guidance via demonstration of package of practices for cereal crops (maize, wheat, rice), spice crops (ginger, turmeric, onion, garlic), nutri crops (finger

millet, barnyard millet, amaranthus), oilseed crops (mustard (mustard/rapeseed), pulse crop (lentils, black soybean, horse gram.

Total of 29,506 demonstrations for high yielding agriculture crops have been conducted covering 5901 ha. Adoption support for High yielding agriculture crops has been provided to 92,725 gross number of farmers. The package under this component includes seeds, package of practices training and support for the select crops for an area of 600 square meters.

Table 71: Area covered under adoption of high yielding agricultural varieties

Year	No. of farmers	Area (ha)
2015-16	1022	61.32
2016-17	9080	544.8
2017-18	15779	946.74
2018-19	16514	990.84
2019-20	16827	1009.62
2020-21	23757	1425.4
2021-22 (till jan 2022)	9746	584.76
Total	**92725***	**5563.48***

*gross number of farmers and area

The impact of introducing HYV seeds of cereals, pulses and millets is much greater in all the demonstration plots in terms of productivity improvement. It was achieved through proper crop husbandry, nutrient management with integrated use of FYM, Vermicompost and Green manure. Adoption of other improved farming practices like seed treatment, line sowing etc. has also helped further in harnessing the genetic potentials of HYV in enhanced productivity in the demonstration plots. Traditionally, for growing cereals and pulses, farmers plough their field two to three times before and use broadcasting method of sowing. Gramya II introduced the practice of line sowing, seed treatment and mulching which has been greatly beneficial to the farmers. More than half of the farmers in the area have adopted one or multiple of these technologies and gained benefit. As discussed under Intermediate Indicator 5, seed treatment (followed by 78.9 percent farmers), Bio-compost (followed by 51.4 percent of farmers) and Mulching (followed by 41.6 percent of the farmers) are the most popular practices.

Demonstration for high yielding vegetable crops (0.08 ha for irrigated area)
A total of 31,456 demonstrations were conducted covering in area about 2516 ha. Overall productivity of all vegetable crops has increased by 16 percent over the baseline productivity. Maximum productivity of high value crop is observed in off-season vegetables such as cabbage, cauliflower and in tomato.

Excessive and continuous use of inorganic pesticides has on one hand resulted in immunity and resistance of pests to some pesticides and on the other excessive residues of pesticides in the produce, polluting ground water and streams. Integrated Pest and Disease Management plays a vital role in reducing the water pollution, environmental hazards and reducethe risk to human health and the environment. In order to sustain the high vegetable production achieved across the project locations, beneficiary farmers are provided with the training and support for organic manure (vermi-compost) production, liquid fertilizers, biofertilizers and other pest and disease control agents, both chemical and organic in origin for Integrated Pest & Nutrient Management. Apart from chemical pesticides and biological control agents,yellow sticky traps and solar powered light traps are also used by more than 30 percent of the farmers for the physical control of the insect pests.

Adoption of climate resilient practices like application of organic manure, seed treatment, application of fertilizers based on soil test based recommendations, line sowing and proper management of plant populations, mulching, diversified farming, proper mechanization, life-saving irrigation etc. has significantly increased the yield and productivity of the high value vegetable and other horticultural crops across all the study villages.

Seeds and Seedlings (High value crop demonstration):
For production of quality high value vegetable crops, good quality seedlings are essential. Demonstration of raising seed and seedlings of high value crops, especially off-season vegetables under protected poly tunnel on raised has encouraged the farmers to raise good quality seedlings for large scale cultivation of high value

crops for better economic returns as well as gaining additional income from distributing the surplus seedlings to the fellow farmers. Farmers have reported that using polytunnels has resulted in 100 percent survival of seedlings as against 70-80 percent in open conditions.

Table 72: Agriculture and Horticulture Activity Progress				
Component Activity	**Unit**	**Project Target**	**Endline achievement**	**% Target achieved**
Agriculture				
Agriculture mini-kit (0.04 ha.)	No.	17603	1482	8.4
Agriculture/Horticulture. tools	No.	2694	3406	126.4
Terrace repair/Vegetative field boundary	Cum	88514	46773	52.8
Horticulture				
Bio Compost	No.	974	523	53.7
Vermi Compost	No.	840	6238	742.6
High value crops mini-kit (0.04 ha.)	ha.	321	21.15	6.6
Homestead plantation (250 plants)	ha.	1719	1713.17	99.7
Orchard Development (250 plants/ha.)	ha.	1777	3233	181.9
Poly House	No.	1601	2908	181.6
Poly Tunnel	No.	4222	8210	194.5

Agriculture mini-kits

Small and marginal farmers are pre-dominant in the project area. More often these farmers operate with minimal resources and therefore are reluctant in adoption of new technologies and practices. In order to boost the adoption of the demonstrated high yielding varieties and recommended package of practices agriculture minikits are distributed to the farmers. These minikits consist of improved seed input, bio-fertilizer application as per soil test based recommendation, inputs for IPM and training on crop husbandry and package of practices for an area of 0.04 ha. The mini-kits help in encouraging adoption of improved practices and new seed varieties by the farmers in the early stage. With adoption support farmers are able to witness the benefits of the recommended crop varieties and practices in their own farms without increased input cost. The benefits derived from the adoption plot contribute to long term adoption by the farmers. Agriculture mini-kits have been distributed to 1482 farmers covering 8.4 percent of the total project targeted farmers.

Agriculture/Horticulture tools:

Farmers in Uttarakhand still use traditional tools and implements which are time consuming and labour intensive. To encourage usage of gender friendly small tools and implements for tillage, sowing, intercultural operations, harvesting, and threshing, the project has distributed 3406 units of improved agriculture tools to the farmers. As part of the selective mechanization to reduce drudgery, power tools are distributed under this intervention such as Power Generated Disc Cultivator, small tractor, Power Weeder, Hand operated & power operated sprayers, etc. The distribution of these tools and implements has increased ease of operation and

reduced the effort required for implementing appropriate crop husbandry practices such as deep ploughing, line sowing, weeding, spraying of pesticides, etc.

Table 73: Agri-machines/Equipment distributed	
Machine/Equipment	**Units distributed**
Power tiller	42
Powe weeder	134
Power Thresher	74
Chaff cutter	114
VL Syahi Hal	390
Nepsac sprayer (Manual)	110
Nepsac sprayer (Battery Operated)	40
Small tools and implements	13185
Total	**14089**

Terrace repair/Vegetative field boundary:
Repair of agriculture terraces and vegetative field boundaries is being undertaken for reducing soil loss and improving agricultural productivity. Adoption support is provided to all rainfed farmers linked to implementation of demonstration programs. The soil and moisture conservation within the rainfed terraces would remain the central focus for improving the overall crop productivity and sustainability. While undertaking terrace repair activities, inward slopes have been preferred especially steep slopes because they guide the surface runoff towards the hillside rather than down the slope. Inward sloping terraces prevent soil erosion with water run-off and also useful in impounding water for paddy cultivation. Farmers are encouraged to cover at least 2/3 of the terraces with vegetative boundaries that would also provide fodder for livestock. Terrace repair and Vegetative field boundary has been done over 46773 cum area.

Bio-composting & Vermicomposting:
To make farmers self-sufficient in terms of on-farm management of plant nutrients, the project has encouraged and provided support for Bio-composting & Vermicomposting. The process does not involve much labour and technical skill and farmers have also been able to create micro businesses through the adoption of this practice. This technique has generated considerable enthusiasm and adoption in more or less similar manner in all thestudy villages. The project has conducted 6238 demonstrations for vermicompost and 523 for bio-compost and it isexpected that this technique would be utilized even after the project completion. The reasons of adoption areas follows.

- The quality of compost is very high as compared to that of other composting techniques
- Less labour intensive
- Simple and low-cost technique of easy in-house breeding of earthworm
- Becoming a source of income by sale of surplus earthworms and vermicompost.
- Suitable for use in kitchen gardening, vegetable nursery, and commercial vegetable crops.

The construction of compost tank has been replicated in considerable numbers in the study villages, where cow dung is available and villagers see the technique efficient enough to decompose in less time and maintain hygiene around the house. However, some of the farmers have been observed to not follow the recommended practice of alternate layering of cow dung, biomass and soil in the pit as it is labour intensive work. Some of the pits were also observed to have low moisture levels. Federations that will be the buying agency for the vermicompost are recommended to ensure the production techniques are followed and also undertake the testing of the compost to add more sale value to it.

Success Story: Vermicomposting as micro scale enterprise

Beneficiary: Gopal Singh
Village: Kafli khal, Almora

Gopal Singh is farmer in Almora division. He has a family of 5 members due to the subsistence nature of farming he was looking for a source to generate secondary income for his family. In year 2018, he approached to Gramya for their support through which he received training for initiating vermicomposting. The project has provided him support to construct 12 pits for vermi composting in which he is able to produce ~35 qtls of compost annually worth almost Rs. 50,000. He is utilizing the compost in his own farm as well as selling it under the Gramyashree brand through the federation. He is producing fortified compost which is Trichoderma blended with the compost to improve its quality. Through the project he has received forward linkage for marketing and purchasing the produce and backward linkage like providing Trichoderma for blending with vermicompost and packaging bags etc. Hard work and dedication of Gopal Singh and his family made their work a success story.

High Value crops mini-kit:
High Value crops mini-kits have been distributed to farmers and adapted to the recommended crops including medicinal plants, aromatics, flowers, spices such echinacea, kutki, kala jeera, marigold, lilium etc. along with the recommended package of practices and bio fertilizer input provided as part of the minikits, which contains seed input, bio-fertilizer and training on the PoP as per each crop. The achievement under this component was low due to the market limitations for high value produce. Framers are only producing the crops which have an assured market linkage as the investment cost is high for the cultivation of these crops.

Homestead plantation:
Homestead plantations are fruit trees planted to supply nutrition and additional income. The survival rate of these plantations is better as farmers live close to the plantation enabling better management of pests and diseases resulting in good survival and productivity rates Homestead plantation has been undertaken in 1713.17 ha area. Plantation of fruit trees like Amla (Indian Gooseberry), Harad (Chebulic myrobalan), Sehtoot (Mulberry), etc. is being done under this intervention. Farmers are provided quality seedlings or assistance in procuring them through local certified nurseries.

Orchard Development:
Orchard developments have been undertaken to help farmers diversify their income sources and reduce the risk that comes with agriculture production. The major fruit orchards under the project are Apple, Pear, Peach, Plum, Walnut, Apricot in high altitude zones, Kiwi, Litchi, Pomegranate, Citrus in middle altitude and Mango, Guava, and Citrus in the low altitude zones. Under these plantations, 3,233 ha has been covered. The project thus envisaged specific interventions to improve the quality and productivity of fruit orchards for diversification and risk reduction. The interventions include assistance for procuring good quality fruit

saplings (including financial), technical guidance for planting, digging of specific pit size, plastic mulching material and insect/pest and disease management. Majority of the orchards have been planted in 2015-16 or later thus, their commercial fruiting has not started. In some areas collective orchards are also been planted with the support of the project. The field survey has also shown that many migrants who returned to their villages after loss of jobs during Covid-19 have also undertaken orchard plantations as it is less labour intensive than agriculture.

Table 74: Production details of orchard clusters

Year	No. of Clusters	Area (in ha.)	Production (in qtls.)	Turnover (Rs. million)
2015-16	42	208	0	0
2016-17	95	476	0	0
2017-18	145	783	0	0
2018-19	234	1096	0	0
2019-20	293	1350	18.05	4.22
2020-21	318	1468	82.25	7.53
2021-Jan 2022	318	1496	273.83	31.701
2021-22	**318**	**1496**	**374.13**	**43.451**

Poly tunnel & Poly house:

Protected cultivation under Polyhouse is gaining importance since it enables:

a. Off Season cultivation of vegetables/fruits which enables the farmer to have a better price realization.
b. High quality produce free from pest, disease or blemishes
c. Extended life cycle of the crops.
d. Check damages or losses from insect, diseases & adverse weather conditions and more crops.

Additionally, polytunnels have also been used to grow seedlings. Polytunnels protect the germinating seedlings from frost, rain, and excess sun and also from pest and diseases.

Farmers have been provided polytunnels to promote good quality seedling production through protected nursery for vegetables and fruits crops. It includes the standard polytunnel with a wooden frame. These are used to raise plant nurseries; Poly tunnels were distributed widely across the project beneficiaries owing to its ease of use and opportunity to produce good quality seedlings. Adoption of polytunnels has been fairly as it was simple to use and giving 100 percent survival of seedlings. Good quality seedling is the important first step to get good crop yields and thus poly tunnels have good positive impacts in increasing the productivity and reducing the loss.

Polyhouse unit consists of a poly house either with wooden, aluminium or steel frame. Farmers use polyhouses to produce high value vegetable crops under protected cultivation. The yield from polyhouses is observed to be double for many vegetable crops such as cabbage, cauliflower, capsicum, peas and other exotic vegetables broccoli, purple cabbage, coloured capsicum and flowers such as lilium, orchids, etc.

The progress achieved in Poly house and Poly tunnels intervention is over and above the GPWDP targets and 2908 poly house and 8210 poly tunnels have been provided to farmers in the project area. All polyhouses in the study villages found to be naturally ventilated without micro irrigation facility.

Productivity comparison of poly house and open cultivation

The productivity of crop is observed greater under poly house i.e., 3.28 time more than the productivity in open area. Cultivation in poly house is less labour intensive and there is a better management of inputs like irrigation, seed, sapling, fertilizer/ manure and IPM inputs and others. The germination percentage under polyhouse is also higher than of open area.

Table 75: Productivity comparison of poly house and open cultivation

Vegetables	Productivity in Open cultivation (per 200 sq. m.)	Productivity in Protected Cultivation (per 200 sq. m.)	Percentage increase (%)
Tomato	500 kg	2200 kg	440
Cauliflower	250 kg	400 kg	160
Green pea	100 kg	180 kg	180

Promoting community-owned and managed irrigation system

As per the survey of beneficiaries, majority of the farmers use Field Irrigation or irrigation channels followed by HDPE pipes. Few farmers use Drip (7.5 percent) and Sprinkler irrigation (10.68).

Table 76: Response of Farmers on Irrigation Techniques

Irrigation Technology Used	Project (%)	Control (%)
Drip	7.5	3.6
Sprinkler	10.68	1.8
HDPE pipes	38.84	19.9
Field Irrigation	70.0	59.3

The use of drip and sprinkler shows the farmers' interest in water saving techniques. Although the percentage of farmers utilising these techniques is low, it shows promising growth especially since the percentage is considerably higher in project farmers than in farmers of control areas.

Overall, the percentage of farmers utilising irrigation techniques is much higher in the project areas than the control areas. The provision of irrigation to farmers has enabled them to take more crops over the year and cultivate off-season produce especially vegetables which gain high market prices. The irrigation structures are constructed under the GPWDP plans with funds from the project and community contribution. The project has formed 1381 water users groups at the GP level for the operation and maintenance of these structures.

Table 77: Water User Groups formed by the project

Division	Total Groups	Male Members	Female Members	Total Members	Funds saved (Rs. in Lakh)
Almora	330	1674	669	2343	5.95
Bageshwar	127	816	610	1426	7.19
Pithoragarh	100	932	265	1197	3.29
Pauri	69	109	450	559	10.79
Tehri	156	1151	209	1360	17.96
Uttarkashi	91	743	55	798	1.86
Vikas nagar	415	2378	82	2460	6.93
PMU	14	104	0	104	2.18
Rudraprayag	79	320	260	580	1.93
Total	**1381**	**8227**	**2600**	**10827**	**58.08**

The groups have been formed on the basis of area and group of consumers. Hence, one group looks after all the structures that are used by the members. For example, the group taking care of an irrigation tank is also responsible for the Irrigation Pipeline/ Channel provided with the tank. The funds saved by the groups are utilised for the repairs and maintenance of the structure and any other development works required.

11.2 Impacts

Changes in cropping pattern & natural resource conservation

To promote efficient use of harvested rainwater, improved crop production technologies with emphasis on cultivation of vegetable crops is being popularized through demonstrations and linked to adoption groups covering all irrigated farmers with adoption support. The interventions by the project have resulted in a change in cropping pattern in the project area wherein farmers have started cultivating more crops through the year as well as the crop basket has also diversified. The cropping intensity has increased from 152 percent at baseline to 161 percent at the end of the project in rainfed area and in irrigated area from 171 percent to 227 percent.

The recommendation of appropriate agro-ecological practices has helped to improve the soil fertility, as it is evident from soil testing reports as well as improved crop productivity. Agro-ecological practices augmented the biological diversity on farms significantly. Natural assets which include water, land, biodiversity and local environment has gradually started changing. The increase in natural resources – as per farmers' perception and testing reports is in the form of land fertility and increase in biodiversity, which includes enhanced noticeable number of earthworms in their soil and increase in natural enemy population in their fields.

Due to increased awareness on natural resource conservation, soil and water is better conserved in the project targeted villages and farmer are taking appropriate steps to further enhance the productivity by harnessing the benefits of water harvesting structures established as part of the project.

Reclamation of fallow lands

Uttarakhand as long grappled with the issue of out-migration. The impacts of climate change made farming an unprofitable venture forcing people to move to the cities in search of employment opportunities. This has led to the conversion of cultivable lands into fallow lands due to abandonment. Availability of water and increased market linkages has motivated the farmers to reengage in farming as well as expand their area under cultivation through leasing of fallow lands and bringing them under cultivation.

From a total area of 5,528 ha in 2014-15, 2,530.88 ha fallow land has been shifted under cultivation till now through horticulture crop (1669.33 ha), fodder crop (423.95 ha) and agriculture crop cultivation (437.71 ha). The fallow land conversion has been instrumental in improving the cropping intensity as well as giving farmers a renewed income source. During the Covid-19 pandemic, many migrants who were forced to leave their jobs in the cities and return to their home villages in the hills have taken up orchard cultivation in the fallow land with the support of Gramya II.

Enhancement of crop productivity

The project has successfully achieved over 30 percent increase in crop productivity of rainfed agriculture and almost 60 percent in irrigated agriculture through varietal introductions & improved crop management practices. The improvement in productivity has been observed in both rainfed as well as irrigated agriculture and is evident through all the type of crops. The project has provided farmers with exposure to newer varieties which are region appropriate and of shorter duration. Farmers have also been given advise on new and improved crop management practices such as mulching, deep ploughing, IPNM, etc. which have resulted in lesser losses and crop failures. The productivity of crops has increased as well as losses have reduced along with reduction in input costs which has helped to increase the net income of farmers.

Adoption of new and improved technologies

Integrated pest and nutrient management

Farmers have been provided training and demonstration of integrated pest and nutrient management practices specially to follow in high yielding vegetable crops. Azotobacter (AZT), Azospirilium (ASP) and Phosphate solubilizing bacteria are some of the bio fertilizers used in the demonstrations, along with use of Organic Manure (Vermi compost, Neem Cake, Dhanzyme, Neem mix manure, etc.), and IPM & INM interventions (yellow sticky traps, solar light traps, VL kurmula trap, Trichoderma, pseudomonas, organic foliar spray of NPK, zymes, humic acid, etc.). Farmers involved in INM in the study villages have improved their understanding regarding type/number of plants nutrients and their role in various stages of crop growth and

the impact of imbalanced fertilizer use on soil health, fertility, and fertilizer use efficiency. Reduced application of agro-chemicals has considerably checked the chemical pollution in the intervention villages, which keeps the water bodies clean and ecosystem balance.

Experiences of farmers engaged in INM of high yielding vegetables in study villages generally indicates that INM entails various constraints to be effectively managed by the groups or individual in the future.

- Farmers in the study villages reported that INM practice in vegetable production has lowered the fertilizer usage by 35-40 percent and thus has reduced the production cost of crops.
- Most of the farmers in study villages expressed their doubt about the logistics and practicalities of regular soil testing for various crops in myriad hill conditions after the project withdrawal.
- Although project has provided guidance about the procurement of INM inputs, it will be crucial to see if farmers will proactively purchase and use the inputs.

The IPM practices at demonstration sites in the study villages has increased awareness level in following terms:

- Negative impact of inorganic pesticides on soil, plant, human health as well as on farmer-friendly insects.
- Relationship of farmer friendly insects with crop health and vital characteristics to identify farmer friendly and harmful insects.
- Safe usage techniques and proper insecticides to be used for different pest and insects in various crops.
- Benefits of various seed treatment techniques.
- Reduction in use of banned inorganic insecticides for pest control.
- Use of pesticides only after pest infestations has crossed the threshold level in crop

New and improved crop production technologies

Along with IPNM, the project is also promoting crop production technologies that are less labour intensive and giver better results. These include line sowing, deep ploughing, zero tillage and use of mulch. Farmers have shown great adoption levels of these practices because of their low investment and high returns. Poly mulch has been adopted especially in vegetable crops such as capsicum, peas as well as in orchards of citrus, pomegranate, etc. in the early stages.

Farmers have also shifted to line showing against the previous practice of broadcasting of seeds as it has helped them save on seed requirement and also made intercultural operations easier for the farmers.

Increase in the area under new & improved technology adoption

The project has distributed improved tools & equipment to farmers as well as provided them to federations for custom hiring. The equipment has helped to reduce the drudgery of farmers and made interculture operations convenient and less labour intensive. Under this intervention, following tools and equipment have been provided.

Protected cultivation in polyhouses has also been promoted, which has helped farmers grow ff-season vegetable, high value crops in small areas and thus gain premium on price. The project has provided 2908 polyhouses and 8210 poly tunnels which translate to an area of ~9.75 ha and 2.4 ha respectively. Poly houses in 3 different sizes have been provided 27 sq. m., 45 sq. m. and 100 sq. m.

Diversification in crops for high-value agriculture

The project has provided support for diversification to high-value vegetable crops production in areas where agriculture was only a sustenance. Farmers have been provided with input support as well as irrigation facilities and protected cultivation facilities where needed which has helped them cultivate vegetables in a more commercial manner and increase their production. Along with high value vegetable crops farmers are also diversifying into medicinal plants, aromatics, flowers, spices such echinacea, gladioli, marigold, lilium, kiwi, strawberry, lakadong turmeric, etc. The project has provided support for protected cultivation by

providing polyhouses where required along with the recommended package of practices and input. However, the adoption of these is only for those crops which have an assured market linkage as the investment cost is high and with no market availability farmers face high losses.

Empowerment of farmers

At the onset of the project farmers were practicing chemical farming with limited choice. But after becoming part of the project, they have been exposed to the various options which can be adopted when there is a perceived pest or disease problem. The farmers have been empowered with the right knowledge for pest and disease management and have also been equipped to the solutions within their own households in the form of botanical pesticides. This has not only improved the quality of their produce but has also reduced the costs and dependency on outside resources. Moreover, a number of trainings, exposure visits, capacity building on various aspects had helped the farmers in gaining knowledge, skills etc. in various aspects of ecological farming.

The farmers have also become more aware with the backward and forward linkages established with the help of the project for procurement of inputs and for marketing of produce respectively. The social status of the beneficiary farmers has also increased with their improved knowledge and thus an increased ability to establish linkages with other line departments such as agriculture, horticulture, irrigation, etc. Increased involvement of women in agriculture and reduction of their drudgery with promotion of good agricultural practices and provision of tools and implements has helped to garner higher involvement of women in improved agricultural practices instead of just labour work.

11.3 Conclusion

Increase in productivity and production have helped farmers in the project areas experience improved incomes due to satisfactory and reliable yields over the years. Farmers have also benefited from the production and sale of premium quality agricultural produce, which has fetched them the premium price. The project has helped farmers reduce the cost of production by 25-30 percent. This is attributed to the on-farm production of organic inputs (manure, sprays and seeds), using local resources judiciously coupled with 10-15 percent price premium for high quality naturally grown produced has enabled farmers to increase income by almost 50 percent. With increased incomes and lower costs of production and sale, farmers have higher disposable incomes which are being utilised for better farming inputs as well as for satisfying needs of the family. Many farmers are opting to lease the uncultivated lands of neighbouring farmers who have migrated out, thus getting the opportunity to increase their cultivation area. Coupled with availability of irrigation and marketing support through ABGCs and Federations, this has helped farmers further increase their incomes.

Along with increased production, farmers have also adopted improved crop production technologies especially ones that forego the use of chemical and use organic and natural ingredients. Establishment of vermicompost units, use of vermi-wash, herbal pesticides and biofertilizer units are some of these practices that farmers have adopted on a fairly large scale in the project areas. The practice of using organic inputs has increased the potential of farmers to go for organic production. Chemical free produce is not only better market value but also has higher health benefits. Sufficient production for subsistence and income has resulted into the food security of the area. Secure nutrition of the family with diverse and healthy food produced on own farms, good working conditions for both men and women due to less exposure of harmful chemicals, natural farming using local knowledge and tradition as well as new and improved technologies has rejuvenated the interest of farmers in agriculture.

12. Agribusiness

The focus of agricultural activities under Gramya II is on vegetables, agriculture crops and spices. The increase in production of these crops has been the largest impact of the project. Farmers have moved from sustenance farming to farming for high value crops and even commercial farming. This made agribusiness emerge as the most crucial component to help farmers in translating the project investment into income. Agribusiness activities under Gramya II are focused on the marketing of surplus production, value addition through improved post-harvest management and processing, and making marketing infrastructure and trade support available to the farmers. These activities have been supplemented with other efforts such as infrastructure development in form of all-weather roads, bridges, and creating logistics support to enable farmers in meeting the demands of the local and outstation markets and convenient logistics.

The activities undertaken in this component include the following:
a. Promotion of improved variety, technologies and techniques
b. Support for traditional crops
c. Dissemination of technology and provision of advisory services for increased production potential
d. Diversification into crops with high commercial potential
e. Adding value through food processing and post-harvest handling
f. Promotion of farmers' groups (FIG/FF) for cluster farming and marketing
g. Support for marketing of produce and creation of alternate marketing channels
h. Establishment of Agribusiness Growth Centres (ABGC) to facilitate value addition and marketing

12.1 Interventions Undertaken

Promotion of farmers' groups (FIGS) for cluster farming and marketing

Farmer Interest Groups (FIGs) have been formed at Revenue Village (RV) level in project villages that include all those farmers who are adopting new technologies and improved seeds from the project to increase their production. The FIGs help farmers to promote their access to production and marketing services.

The agribusiness strategy for the project emphasis on community ownership for building sustained pathways for market strengthening. The project has connected 17,488 farmers through ,1488 FIGs against a targeted number of 10,660 farmers. Out of the 1,488 FIGs, 727 are exclusively female FIGs (48.8 percent). The groups have been provided extensive capacity building training to be able to function as per group governance norms.

Table 78: Membership composition of FIGs

Division	No of FIGs	Total members	Male FIGs	Female FIGs	Male & Female FIGs	Savings (in Rs. million)
Pithoragarh	136	1192	18	11	107	2.46
Almora	121	1940	27	8	86	3.62
Rudraprayag	288	3255	3	253	32	8.73
Uttarkashi	242	2703	0	104	138	8.63
Bageshwar	193	2169	32	49	112	3.75
Vikasnagar	124	1822	13	109	2	7.35
PMU	28	425	22	3	3	4.67
Thatyur	161	2259	50	22	89	3.51
Pauri	195	1723	2	168	25	6.80
Total	**1488**	**17488**	**167**	**727**	**594**	**49.52**

An aggregate analysis of all the FIGs shows that the production volume of the FIGs was 62,275 tons (Table 80) for the project duration of 7 years of which 50,384 tons was sold through the FIGs. Thus, FIGs were dealing with 80 percent of the production volume of their members for undertaking marketing, value addition and sale. It is important to note that about 1/3rd of the FIGs are engaged only in value addition and processing

activities (such as cleaning, packaging, processing, etc. ancillary to the production activities.). With that premise, the FIGs engaged in the production and marketing have traded at approximately 6 tons per FIG over a period of 7 years.

Table 79: FIG production, surplus and sale value				
Division	**Nos. of FIGs**	**Production till Jan 2022 ('00 tons)**	**Surplus till Jan 2022 ('00 tons)**	**Sale Value till Jan 2022 (Rs. million)**
Almora	121	82.16	62.38	106.79
Bageshwar	193	78.49	58.63	129.64
Pithoragarh	136	73.64	55.03	117.85
Vikasnagar	124	91.07	73.20	109.29
PMU	28	20.89	18.50	34.74
Rudraprayag	287	38.14	28.73	62.05
Pauri	195	61.61	51.57	115.79
Thatyur	162	134.81	119.12	321.62
Uttarkashi	242	41.93	36.66	71.81
Total	**1488**	**622.75**	**503.84**	**1069.58**

A year wise trend analysis of the production and sale (Table 81) shows that the volume of produce marketed by the FIGs in comparison to the total production of the member farmers was 72 percent at the beginning and has risen to 83 percent at the end of the project. This is a positive reflection of the productivity increase as well as for the farmers' interest in collective marketing through the FIG platform. By the end of the project (in the last 11 months of the project) each FIG was trading in an average of 8-10 tons of produce annually including cereals, spices and vegetables.

Table 80: Volume of produce marketed by the FIG								
	2014 -15	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**Apr 21- Jan 22**
Total Production ('00 tons)	0.57	20.59	40.02	64.30	136.17	113.00	139.38	108.71
Volume sold ('00 tons)	0.42	16.62	31.79	53.08	106.40	92.29	112.62	90.62
Surplus available for sale (%)	**72.6**	**80.7**	**79.4**	**82.6**	**78.1**	**81.7**	**80.8**	**83.4**
Total Sale Value (Rs. million)	0.8	27.16	55.12	105.5	212.61	203.87	245.17	219.36
Increase over previous year (%)	NA	3295.0	102.9	91.4	101.5	-4.1	20.3	NA*

*not compared with previous year as time period is different (12 months compared to 9 months)

Additionally, the value of produce marketed by the FIG increased each year at the rate of 100 percentage except for in years 2019-21 primarily because of the Covid-19 pandemic. There were several marketing channels created under the project to facilitate the sale of the produce in profitable rates. There was a higher price realization of some selected crops because of its demand in local as well as out of state markets such as capsicum, tomatoes, cauliflower and exotic varieties of coloured capsicum, broccoli and zucchini.

The FIGs have also been provided with capacity building support through workshops, exposure visits and training programs both in the formation, operation and strengthening of their groups as well as in improved agriculture, post-harvest and agribusiness activities being undertaken. Demonstrations and trainings have

been organised on improved agriculture practices, use of improved tools such as power tillers, power weeders, VL Shahi Hal, and others. Post-harvest management of produce, including processing, making of processed food products such as pickles, jams, squash, bakery products, etc. was also part of the trainings to encourage FIGs take up entrepreneurship.

Table 81: Capacity Building of FIGs		
Name of the event	**No. of events**	**No. of participants**
Trainings	875	30685
Workshops	4231	191139
Exposure Visits	205	4785

Cluster-based farming

Cluster-based approach i.e., collective production allowing bulk production of produce is being followed for promotion of Agribusiness activities and has been useful as it allows functioning collectively, lowering the production costs, delivery of inputs and movement of produce economically. Cluster approach allows to function collectively and saves costs including transportation and marketing. For achieving economies of scale and developing compact supply chains, farmers were encouraged to adopt agribusiness activities in cluster of two to three villages. One or two crops were selected per cluster for bulk production so that effective models can be developed for dissemination of technology & collective marketing of the produce. Organizing the produce in bulk for transport reduced cost and helped increasing farmers' income.

Clusters of different vegetables have been developed based on regional climate and market demand. E.g., capsicum cluster in G.P. Thik, Thatyur and potato cluster in Bari Paniyali, Shama and Leeti GPs of Bageshwar division. In Bageshwar division, farmers are also cultivating Tomato and Potato in clusters of 4.2 ha and 12 ha respectively. Hybrid varieties of both tomato and potato are utilized for increased production along with micro irrigation techniques, mulching, soil and seed treatment (*Trichoderma virdi*, *Buberia bassiana*), IPM and INM techniques (Solar light trap, *Trichoderma virdi*, *Buberia bassiana*, Vermi Manure, Bio fertilizer). In Thatyur over 100 ha of land is under cluster farming of different vegetables such as, Peas, Tomato, Cucumber, French Bean, Capsicum, Tuber crops, Ginger, Chilly and other Exotic vegetables such as Purple Cabbage, Lettuce, Broccoli, etc.

The cluster farming approach has also been helpful in reclaiming fallow land that was left uncultivated due to menace of wild animals like monkeys and wild boars. In these fallow lands, farmers were encouraged to grow spices, aromatic and medicinal crops that are not particularly damaged by wild animals. Farmers in villages Siri, Pothing, Chirabagar, Chetabagar and Sumgarh in Bageshwar division have cultivated ginger and turmeric crop in 4 ha of previously fallow land, In Kimu, Jhuni and Gasi, kutki, kala jeera and mahameda are grown in 4.5 ha area. Along with increasing income of the farmers, the fallow land brought under cultivation has increased overall gross area under cultivation.

Formation of farmer federations

FIGs joined together at the cluster level to form a Farmer Federation (FF). The FF establish market linkages, and also help in processing, grading, and packaging for value addition. The profit earned is used to run the FF and also to help farmers in procuring seeds, fertilizers, insecticides, and the operational expenses. Following on the success of cluster approach and creating farmer federations in Gramya I, Gramya II activities have also focused on forming Farmer Federation by organizing the FIGs and making them self-sustainable through institutional and capacity building support.

At the onset, the project had set a target of formation of two federations in each division thus a total of 18 Farmer federations to be formed over the course of the project throughout the project area. The target was set based on local assessment of FIGs formed and the experience of Gramya I. Federations were formed in regions where the productions clusters are dense and thus federations have enough production of diverse commodities to manage. Under Gramya II, a total of 21 Farmer Federations have been formed till Nov 2021. Out of the 21 federations, 3 federations in Uttarkashi and Vikasnagar have yet to reach a profit making stage.

Table 82: Farmers' Federation Status –Gramya 2				
Division	**No. of Federations**	**No. of Associated FIGs**	**No. of Associated Farmers**	**Savings (Rs. million)**
Bageshwar	2	80	928	1.41
Pithoragarh	3	151	1540	8.1
Vikasnagar	3	67	1005	0.50
Pauri	3	195	1709	7.30
Almora	2	121	1840	9.57
Thatyur	1	87	1311	2.13
PMU	1	28	343	1.04
Uttarkashi	3	242	2652	0.06
Rudrapraya g	3	288	2610	3.92
Total	**21**	**1259**	**13938**	**34.03**

Certified Seed Production by Jagnath Beej Utpadak Sangh, Almora

The impacts of climate change have adversely affected agriculture and led to a decrease in productivity. To mitigate losses and improve the production, the project has focused on ensuring good quality inputs for the farmers, most importantly the seeds. The seed replacement rate for the plains stands at 15 -20 percent, while for the hills it is a mere 3-4 per cent. Hill farmers often save produce from their previous season's crop and use the same as seed for the next sowing season. Although the state agriculture department promotes seed replacement by popularizing high yielding varieties through demonstrations and through subsidies on new varieties, availability of certified seeds is only limited to seed corporations. To address the dearth of certified seeds, the project has emphasised on seed production through a special enterprise in Almora division.

Jagnath Beej Utpadak Sangh, a federation constituted under Gramya II in Almora division is undertaking certified seed production since 2015. It an organised farmers' collective which has enabled the production of foundation and certified seeds of various cereal crops on a large scale. The seeds produced are not treated chemically with any agents or colouring agents and are sold in packaging based on the recommended seed rate of each crop. The seeds are sold to other divisions are well as government departments with seed requirement. The federation takes stock of the demand prior to a cultivation season and accordingly purchases breeder/foundation seed. The breeder or foundation seed is provided to the farmers by the federation with a buy back arrangement. Farmers cultivate the crops in scientific conditions maintaining isolation from other fields. The federation is currently procuring the certified/foundation seed through VPKAS for hill appropriate varieties and other such institutions across the country. The Seed Processing is carried out by hiring the mobile Seed Processing Van of Uttarakhand Tarai & Seed Development Corporation, Pantnagar since inception.

In 2020-21, the federation has produced seeds of wheat, mustard, lentil, and garlic in the Rabi season. In the Kharif season, finger millet, barnyard millet, amaranthus, paddy, horse gram, black soyabean, maize was produced. Currently, over 300 farmers are associated with the federation for seed production. The seeds are purchased by the federation at a higher price than that of normal produce. Thus, farmers are keen on engaging in seed production. Till Sep 2021, the federation has marketed over 120 tons of certified seed with a turnover of Rs 7.78 million. Total profit of the federation till date, is Rs. 4.85 million.

	2015-16	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**	**Total**
Production (tons)	7.05	11.84	15.18	17.34	26.72	25.87	22.770	126.77
Turnover (Rs. million)	0.19	0.39	0.86	1.04	1.82	1.87	1.61	7.78

The seed production is a lucrative opportunity for the farmers to increase their income by cultivating the same crops while following a few scientific production practices. In order to further expand this operation, the federation needs to establish purchase agreements with agriculture departments at the district level which

will ensure them a certain market. The federation can also engage in the production for high value horticulture crops and exotic vegetables which can further enhance their income and market opportunities.

Input Support to Gramya-I federations

The project adopted two types of agribusiness activities in Gramya I, one was marketing of raw surplus produce (mainly vegetables) and the other was marketing after value addition (processed products and commodities). A total of 27 Federation were established in Gramya I out of which 19 federations were running Value Addition Centres established by the project to provide approachable place for Value Addition, Sorting, Grading and Packaging like activities to the members. A total of 410 FIGs were linked to these 27 federation having 6743 Farmers as members. All the FIGs are still working and associated with other FFs.

Majority of the federations were established during the later period of the project implementation (2009-10) and were functioning for only 3-4 years, only one fourth of the FFs were fully functional by end of the project. Many FFs suffered from inadequate working capital and only 13 federations were able to sustain after the end of Gramya-I. It was envisaged that the Gramya II project would provide hand holding support to these FFs through the project.

As part of the project, 14 of the 27 Farmer Federations are being provided training and guidance for increasing their sustainability. Since 2017, Gramya-II has been supporting the revival of these FFs and making them functional/operational. The project supported them by establishing processing centres under which juicer, pulper, utensils, masala grinder, vacuum packaging machine, packaging material was provided.

A tripartite agreement was signed between the Federation, Gram Pradhan of the GP where these processing centres were established and the project before the closing of the project. According to this agreement after the closing of the project the FF and Gram Pradhan will be responsible for the management of the processing centres and maintenance of the equipment.

Establishment of ABGC to facilitate value addition and marketing

Traditionally, whatever the individual hill farmers are growing is not enough for marketing to the nearby *Mandis*. Farmers with surplus produce are not able to market it at a good price and also the infrastructure facilities available nearby to semi process- mill, grind, and grade and store their surplus produce are expensive due to low volumes. To address these issues, establishing Agribusiness Growth Centres has been helpful as it supports the farmers in exploring, developing, processing, marketing, knowledge sharing, information dissemination and financing of the bulk farm produce from the village clusters.

The ABGC are important institutions for the farmers as they provide input and output support facilities to the farmers in the nearby village cluster. There are 6341 members from the 556 Figs linked to the 10 growth centres. The Growth centres provide input and output support facilities to the farmers in the nearby village cluster.

Table 83: Details of Agribusiness Growth Centres					
Name of Growth Centre	**Establishment Year**	**No. of FIG**	**No. of Members**	**Turnover of Growth Centre (Rs. million)**	**Profit of ABGC (Rs. million)**
Punah Pokhari Growth Centre, Vikasnagar	2018	17	245	3.67	0.60
Growth Centre Thano, Dehradun	2018	28	343	4.94	1.81
Khyarsi Growth Centre, Thatyur	2018	17	257	9.18	1.88
Simar Growth Centre, Pauri	2019	69	682	2.07	0.37
Amotha Growth Centre, Pauri	2019	58	483	2.12	0.35
Shama Growth Centre, Bageshwar	2018	44	586	2.58	0.56
Falyat Growth Centre, Almora	2019	121	1840	15.75	2.54
Nachni Growth Centre, Pithoragarh	2018	52	458	4.03	0.82
Dobliya Growth Centre, Rudraprayag	2019	90	830	1.59	0.18
Dhivra Growth Centre, Uttarkashi	2020	60	617	0.45	0.05
Total		**556**	**6341**	**46.38**	**9.16**

The following common facilities provided to the farmers;

Input, advisory and extension support

i) Input delivery providing high yielding varieties of seeds, fertilizers, insecticides, and pesticides.
ii) Mobile Soil testing facility
iii) Animal health vaccination and A.I. facility.
iv) Farm machinery bank run by the farmer federation/ FPO
v) Advisory services to the farmers regarding value chain development.
vi) Establishment of Kisan call centre
vii) Enhancement in the skills of the farmers through trainings and orientation Programs
viii) Establishment of Agro met station.

Value addition, Marketing and Logistic Support:

i) Facilitating market linkages through e-marketing and networking.
ii) To create a platform to provide service providers for logistic support.
iii) Grading and packaging services.
iv) Solar dehydration facility.
v) Storage facilities so that there are options for collective marketing of the farm produce.

These Agri-business Growth Centres have been established with institutional support of the Gramya II i.e., the capital investment has been provided to them in form of a grant. This includes the building and infrastructure, equipment and material handling and packaging products. The ABGC are managed independently by the respective federations. The federations are collecting membership fees as well as shareholder fees which will help them build a kitty to continue operations after the project ceases.

To help support the marketing efforts of farmers through the FIGs and FFs, the project facilitated buyer-seller meets to showcase the farmers produce and introduce the buyer market to the farmers. A total of 31 such buyer seller meets have been organized from time to time, facilitated by the project. As a result of these meets, farmers are able to connect directly with buyers instead of going through middlemen and thus get better price for their products.

Table 84: **Details of buyer seller meets organized**

Division	Number Of Buyer Seller Meets
Bageshwar	5
Vikasnagar	4
Almora	4
PMU	3
Pithoragarh	3
Rudraprayag	2
Pauri	4
Uttarkashi	2
Thatyur	4
Total	31

Agribusiness Growth Centre, Almora Division

Agribusiness Growth Centers (ABGC) are a unique facility made available to the farmers through the project area. The growth centres provide a one-stop solution for all the needs of the farmng community from input support, post harvest services, marketing as well as knowledge and capacity building. One such ABGC has been established in Danya village of Almora division. The growth centre is being managed by a farmer federation Athgaon Falyat Krishi Swayatta Sahakarita. There is a board of 5 members who manage the day-to-day operations of the growth centre. 121 FIGs including 1840 members are affiliated to the growth centre.

The growth centre was established in 2020 and provides farmers with various services from input support to custom hiring of equipment such as tillers, weeders and sprayers. The growth centre also has provision to support post-harvest of produce such as Milling of pulses, spices, Flour grinding, Oil extraction etc. There is a provion of training space where trainings are conducted for farmers in the vicinity.

Additionally, the growth has established counters of other essential services in collaboration with different organisations to give farmers a one-stop solution for all their needs. This includes,

- Mini Bank in collaboration with State Bank of India
- Common Service Centre for services related to rights and entitlements
- Paravet services

- Counter for Ringal Products and Aipan products which are traditional Uttarakhand arts
- Counter for agriculture services in collaboration with Agriculture department
- Seed production and sale

The growth centre in convergence with the ICDS is also engaged in the procurement and packaging of the take-home-ration packages that are supplied to the anganwadis in the block.

The growth centre has been established with an expense of Rs. 4.37 milllion including construction of the building, furnishing and equipment. operational expenses of the growth are about Rs. 20,000 per month, which includes utilities (electricity, water, maintenance) and the salary of a caretaker. The board members work on a honorarium. Until 2022, the growth centre/federation has clocked a turnover of Rs. 15.75 million and made a profit of Rs. 2.54 million.

Promotion of improved variety, technologies and techniques

Encouraging commercial production

Agriculture was majorly a sustenance farming concept in the hills. Majority of local crops such as millets, rice and even vegetables were grown only for self-consumption or sold in the local markets if there was surplus. Farmers had marginal lands with fragmented areas which made it impossible for them to think about commercial crop cultivation. Through the project farmers have been enabled to grow crops on a commercial level thus increasing their income. This has been done through cluster based farming, wherein, a number of farmers in the same geographical area grow the same crop, thus producing large volumes which can be sold at good prices in the market as opposed to the earlier fragmented production. The project interventions have also helped to increase the productivity and this coupled with the increased cropping intensity (ability to undertake more crops per year) due to the availability of irrigation has helped farmers increase the marketable surplus.

High value crops and improved variety seeds introduced under the project (for traditional crops and new crops):

Table 85: Details of High value crops and improved variety seeds

Crop	Variety	Characteristic
Wheat	VL 832, VL 829, UP 2575, HD 2966	Higher production
Finger Millet	VL Mandwa	Climate resilient and hill appropriate
Cabbage	Varun, NSC Longyard	Higher production
Cauliflower (I)	Snow crown, Snow white, Moti	Higher production
Garlic (I)	Agri found Parvati	Higher production
Pea	GS 10, Arkel	Short Duration and higher production
Maize	Vivek Makka, TATA DMH-849	Higher production
Soyabean	PS 1225	Climate resilient and hill appropriate

Farmers have also taken advantage of polyhouses to grow off-season vegetables in limited land areas which gives them a higher productivity than open cultivation and also better quality of produce. The polyhouses are also utilised for high value crops such as strawberries, lilium, gladioli, etc. which have good commercial value. Many crops with high commercial potential have been introduced on a pilot basis for farmers to explore earning higher revenues without having to depend on traditional agricultural produce. These include floriculture (marigold, lilium, orchids, etc.), medicinal plants (kutki, kala jeera, echinacea, sweet basil, etc.) as well non-traditional fruits such as kiwi and strawberries.

Table 86: Crops with high commercial potential

Category	Crops	Region
Floriculture	Marigold	Almora
Vegetable	Coloured Capsicum, Brocoli, basil	Almora
Herb	Echinacea	Almora
Fruits	Kiwi	Bageshwar, Pauri
Medicinal & Aromatic	kutki, kala jeera	Bageshwar

Floriculture	Lilium, Gladioli	Dehradun (PMU), Almora
Medicinal & Aromatic	Moringa	Dehradun (PMU)
Fruits	Strawberry	Pithoragarh

The selection of these diversified activities has been based on the local area- climate, soil types, availability of resources, as well as market demand. The project is also helping the farmers with market linkage for the sale of their produce. The innovative products also find place in the ABGC stores.

Kiwi Plantation

Beneficiary: Bhawan Singh
Village: Sama, Bageshwar Division

Bhawan Singh a former school teacher in Sama village of Bageshwar has gained popularity in his region for his innovative fruit orchard. Bhawan Singh retired from his teaching profession in 2010 and post-retirement wanted to take up agriculture but with something that was not traditionally practices. His curiosity of doing something different and productive took him towards kiwi cultivation. He established his Kiwi orchard 12 years ago in an area of 1.4 ha. He was facing many challenges like small size of fruit (grade C) which got low market price, difficulties in marketing and low productivity due to lacking knowledge.

When Gramya II project was initiated in 2015, he approached the project for support in improving his kiwi orchard. Bhawan Singh and a few other farmers who were interested in kiwi cultivation were first sent for cultivation training to Himachal Pradesh to address their problems and to link these farmers with university professors and experienced kiwi farmers. Along with training, the project provided them support for cultivation like provision of irrigation facilities, polyhouse for raising kiwi nursery and iron T bar's for supporting kiwi plants, etc. and linking them to traders those who can provide inputs. Through Gramya, they also received forward market linkage to those who can purchase their produce as well as the kiwis are purchased by the ABGC for value addition and turning into kiwi jam, pickle, chutney and squash. The product is new and has not gained much market yet.

Bhawan Singh says "before the training, majority of my fruit was of grade C and there were heavy losses too. After training, I have learnt the right cultivation [practices and, management of pest and diseases and most importantly, current training practices due to which now we are producing Grade A fruit majorly." In 2020-21, the production of 140 qtls was achieved and net income of rupees 16,76,500 was generated.

Input Support
The prominent crops targeted for high value agriculture under the project were selected based on the area covered in the watershed region and its production potential. To ensure varietal improvements for productivity increase the project has provided farmers with input support through various avenues. The FIG, FF and ABGC have supported the farmers through providing seeds, fertilizers, pesticides and other technical know-how of new and improved practices such as use of IPNM, bi-compost, vermicompost, mulching, etc. The project has helped establish backward linkages for the procurement of these sources includes seeds of climate resilient, locally suitable, high yielding varieties for sustainability of the project interventions.

Chain link fencing
Farmers in many hill areas are gradually quitting agriculture due to increasing incident of crop destruction by wild animals. Farming is majorly sustenance farming, and whatever little farmers sow wild animals, especially wild boars, monkeys or porcupines, destroy it. The destruction leads to crop losses which are irrecoverable leading to many farmers in giving up farming and preferring to work as labourers in others' fields instead of cultivating their own crop. To resolve the issue of man-animal conflict, the project is providing chain link fencing sold through the federations which would help in protection of farm lands. It has been observed that the number of hectares of crops damaged has been dropping due to this provision. The project has provided 5947 bundles of chain link i.e. 94,005 running meters of fence which has been utilised to fence 332.17 ha area.

Seedling cultivation



Agribusiness Growth Centres have been established throughout the project area which act as centres for farmers to procure inputs at low cost. Along with providing seeds at a subsidized cost, ABGC, Thano under PMU division has also set up a seedling nursery for providing seedlings to interested farmers. Along with utilizing their own poly house, the ABGC also contracts other farmers for growing seedlings of different crops with a. buy back agreement, to sell further to member farmers and even to other line departments.

Mambeer Singh is one such farmer with whom the ABGC has collaborated for the cultivation of onion seedlings on a direct purchase agreement. The farmer has cultivated onion nursery in the rabi season of 2021. The ABGC has provided the farmer with seed at the price of Rs. 100 per kg. The farmer raises the nursery seedlings in his own farm with his own inputs. Once the seedlings are ready, the ABGC is purchasing 40-50 day old seedlings at the rate of Rs. 150 per kg. of seedling weight. These seedlings are further sold at the rate of Rs. 160 per kg to commercial nurseries, individuals and to the horticulture department. Over all Mambeer Singh has earned Rs. 2,79,500 gross income from raising onion nursery in one season. This initiative of raising nursery has creates as good source of income for beneficiaries in a short duration of time.

Promotion of new and improved technologies

Demonstrations are a particularly powerful method to train farmers who are not generally conversant in understanding from reading documents and pamphlets. The demonstrations showcased important practices like mulching, Use of solar insect raps, yellow sticky traps, bio compost, vermi composting, line sowing, small scale mechanization like power tillers, power weeders, deep ploughing, etc. This has received good response and adoption by the farmers in and around the project area thus corroborating the success of 'watch and learn' method. During eth Covid-19 pandemic when there were restrictions on travel and meeting with farmers. The divisions created WhatsApp groups with farmers in different clusters. This helped them stay connected with the farmers as well as provide guidance without having to personally visit. The WhatsApp groups were also beneficial in peer learning for the farmers.

Some of the improved technologies and techniques promoted

- Pre harvesting techniques promoted- nursery raising, line sowing, seed treatment, seed selection
- Improved cultivation practices- mulching, line sowing, poly house, seedlings raising in poly tunnels, IPNM
- Post harvesting techniques promoted- grading, packing, transportation, preservation, drying, cleaning, and vacuum packaging
- Modern farming equipment- power tiller, high speed spray machine, millet thresher, paddy thresher

Details about the new and improved technologies promoted by the project have been shared in the chapter on Agriculture interventions.

Logistics support

The project has constructed 572.6 km of rural roads and 756 small bridges to help with logistics support for the farmers. These interventions have helped with connectivity for the farmers to easily reach the markets. Another innovative initiative was implemented in Thatyur division to install one mechanical and one gravitational pull based ropeway trolleys to connect high altitude hill farms with roadsides in a cost and time

effective manner. This initiative has been very helpful to farmers in saving the cost of transport of produce which was previously done with help of mules or manual labour. It is also saving them time as earlier the produce would take 5-6 hours to reach the roadside and is now done is a matter of 30-45 minutes.

Post-harvest (Logistics) support to Farmers group

Devan and Ghansi villages in Thatyur division are engaged in commercial tomato farming since last 10 years. The farmers in the region produce tomatoes in the range of 200-250 tonnes each year however, the terrain of their villages which are remote and lack of connectivity to roadhads pose severe limitations in the marketing of this produce. The nearest roadhead is situated about 3.0 km from the villages and connected by a steep kacha road traversed only on foot or by mules. In the harvesting season, each farmer had to travel around 22-24 km per day with his mule/horse to transport the harvest in an average of four rounds and in each round, a of load 4 crates (80-90 kg.) were transported by a mule/horse and it costed around 150 Rs. (i.e Rs.37.5/crate or Rs. 1.60 - 1.85/Kg.). Transportation losses are high as the mules/horse have to go through difficult uphill terrain of the region. Moreover, the time taken for transporting one quintal of produce take around 45 minutes and one man's labour.

To overcome this adversity, a 300 m long ropeway was built to transport the produce from the farm to the road head. The intervention was designed with an objective to achieve community participation and community ownership. After finalizing the possible potential villages, the project team interacted with the community/stakeholders about the possible interventions. After three rounds of community meeting at different villages, a total 61 farmers of different villages were identified for formation of User groups; and matters such as cash contribution, construction, operation and maintenance issues were discussed. The installation cost of the ropeway was approximately Rs. 8.00 lakhs. The ropeway has a capacity to lift more than one quintal at a time over the distance and it takes around 60 to 80 seconds per run. A charge of Rs. 10/crate and Rs. 12 for small gunny bags is charged so 4 crates can now be transported for Rs. 4 instead of Rs. 150 by mules.

The FIG has also established a grading and sorting centre adjacent to the ropeway site. Two individuals have been employed for operating the ropeway from each end. Training on operation and maintenance is provided to these people so that minor repair work can be handled on site.

The project intervention had a positive impact on the livelihoods of the villagers. Devan, Ghansi and five other villages are now able to transport their high valued crops (primarily tomatoes & mangoes) to the market at Nainbagh using the ropeway built under the project. The risk of damage to the produce caused due to slow transportation as reduced because of faster transportation by the ropeway. The efforts and cost beared by the farmers in rearing mule/horse is also now saved as ropeway is now the major means of transportation for the seven villages. The ropeway has also enabled the farmers in getting better prices for their produce.

Adding value through food processing and post-harvest handling

Value addition to produce especially when market demand is low and returns are diminished is a valuable proposition for the farmers. Gramya II has supported farmers with various trainings and capacity building interventions to add post-harvest value to their produce. The training of FIGs was done at a) at unit Level & b) at division level. The training was given for Formation & Strengthening of FIGs and technical knowhow on Agribusiness. Also, workshops were conducted for various value addition processes such as making of pickles, jams, squashes, bakery products, etc. The value addition activities are very use for women composed FIGs allowing women the opportunity to earn an income independent of fixed working hours. Along with food processing, FIGs are also engaged in other post-harvest value addition such as cleaning, sorting, grading and packaging of produce. The Federations hire the FIGs for the post-harvest packaging of the produce as well as for processing at the federation l or purchase the prepared products from the groups. This model helps the groups earn a substantial income through wage labour without having to invest in the capital costs.

Advisory services for marketing

The project has supported initiatives for institution strengthening, organizing and conducting demonstrations, formation of FIGs at G.P. level, formation of Farmers Federation at cluster level and their legalization, capacity building and skill upgradation of FIG and FF with respect to production and market intelligence and linkage of FIG/ FF with Financial institutions to address to sustainability issues. The FIGs are also provided information for identifying new opportunities in crop production through providing information about the improved varieties, improved crop technologies and development of crop plan for each FIG/ G.P. for both irrigated and unirrigated area. In order to provide a thrust to the agribusiness, the produces, and products under Gramya –II are packed and marketed under the common brand name of 'Gramyashree'. This brand has given an identity to the products and are sold throughout the state as well as in out of state markets.

Marketing Linkages and Brand Promotion

The project has successfully provided forward market linkages and guiding federations to develop local and outside markets for the sale of products. This not only helps in sale of local products but also aids in generating market demand and brand building of products, besides building farmers' confidence and developing entrepreneurship skills in them.

The federations are currently selling their products at the following outlets

- Two Gramyashree stores, Dehradun (one in WMD campus, one on Rajpur Road)
- Agribusiness Growth Centre Shama (Bageshwar division)
- Agribusiness Growth Centre Thano (PMU Division)
- Chaundkot Sahakarita outlet (Pauri Division)
- Teelu Rauteli Sahakarita outlet (Pauri Division)
- Agribusiness Growth Centre Khyarsi (Thatyur Division)
- Kamal Ghati Gramya Swayatta Sahakarita outlet centre (Uttarkashi Division)
- Yamuna Ghati Gramya Swayatta Sahakarita outlet centre (Uttarkashi Division)
- Kedar ganga Gramya Swayatta Sahakarita outlet centre (Uttarkashi Division)

In addition to these outlets, the products are also sold to various local and out station shops. For example, Thatyur division is selling their products to 18 shops locally in Thatyur, Suakholi, Mussoorie, Kempty, Chamba, Nainbag area, 8 shops in Dehradun, 2 in Vikasnagar and 1 each in Haldwani, Srinagar, Rishikesh and also selling to stores in Delhi-NCR. They have also established B2B linkage and selling the products in bulk to commercial units Kashipur, Selaqui, and Dehradun. The flagship products like mustard oil, millets, pulses, pickles, millet cookies, naal badi, kidney beans are having good demand in nearby local market as well as city like Dehradun & Delhi, etc.

The project has also taken concentrated efforts for the brand building of Gramyashree products through billboard advertisements, radio jingles, leaflets distribution to reach the general audiences and gain exposure for the products. The newly opened Gramyashree outlet on Rajpur Road, a busy market area in Dehradun, has got excellent response from customers in terms of increased footfall, repeat sales and greater trust on Gramyashree brand and products.

Gramyashree store, Rajpur Road

The project opened the second exclusive Gramyashree outlet on Rajpur Road in September 2021. The first outlet was opened 2015 and is located in the WMD campus. Rajpur road is busy market place in the city and the purpose often store was to get more visibility for the Gramyashree projects. The store is located in a 250 sq. ft. area with products on display. It is an inviting shop and bound to get people to step in even of it is to look at the products. All the federations from the project divisions are supplying their products to this outlet.


The store is open 7 days a week from 10 am to 7 pm and is managed by a store manager who works on 20% share from the sale of products. The rent and other utility cost are currently being covered by the project however, post project, these will be covered from the profits made from sale.

Some of the most sold products at this store are mustard oil, apricot oil, garlic pickle, kidney beans, red rice, barnyard millet, finger millet flour, multigrain flour, etc.

The average monthly sale of the store from Sep 2021 to jan 2022 has been Rs. 57,000. Value wise, majority of the sale was from mustard oil, Apricot oil and gehat dal (horse gram) millet cookies (10%) and barnyard millet (10%). Value wise, majority of the sales is from mustard oil (8%), Apricoat oil (4%) and Gahat Dal (3.5%).

Table 87: Details of sale for Gramyashree outlet, Rajpur road, Dehradun

Month	Store sales (Rs.)
Sep-21	54,873
Oct-21	74,008
Nov-21	57,718
Dec-21	70,193
Jan-22	29,520
Total	**2,86,312**

The store manager has expressed that the millets and pulses have a good demand along with mustard oil. There are many varieties of squash also available and he is hopefull of their growing demand in the upcoming summer season. The store also stocks other decorative and gift items such as the aipan artefacts, bamboo and ringal products however, the demand for these is low due to their cost. However, these are off-farm products and intend to give the FIGs year round activities thus their inclusion in the product portfolio is important.

Table 88: Details of sale for Gramyashree outlet in WMD campus, Dehradun

Year	Annual sale (Rs.)	Average monthly sale (Rs.)
2018-2019	1,56,598	13,050
2018-2019	62,079	5,173
2019-2020	1,29,909	10,826
2020- 2021	28,520	2,377
2021-2022 (till Jan)	45,250	3,771

Prior to the Covid-19 pandemic, the FIGs and FFs were also participating in exhibitions and Haat bazars. These provide a suitable platform to the farmers where they can directly deal with the end user of their products and have one to one interaction with them helping them understand the customer demand, feedback, and also assess the real worth for their products. Post lockdown, the number of exhibitions are reduced however the FIGs and FFs participate whenever there is an opportunity. A recent exhibition was organized at the Raj Bhavan, Dehradun on the occasion of Spring Festival. As a result of these exhibitions, sales worth Rs. 80,000 were made by the 4 participating FIGs. The participation at such platforms also provides a state- and nation-wide exposure to the products and motivates the farmers to engage more enthusiastically.

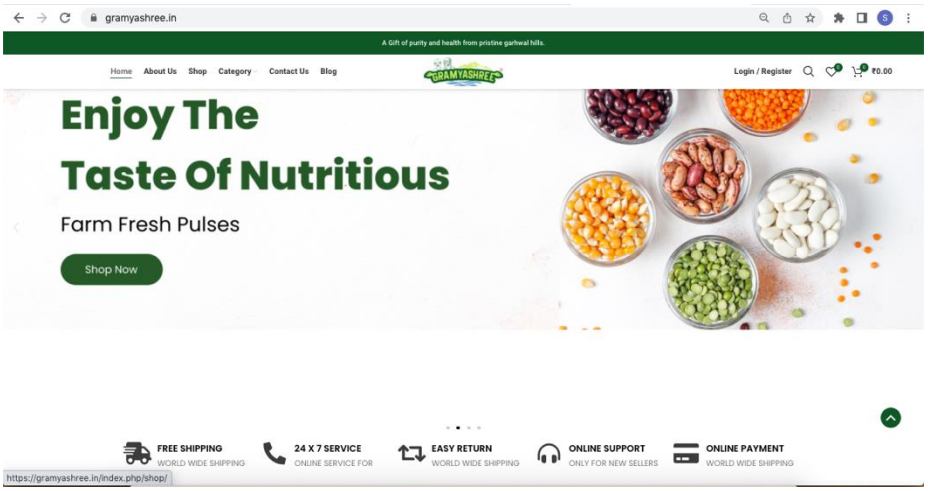
Table 89: **Details of participation in exhibitions-sale, number of participants**

Division	No. Of Exhibitions	Products sold	Sale in (Rs.)	Number of Participants
Bageshwar	7	Kiwi Jam, Kiwi Chutney, Kiwi Fruit, Kiwi Candy, Kiwi Squash, Hilly Jadi Buti (medicinal and aromatic produce), Ringaal Product, Rajma, Finger millet flour, Bhangjeera, Bhangdana, Ginger powder, chili pickle, Mango Pickle, Methi Pickle, Garlic Pickle, Ginger pickle, Honey, Roli, Nimbu Chukh	1,92,231	82
Vikasnagar	8	Rajma,Urd,Walnut,Mandua Flour, Maize Flour	26,345	96
Almora	8	Certified Seeds, Turmeric, Amaranthus, Finger Millets, Bamboo Hot Case, Moong Dal Nuggets, Bamboo Lamp, Coriander Powder, Turmeric powder, Chilli powder, Black soyabean, Marigold flower	6,44,885	107
PMU	6	Vermi compost, Seedlings, Naal Badi, Mandua biscuits, Arse, Madua Atta, Jakhya, Rajma, Urad, Jhangora, Haldi Powder, Kala Jeera, Mirch Powder, Dhaniya Powder, Rajma, Gahat, Tor dal	1,39,000	53
Pithoragarh	7	Maduwa flour, Lentil, Soyabean, Ramdana, Turmeric, Coriander, Cumin, Chilli, Malta juice	9,477	6
Rudraprayag	6	Choulawai &Ramdana laddu, Urd, soybean, Maduwa, Ginger powder, Gahat	10,910	15
Pauri	8	French bean, Garlic, Soyabean, Black Gram, Gahat, Red Chilli, Ghee, Peas, Jhangora	48,960	26
Uttarkashi	5	Red Rice, Finger millet flour, black soyabean, gahat	25,741	7
Thatyur	9	Mustard Oil, Herbal Holi Colors, Burans Squash, Malta Squash, Mint squash, Apricot oil, sesame oil, Finger millet flour, Gahat, Jhangora,	56,147	56

Integration with e-channels

For the sale of products, in addition to their sale outlets, the federations also have presence on Facebook, Instagram for the promotion and marketing of their products and also take orders via WhatsApp. The outlets are all well set-up, their records are being maintained promptly. They also have facilities for accepting online payments and payments through money wallet apps like PhonePe, Google Pay, Paytm etc.

PMU Dehradun has also set-up an online ordering website for the sale of their products (www.malkotiuttarakhand.org). The Gramyashree store in Dehradun has also launched their website www.gramyashree.in for the online sale of products.



Till Nov 2021, the federations have sold products worth Rs. 9.68 million from the outlets at the federations. Along with this the federations have also made sales worth Rs. 4.22 million from sale to other non-project outlets in and outside the state.

Gramyashree App

A real time reporting tool in the form of a mobile application - *Gramyashree Mobile App*, has also been developed to facilitate the marketing linkages through online marketing system. The mobile app has been pivotal in empowering the FIGs by direct selling of their harvested produce to vendors through Agribusiness Support Organization (ABSO). It supports the FIG to collect the production data through mobile App and create a structured database of the produce link between FIGs (seller) and vendors (buyers) at WMD level. Detailed production details, crop wise and season wise across all Divisions can be accessed through this app.

As the Table 91 below shows, the total sale achieved by Gramyashree is Rs. 1.69 million. The mobile app is real time business intelligence and the number of sales corroborate its success. Other specialty of app is that it works in remote areas, and low bandwidth environments. It reduces the operation cost and has better forecasting accuracy and yield management. Further, it ensures premium for certified farms/commodities and has efficiently increased internal control. Gramyashree Mobile App includes details pertaining to FIGs including Production details, Crop Details, Vendor Details, etc.

Table 90: Sale of Gramya products

Division	Sale through Gramyashree App (Rs. million)	Sale through Gramyashree outlets (Rs. million)	Sale to other outlets (non-project) (Rs. million)
Bageshwar	3.25	6.98	0.45
Vikasnagar	0	0.12	1.25
Almora	0	0.38	0.84
PMU	7.13	13.55	5.92
Pithoragarh	0	11.1	2.26
Rudraprayag	0	3.2	0
Pauri	0	36.3	2.63
Uttarkashi	1.36	0.76	0.04
Thatyur	9.14	35.08	29.53
Total	**20.88**	**107.47**	**42.92**

The Impact of Gramyashree mobile application include;

a) Vendors/Buyers registered - Till Jan 2022, the app has registered 309 vendors/buyers
b) Farmers registered in Gramyashree mobile app – Till Jan 2022, 7729 farmers in 715 FIGs have been registered across all Divisions.

Marketing Studies undertaken

The project has, from time to time, undertaken studies for improving the value chain processes and marketing efforts. Some of these are enlisted below.

Developing a marketing strategy

The objective of the study was to build a retail sale strategy that federations could utilise for the marketing of their products under the Gramyashree brand. The strategy developed by the study focused on retailing of the commodities by using a combination of physical stores, B2B marketing, B2C marketing and e-commerce platforms.

i. A **Business to Customer (B2C) strategy** involves the primary producer placing their products at supermarkets, kirana and other provision stores to sell to customers based ion local demand analysis.
ii. **Business-to-Business (B2B) strategy** involves transaction of the products using a fixed contract between the primary producer and other businesses through bulk-wholesaling contracts with nearby hospitals, government canteens and hostel mess and other such organisations.
iii. The **E-commerce marketing strategy** involves setting up an online store on an e-platform like Amazon, to sell products. The products to be sold online are to be selected conducting marketing evaluation of the products, packaging and delivery systems.
iv. The **Brick & mortar store strategy** involves setting up a physical store location by the primary producer to sell only their products. Store are to set up in commercially viable location to ensure high footfalls.

Formation of an Apex Institutions

A study was conducted to assess the viability of forming and Apex level marketing institution for the governing of the Farmer Federations formed under Gramya II. The study analysed the roles and responsibilities that this Apex level institution would need to fulfil and also proposed a methodology for its forming formation.

It was proposed that the Apex institution would act as the central body for coordination and marketing purposes and provide support to the farmer federation through facilitation of policy advocacy initiatives, market linkages and joint ownership initiatives. Additionally, the institution can provide technical assistance to farmers and undertake activities to diversify businesses. The key functions of an Apex institution are as follows:

- Filling need gaps and providing customized services
- Creating a self-help promotion system
- Establish growth centres and district and state levels
- Processing and value chain addition
- Standardization, Quality Control and Branding
- Up Scaling and Collective Actions beyond a cluster

However, due to slow down of activities during the covid-19 lockdown, this proposed Apex level institution could not be formalised. In lieu of it, the Khyarsi ABGC, which is one of the first ABGC made function through the project, has taken up the responsibilities similar to that envisaged for the Apex body. Details of the same have been share in the section further.

Value Chain study of major crops

A study was undertaken to analyse the competitiveness of eight major value chains supported by the project on the basis of various factors. The identify eight value chains include Turmeric, Tomato, Ginger, Capsicum, Kidney Beans, Kiwi, Barnyard Millet ad Ragi and their profitability was analysed in terms of processing done at ABGC level.

The value chain analysis was carried using quantitative research techniques for collection of data. Data from both primary & secondary sources was be collected, analyzed and presented in the deck. Focused group discussions were conducted with farmers and project staff in different districts. The discussions for the assessment were conducted using a semi-structured questionnaire, which was structured around specific parameters. This also included combining open-ended discussions with farmers on certain topics such as challenges faced in production, government support availed, etc.

Kiwi Value chain analysis

A value chain analysis was undertaken specifically for the kiwi fruit production in in Kapkot Tehsil of Bageshwar district. The analysis helped to identify the gaps in kiwi production and limitations of farmers that were keeping them from commercial production of kiwi in a profitable manner. The main issues that the farmers faced were,

- Unavailability of good quality kiwi saplings.
- High cost in orchard plantation and maintenance in staking of plants, training pruning, irrigation facilities, etc.
- Low production and poor quality of fruits coupled with high packaging cost and high transportation was earning a very low profit margin for farmers.
- Absence of cold storage facilities for storage of fruit in off-season leading to poor market rates.
- Lack of marketing to sale processed kiwi fruit products such as jams, chutney, squash, etc.

Keeping these inefficiencies in mind, agriculture marketing Value Chain was created in Bageshwar to address the transportation issues and find buyers that could pay better price for produce to the farmers. The following interventions were undertaken to realise this:

- In order to sell the produce at good rates pan-India, it was important to upgrade the product packaging. Accordingly, packaging boxes were upgraded to 3ply/4ply corrugated boxes with trays that could carry 30 pieces in one box. The boxes had Gramya stickers on them as brand identification. These boxes helped in reducing the in transit damage to 90 percent as compared to previous year when 2ply boxes were used or fruits were sent in crates with no packaging.
- Secondly, the project explored the correct target market and buyers for the farmers. An intensive primary research was conducted to understand the best buyers and maximum benefit for the farmers. Based on the findings, local Mandis such as Haldwani, Dehradun & Bareilly were found to be a suitable market for small farmer as the quantity grown can be easily procured and the transportation cost is less. Second lucrative market are the boutique shops/sellers based in Delhi who purchase Himalayan fruits in quantities of 100-150 kgs which can be easily supplied by the farmers who produce in small quantities. The project farmers produce was sold at Rs. 180 per kg to boutique buyers in Delhi.
- Third intervention was to work on the post-harvest strategy for getting better returns from processed products. The structure of SHGs was effectively leveraged and top processed food trainers were roped in to deliver trainings for the growth centre workers to upgrade the quality of products with standardized recipes and appropriate processes. Products like dehydrated or dried kiwi and kiwi candies were added in addition to chutneys, jams and squash of better quality that before. The packaging of the products was also improved to get good market visibility.

As a result of project interventions, the farmers were able to transport the produce was transported at Rs. 5 per kg from Sama to Haldwani instead of Rs. 8 per kg prior to the intervention. The cost of packaging was also reduced to Rs. 30 per box that too with an upgraded 3 ply/4ply corrugated boxes with trays. The produce was sold at Rs. 180 per Kg in Covid -19 scenario market being unfavourable and in low demand.

12.2 Impacts

Increased potential for income generation

There has been an increase in productivity of the targeted crops owing to extensive demonstration activities carried out in the region, availability of irrigation, varietal changes and integrated crop management. The percentage increase in productivity at midterm of irrigated crops was 37.2 and in case of rainfed crops 27.2 percentage point increase. During the final impact assessment, the productivity of irrigated crops increased by 60 percent and that of rainfed crops by 33 percent in comparison to the productivity documented at baseline evaluation. The achieved productivity and consequent marketable surplus for the crops has been assessed through an evaluation of the FIGs and share of Area Vis-à-vis production escalation.

A sample analysis of the FIGs has shown that 109 FIGs that are engaged in collective production and marketing traded in 321 T of produce (including cereals, pulses, vegetables, spices) during one year (2019-20) equivalent to 3 tons per FIG (Table 92). The marketable surplus of the crops i.e., volume sold via FIGs is at 70-80 percent for most crops. Farmers either prefer to sell the remaining produce in local markets or keep it for self-consumption. It has also been seen that the volumes sold through FIGs are not very high as compared to the areas under the crop. Thus, there is immense scope there for the farmers to utilize the FIG and Federation markets for the sale of their produce. Also, it has been observed that majority of the FIGs sell vegetables through the FIG platform. The platform can be utilized for the sale of agriculture crops as well.

Table 91: Potential Marketable Surplus

Crops	Project area under the crop (2020-21)	% share of the project area in the state*	Current Marketed qty (tons)**	Current earnings (Rs. million)**	Potential Marketable Surplus (tons)***	Potential earnings (Rs. million)#
Ginger	1946	38.45	1.38	8.96	229.04	1488.79
Turmeric	2224	125.72	1.09	2.72	203.94	509.85
Garlic	3,242	154.97	78.48	667.11	225.32	1915.21
Maize	2680	21.78	0.19	0.35	39.66	71.40
Wheat	4439	4.08	24.31	48.62	80.35	160.69
Rice	4102	5.15	42.04	58.86	40.61	56.85
Finger Millet	6393	8.66	15.24	38.11	93.34	233.35
Barnyard Millet	2641	7.02	14.77	29.54	33.80	67.61
Tomato	1390	14.85	11.49	28.73	177.64	444.11
Capsicum	2289	81.54	4.06	8.12	149.24	298.49
Cauliflower	2958	87.85	92.61	111.13	356.14	890.36
Cabbage	899	13.09	3.04	9.13	120.11	360.32
Green Pea	2680	19.86	4.37	26.24	201.00	1206.00
Mustard/Rapeseed	1668	20.62	1.29	10.32	12.68	101.41
Black Soyabean	1668	25.23	12.16	48.64	14.18	56.71
Horse gram	2641	25.19	14.58	182.27	21.39	267.40
Total	**43,860**	**654.06**	**321.11**	**1278.85**	**1998.45**	**8128.55**

*based on agriculture and horticulture department data 2019-20
**based on 2019-20 data for 109 FIGs
***calculated based on analysis of productivity and area under the crops in project area (2020-21)
#calculated based on average market prices of 2020-21 and project area under the crops (2020-21)

The above analysis in Table 92 also shows the potential for the project area to improve its agriculture and horticulture growth based on current cropping pattern and market prices. If the practices and cropping pattern are followed throughout the project area, there is a potential for a turnover of Rs. 8128 million. This shows that with proper planning and implementation of new and improved technologies, the state has immense scope for the expansion of the agriculture & horticulture activities and ensure a sustainable increase in the farmers' income.

Impact of value addition and market initiative

Adding value to agricultural products beyond the farm gives farmers several times the economic benefit that that of agricultural production alone. However, producers receive a very small portion of the consumer's price than the food processors, especially processors who produce brand name items. However, with the involvement of federations which are a farmer run institution and not a commercial business, it has made possible to give farmers a higher share from the consumer's rupee.

Barnyard millet is purchased from farmers at Rs. 20 per kg by the federations. The produce is raw and after cleaning sorting, grading, there is 70 percent loss in weight for the final produce. The cleaning & sorting cost is Rs. 2 per kg and the packaging cost Rs. 5 per kg. The product is sold at Rs. 90 per kg to the retailers/traders who in turn sell the product at Rs. 110 per kg. In this scenario, the percentage share of the farmer's price is Rs. 60 percent while that of the trader's margin is 21 percent.

The federations are an independent entity and the profits made by the federation are not transferred to the farmer in terms of value as federation profits are shared only among shareholders. However, the federations have helped farmers get more value to their produce with lesser efforts. They are able to sell their produce through FIGs and to Federations which has saved them the transport and marketing costs. Having an assured market in the vicinity has also made them less vulnerable to the ups and down of traditional mandis. While more than 70 percent of the farmers still depend on these traditional mandis and the middle men for the sale of their produce, the new marketing initiatives that have started under the project especially the Agri Business Growth Centre have started a new trend where farmers feel more empowered and more in control of the prices. For example, the rate of finger millet was Rs. 12-13 in the open markets while the federation purchased the same at Rs. 25 from the farmers during 2020-21. Both farmers as well as farmers were able to save their time, money and effort of selling/purchasing from the mandi.

Another lucrative avenue that the project has brought forth to the farmers is that of seed production. Through seed production, farmers are able to get more value for their produce than consumable produce by following a few extra practices. For example, certified seeds of garlic are sold at Rs. 150 per kg and Foundation seeds are sold at Rs. 250 per kg as against Rs. 70-80 per kg for food quality garlic. This is an 80-100 percent increase in the earnings of the farmers.

Improvement in supply chain dynamics of selected commodities

There are only 10 growth centre in the project area as of now, therefore it is not feasible for all the farmers in the project areas to sell the produce through the federations considering the limitations of time, distance and perishability of the produce. But the project has helped to change the supply change dynamics in the project areas. While the local markets and mandis are still the preferred markets for vegetables and other perishable items, farmers are looking at federations as primary buyers for the non-perishable produce and produce that gains more value with value addition. Farmers are also able to get better rates as they are able to negotiate prices with the federations.

Market penetration of new brands promoted

The visit to the ABGC outlets and stores across the divisions has brought forward the crucial need for brand management and maintaining uniform quality across locations. The products produced by the ABGC are sold under the Gramyashree brand throughout the project areas and there has been a slow and steady increase in the brand recognition and appreciation of quality. All the food products sold by the Federations are made under a FSSAI license and guidelines however since the production is decentralised, the taste and quality of products is not uniform. For example, pickles are being made by all the federations involved in value addition but each federation follows a recipe traditional to their local region and the final product is different in taste. It will be beneficial to market these as individual products highlighting the different taste, quality inherent to the local region. Each growth centre is also using their own packaging design. To create a high brand recall value, it is important to keep a uniform branding throughout and efforts on the same may be directed accordingly in the future.

The products are currently being sold under the Gramyashree brand at the Gramyashree outlets in Dehradun and some other outlets across the state. From the evaluation of the Gramyashree outlets, it was observed that brand awareness of the products is steadily increasing and there are repeat purchases. However, the brand recognition is not very high in customers that are not aware of the same. To get more brand visibility for the products and increase their commercial value, it is important to present them in a uniform taste, quality and packaging and implement a uniform branding strategy which will be instrumental in achieving this brand recognition for the Gramyashree products.

12.3 Conclusion

The agribusiness component of the Gramya 2 project was envisaged to encourage aggregation of farmers into FIGs to allow for collective marketing and further formation of Farmer Federations for the collectivisation and management of FIGs and to explore marketing opportunities for better positioning and marketing of the fresh as well as processed produce. However, over the course of the project, it soon became evident that the production levels of agricultural produce had increased exponentially more than anticipated. The project also successfully aggregated over 10,000 farmers into FIGs by the third year against a target of 6,000 resulting in the need of focused efforts to provide marketing support to the increased volume of production. Thus, the Agribusiness component became an important one for the project and the project interventions were accordingly planned for the growing marketing and value addition needs of the farmers.

As part of these efforts, agribusiness interventions under the project have helped promote value chain addition through formation and capacity building of FIGs and their consolidation into Farmer Federations (FF). A cluster-based approach was adopted and farmers were encouraged to undertake activities in a cluster of two or three villages to achieve economies of scale and develop compact supply chains. The project has connected 17,488 farmers through 1488 FIGs and the groups have been provided extensive capacity building training to be able to function as per group governance norms. The volume of produce marketed by the FIG in comparison to the total production of the member farmers was 72 percent at the beginning which has risen to 82 percent at the end of the project. Additionally, the value of produce marketed by the FIG increased each year at the rate of 100 percentage except in years 2019-21 primarily because of the Covid-19 pandemic. The project has also promoted the diversification through adoption of floriculture, horticulture and medicinal plants to gain commercial advantage for the farmers. Moringa, strawberry, kiwi, coloured capsicums, zucchini, broccoli, etc. are some of the promoted crops. A total of 21 FF have been formed till Nov 2021. The progress with respect to self-sustainability of the federations has exceeded the target and volume of marketable produce has increased multifold.

In addition to the planned efforts for marketing and value addition, the project has established 10 Agribusiness Growth Centres (ABGC) which are managed by federations in areas of high production. ABGC are inclusive centres that support the farmers in exploring, developing, processing, marketing, knowledge sharing, information dissemination and financing of the bulk farm produce from the village clusters. There are 6341 members from the 556 FIGs linked to the 10 growth centres. The growth centres provide input and output support facilities to the farmers in the nearby village cluster. The following common facilities provided to the farmers;

ix. Input delivery providing high yielding varieties of seeds, fertilizers, insecticides, and pesticides.
x. Animal health vaccination and A.I. facility.
xi. Farm machinery bank /custom hiring of equipment
xii. Advisory services to the farmers regarding value chain development.
xiii. Enhancement in the skills of the farmers through trainings and orientation Programs
xiv. Facilitating market linkages through e-marketing and networking.
xv. To create a platform to provide service providers for logistic support.
xvi. Grading and packaging services and other post-harvest value addition services

The products created by the FIGs and federations are marketed under the ‘Gramyashree’ brand through outlets at the federation as well as sold to other shops in the areas and in nearby towns and cities. Several marketing linkages have been established with retailers, bulk buyers and industrial to facilitate the sale of the produce in profitable rates along with 9 project operated stores across the 9 divisions. The federations also have presence on Facebook, Instagram for the promotion and marketing of their products and also take orders via WhatsApp and the website www.gramyashree.in. They also have facilities for accepting online payments and payments through money wallet apps like PhonePe, Google Pay, Paytm etc.

13. Animal Husbandry

Uttarakhand is well endowed with a variety of livestock like cattle, buffalo, goat and poultry. However, large populations and low productivity across all species are the hallmarks of animal husbandry in Uttarakhand. Cattle are the most popular and so preponderant species. Livestock production in Uttarakhand is the endeavour of the marginal, small and landless farmers; and takes place in millions of small holdings scattered across the state. The dominant farming system is mixed crop-livestock farming. Individual livestock holdings are small (2 or 3 animals), often made up of a mix of different species, the combination made up invariably of cattle (cow, buffalo) and goat. Sheep are held in larger flocks of 10-15 animals along with a few goats in some cases, except by the tribal and nomads where flocks are much larger (100-1000 sheep, goats or both) and migratory (summer grazing in the alpine pastures in the upper reaches).

The distribution of livestock is equitable, almost 80 per cent of total animals of all species are owned by the marginal farmers. A much smaller percentage is held by the small farmers. Landless rural households own milch animals where milk marketing infrastructure exists and indigenous poultry, often, for supporting family nutrition. The livestock sector provides much needed supplementary income to these households which is more equitably distributed compared to income from land. However, prevailing non-descript breeds of animals, short supply of quality green fodder, lack of adequate health care facilities and poor management practices are the major problems, hampering the growth and sustainability of the livestock sector in the state.

Taking this into cognizance, the Livestock component of the project envisaged to improve the genetic potential of the local non-descript animals along with enhancement of quality feed and forage production and encouraging stall feeding practices to reduce livestock pressure on the forest. The objectives of the livestock component envisaged under Gramya II are as follows-

1. To improve the productivity of livestock by upgrading local animals and better feeding and management practices, including health care.
2. To reduce the livestock pressure on the fragile land by reducing the extent of open grazing and encouraging stall feeding for livestock.
3. To improve the contribution of the livestock sector to natural resource management in the project.
4. To finally improve the livelihood of the people of the project area.

13.1 Interventions Undertaken

To attain the objectives of the livestock component the following activities have been undertaken in the project area:

1. Breed Improvement Program:
   * Establishment of Natural Breeding Centres (NBCs)
   * Paravet Centres
   * Mass AI with ordinary and sex-sorted semen.
2. Fodder Production Program:
   * Demonstration of on-farm fodder crops (fodder minikit distribution)
   * Napier crop border plantation in agriculture field bunds.
   * Forage row plantation.
3. Livestock Health Care Program:
   * Organize animal health care camps
4. Stall Feeding Program:
   * Construction of animal shelters/shed, mangers and Chari
5. Others- livestock income generation activities

Livestock breeding program

Livestock breeding is one of the most important interventions of the project for the genetic improvement of non-descript, low producing cattle, buffaloes and goats and for maximizing their lifetime production through scientific rearing. Under its livestock breeding program, the project supported activities like (i) Natural breeding through establishing Natural Breeding Centres (NBC), (ii) Artificial Insemination through Paravet and (iii) Mass Artificial Insemination in Technical collaboration with ULDB.

Livestock Improvement	Unit	Progress till Endline
Natural Breeding Centres	No.	1132(332-Milch animals and 800-Bucks)
Paravets trained (AI service)	No.	44
Mass AI service	No.	2100
Fertility Management Camps	No.	1210

Natural Breeding Centres (Milch animals) & Goat

Natural breeding is one of the preferred options of breed improvement of local non-descript milch (cattle and buffaloes) animals with bulls of high genetic merit. The project has established NBCs at strategic locations covering 4-5 revenue villages in a cluster keeping in view the breeding population in the area. For cattle breeding, crossbred bulls of Jersey, Holstein Friesian and indigenous Red Sindhi have been procured and distributed among the beneficiaries selected for running the NBC, while Murrah breed bulls have been provided for breeding of buffaloes. The bucks of Beetal, Barbari and Sirohi breeds were distributed for breed improvement of local goats. Cow and buffalo bulls were procured under the guidance and in coordination with ULDB, while bucks were purchased directly from ICAR farm, Makdoom, Mathura. A total of 332 NBC (cattle & buffalo) and 800 goats NBC were established till endline against the end project target of 180 NBC.

Table 92: Project Progress under NBC (milch animal & goat)				
Livestock Details	**Total no. of NBC**	**Total no. of covering (Endline)**	**Total no. of progenies (Endline)**	**% Success Rate**
Buffalo Bull (Murrah)	250	15500	10300	66.45
Cow Bull (Red Sindhi)	82	1537	780	50.75
***Bucks (Barbari, Sirohi, Beetal)**	800	22300	18000	80.72
	1132			

Note: *The figures given in the Table 93 related to no. of NBCs, no. of coverings and no. of progenies for both milch animals and goats are the sum of No. of coverings undertaken by the project and animal husbandry department in convergence. *800 Goat NBC includes 42 Stud Bucks provided exclusively for the breeding purpose and the rest 758 bucks that come with Goat rearing units (4 Doe + 1 Buck) provided to VG members as well as stud bucks added by the animal husbandry department under convergence.*

The caretaker of NBC has been selected by the villagers based on their wealth ranking. The NBCs were initially provided with bull shelter along with bearing the cost of transportation, insurance of the bull and 5 bags of compounded feed starter. The NBCs levy a charge from the livestock owners for the covering in two parts- one at the time of covering and one at when the calf is born. This initiative has become a good income generation activity for the beneficiary farmers who are taking care of the bulls.

Natural Breeding Centre as a source of income

Beneficiary: Dev Singh
Location: Dhaspad, Almora division

Dev Singh of village Dhaspad under Almora division is a landless farmer. In 2019, he was provided with a bull to set up a Natural Breeding Centre as an income-generating activity. The beneficiary was provided with a cattle shed for the bull and insurance. He was also provided with a starter feed until the provision would start making money for him. The beneficiary charges Rs. 1500 for every calf born, Rs. 200 at the time of coverage and the rest Rs. 1300 when the calf is born. At the time of visit, this NBC had yielded 56 calves and had a net saving of Rs. 84,000 in 2 years.

Natural breeding has an advantage over AI in that it can reduce the need for heat detection, which is one of the biggest challenges in hill cattle and it has been perceived that it has increased the rate of conception considerably. In some places, improved female claves born out of this arrangement would yield better and fetch more money to the farmers.

Establishment of Paravet Centres for Artificial Insemination (AI) & Veterinary Services:
The project undertook rural extension services like AI and minor veterinary service for livestock development in a comparatively inaccessible area and where the Animal husbandry department is unable to provide the services regularly. These services are being provided with the help of Paravets, local educated (minimum selection qualification is 10^{th} std. pass) and unemployed youth, who have been selected at GP level.

These Paravets were trained for four months in A.I. and minor veterinary services at U.L.D.B. training centre and were equipped with LN2 container and AI Kits through project fund after the successful completion of the training. These Paravets extend their services at 15 to 20 village clusters and charge Rs. 300-350 per insemination and Rs. 100 for Pregnancy Diagnosis from cattle and buffalo owner. The service of these Paravets is also hired by the line department for vaccination and other minor veterinary services. The project has trained 44 Paravets and equipped them to run Paravet Centres across all project divisions.

Table 93: Artificial Insemination by Paravets

Livestock Details	Total no. of coverings	Total no. of Progenies	% Success Rate
Buffaloes	2835	1667	58.81
Cows	6909	3648	52.8

The progress of Paravet centres has been represented in the above Table 94. Paravets have performed 2,835 coverings in buffaloes with a 59 percent success rate yielding a total of 1667 progenies. In the case of cows, the success rate was 53 percent, yielding 3,648 improved progenies after performing 6,909 coverings. Artificial insemination through Paravet services has demonstrated that it is an appropriate, cheapest way of doing breed improvement and ensuring effective use of high genetic merit bull semen. Sectoral sample data of final impact assessment on the type of service received suggests that extension services at the doorsteps of the cattle owner have achieved good coverage among beneficiaries.

Table 94: Percentage of beneficiaries by type of service received

Service	Insemination	Vaccination	Deworming	General Animal Health	First aid services at doorstep
Percentage beneficiaries	74.7	70.2	80.5	82	60.4

Other rural extension services like training in heat detection, pregnancy diagnosis, along with AI have also been improved considerably. Timely detection of heat and insemination at right time has resulted in a decrease in service period and consequently shorter inter calving period. Timely diagnosis of pregnancy has reduced the cost of keeping non-pregnant animals. The money, feed, concentrate etc. can be used only for good animals with higher reproductive and productive returns. This intervention again has allowed local youth to earn through providing AI and minor veterinary services in the community.

Gainful Employment Through Paravet Services

Beneficiary Name: Dhan Singh

Location: Almora division

Shree Dhan Singh an unemployed graduate got training in Paravet services, supported by Gramya II, Almora Division. He extends his services in about 10-12 village clusters and charges Rs. 300-350 per insemination and Rs. 100 for PD from cattle and buffalo owners. His service is also hired by the line department for vaccination and other miner veterinary services. The records he maintains at his Paravet Centres shows that the total no. of insemination carried by him was 270 (both cattle and buffalo) with a conception rate of 52 percent, as is reflected from his pregnancy diagnosis data. In addition to this, he extends his services in the field of post-partum management to the cattle owner along with heat detection and PD. His charged services to the livestock owner fetch him Rs. 5500-6000 per month on an average. This intervention again has allowed local youth to earn through providing AI and minor veterinary services in the community.

Mass Artificial Insemination through technical collaboration with ULDB:
Poor reproductive efficiency among these local animals is the largest single cause of losses to the farmers and hence, dairy activity is still taken as an auxiliary chore rather than a profit-making enterprise. Artificial insemination is an important tool to infuse new and improved genetics into the herd. Recent advances in estrus synchronization protocols and fixed-time AI techniques have increased the number of cows that can be bred during a shorter period.

Following are the advantages of heat synchronization and mass insemination techniques:

- Ensures timely AI service in a group of animals in one single visit of expert inseminator saving of time, fuel & skilled manpower.
- No need for proper heat detection by the cattle owner, which ultimately saves the expected losses which occurs due to error in heat detection.
- It reduces the losses due to anestrus & repeat breeding.
- Timely insemination decreases the cattle dry period
- Improvement of the breeds by the insemination with quality semen.

The application of timed-AI can improve reproductive efficiency in dairy cattle but if proper levels of nutrition, body condition and health are not maintained, the program is likely to fail. Improvement in facilities and management may be necessary before implementing an estrus synchronization program. Keeping the constraints in view the mass artificial insemination programs were started in the year 2017-18 in collaboration with the ULDB in selected villages of the Pauri and Purola division. Under this mass A.I. program, breeding animals in a cluster are induced to heat by the process of heat synchronization and ovulation through hormonal therapy. This is followed by the mass AI of the cattle in heat with ordinary as well as female sorted sexed semen.

Details of coverings and progeny yielded out of mass AI program of the project with ordinary as well as sex-sorted semen have been given below. The Table 96 suggests that Mass AI with ordinary semen among 362 cattle, 168 (89 -M & 78-F) were obtained with a 46.1 percent of success rate (success rate was 44 percent at midterm). The result on Mass AI with sex-sorted semen shows that 1,244 female calves of improved breeds were born out of 2,100 coverings, a 46.1 percent success rate.

Table 95: Details of Mass AI

Mass AI Details	Total no of covering	Total no progenies	% Success Rate
AI with ordinary semen	362	89 (M) & 78 (F)	46.13
AI with Sex sorted semen	2100	1244	59.2

Results of Livestock Breeding Program
Initial improvement by crossbreeding of non-descript cows and buffaloes through NBC, Mass AI and Paravet Centres has been represented in the Table 97 given below. These initiatives have yielded a total number of 9,286 (5,174 buffaloes & 4,112 cows) **Improved Breedable Animals**. Out of total F1 female progenies born, 369 (193 buffaloes & 176 cows) have become the first calver and 1255 (602 buffaloes & 653 cows) have attained pregnancy. However, 2,770 F1 generation female progenies (1,512 buffalo & 1,258 cow) are

non-pregnant heifers and 3,978 (2,341 buffalo & 1,637 cows) are nearing puberty. Whereas Goat NBCs so far have yielded 5,313 improved progenies. 1,356 male goats born have attained serviceable buck age group, 1,785 female goats born have reached puberty (doe) and the remaining 2,172 are at the different growth stages (kids).

Table 96: Results of Livestock Breeding Program

Progeny Details	No. of Female calves nearing Puberty	No. of heifers (F1 Gen.)	No. of pregnant heifers (F1 Gen.)	No. of first calvers (F1 Gen.)	No. of pregnant animals (F2 gen)	Total No. of Improved breedable animals
Buffalo	2341	1512	602	193	526	5174
Cow	1637	1258	653	176	388	4112
Total	3978	2770	1255	369	914	9286

Table 97: Results of Livestock Breeding Program

Progeny Details	Kids	Doe (Reached Puberty)	Buck (Serviceable)	Total
Goat	2172	1785	1356	5313

As it is evident from the above data that these improved female claves have started being recruited in the production group, the animal owner would have an additional milk yield of 50 litres per animal per year, reduce the age at first calving from 10-15 months, 4-6 months less dry period etc. apart from the use of infrastructure facilities developed during the project period. The actual increase in milk production across all divisions due to the improvement in the genetic potential of the low producing milch animals.

Livestock health care program

Animal health care activity is one of the components envisaged by the project for the enhancement of milk production and to reduce the farmers' losses by want of health care service to their livestock holdings. The project has organized several health camps through the project team (Livestock Extension Officers) and paravet centres established under the project. Attempts have also been made for the reduction in infertility of the livestock and the spreading of awareness among cattle owners about the best practices of cattle rearing like proper nutrition and vaccination against contagious diseases.

During the camp, vaccination of different diseases like FMD, BQ, HS ware carried out and sick animals were treated. Medicines and mineral mixtures were also provided to the livestock owners for managing the health of their animals. The project has organized 1210 livestock health camps. Veterinary services like pregnancy diagnosis, vaccination and animal first aid service were 1823, 6950 and 2098 in the case of buffaloes and 5198, 8159 and 5046 respectively in the case of cows.

Table 98: Details of veterinary services provided

Livestock Details	No. of beneficiaries		
	No of Diagnosis at 3 months Pregnancy	No. of Vaccinations done	No. of First aid Veterinarian services given
Buffalo	1823	6950	2098
Cow	5198	8159	5046

Managing the good health of livestock has a direct bearing on the economic return from this sector. The health camps have helped the livestock owners in keeping the good health of the animals with better economic returns. Deworming, Vaccination, treatment of sub-fertile animals and veterinary aid etc. helped in saving energy, time and money in treating affected animals.

Fodder production program

The production potential of crossbred animals can be exploited only if the availability of quality green fodder, especially leguminous crops is maintained round the year. Green fodder ensures the supply of nutrients for dairy animals, as it is very highly palatable and digestible and thereby attributes to the increased milk production at a reduced cost. Shortage of feed and fodder supply is a crucial contributor to the low

productive capacity of livestock production in Uttarakhand. Due to the scattered and fragmented land holdings, and poor irrigation facilities, the practice of growing conventional fodder crops on agricultural land is not in practice in the hilly region of the state. Most of the fodder needs are met from natural grasses growing on individual or community-owned fallow lands. The other sources of fodder/feed for the domestic cattle are agriculture wastes like hay, husks, grasses and lopped branches of fodder trees grown on bunds of agricultural land, Van Panchayat (VP), Reserve Forests (RV) and Civil Soyam Forests. In order to augment the availability of fodder for the livestock Gramya II has undertaken the following initiatives.

Fodder Minikit distribution

The project has distributed fodder minikit for 2 nali area (0.04 ha) in both Kharif and Rabi seasons. During Kharif Season, fodder minikit contained the seeds of Maize varieties Jawahar, Vijay composite, Ganga, Lobiya varieties C.S- 88, C-14, Chari varieties Sirsa, T.L-1. During Rabi season, fodder minikit contained the seeds of Jaie verities Kent, OS-6,7. Berseem varieties Maskavi and Vardan.

Napier Crop Border plantation

Under this activity, the project has promoted the improved variety Napier (hybrid napier, IGFRI-7,10) and the tufts were planted in the agriculture terraces and abandoned land, in the villages. The grass tufts were procured from the Forest department nurseries, U.L.D.B. centres, KVK centres or Kisan Nurseries.

Napier cultivation along the bunds as nonconventional forage production has been a very effective intervention in all divisions, which has helped the animal owners in compensating for fodder during the lean season.

Intervention	Unit	Achievement till Jan 2022	Production In MT
Fodder Minikit (0.04 Ha)	No.	29741	17209
Napier crop Broder Plantation	ha	907.5	8741.37
Forage Row Plantation	ha	171	1368

The project has distributed 29741 fodder minikit (1 minikit for 0.04 ha). Total production of nutritious green fodder from minikit distribution for 1189.64 ha has been 17844.6 MT @15 MT/ha. Also, the project has seen a considerable increase in the area under Napier border plantation and has reached 907.5 ha. with an average annual production of 7260 MT @ 8 MT/ha. While the increase in forage row plantation was found to be 171 ha. yielding 1368 MT.

Interventions for augmenting fodder production have fulfilled the partial requirement of fodder, especially during the lean season. It is expected that increased production vis-à-vis the availability of green fodder during the scarcity period would check the sharp drop in animal production with the substantial economic gain by the animal owners. In order to feed the increasing population of improved breeds in the field resulting out of breeding program and distribution of improved breeds of animals to VG under income generation activity more such innovative efforts are required to increase the fodder production further, so that the genetic potentials of the animals are manifested in increased production.

Improvement in livestock rearing practices

Small-scale dairy farming under the stall-feeding management system has been promoted by the project as means of increasing farming system productivity in the area while at the same time ensuring environmental protection, especially controlling erosion of soil due to grazing.

	Unit	Progress till Endline

Animal Shelter/ shed	No.	13965
Manger	No.	6379
Animal Chari	No.	3522

Animal Shelter/Shed

Animal housing is required to protect the animals from inclement weather and predator animals, in addition, to providing clean, comfortable stay for the good health of animals and efficient management. The project has financially supported the beneficiary dairy farmers to construct the animal shelter of a size of 3.6 x 3.0 x 1.8 sq. m (LxWxH) with a proper ventilation window of 3 feet x 2 feet and a ventilator of 1.5 feet x 1 feet. The shed has also a soak pit of 2 x 2 sq. ft. outside the shed for proper disposal of urine and other wastes. Except for a few cases, the team observed that the construction of sheds is as per the prescribed standards and quality. The project has supported the construction of 13,965 animal sheds throughout the project period.

The beneficiary farmers have experienced immense benefits in terms of protection for their animals from environmental extremities and predators, especially from the forest area. Animal shelters have contributed to managing the proper health of the animals, providing better care and management. The improved animal management through cattle shed subsequently has resulted in the production of good quality clean milk with remunerative price and better profit from dairy.

Stall Feeding (Manger) Program

To discourage open grazing the project has promoted stall feeding in the project area by providing Manger to the animal keepers. Some project divisions e.g. Pithoragarh has supplied mangers made out of steel frame and fibre, which could be conveniently taken to any place because of its lightweight, while most of the divisions have constructed the conventional RCC 'Khurly'. A total of 6,379 mangers were constructed across all project divisions throughout the project period.

Household data and the findings of group discussion suggests that stall feeding facility has enabled the animal keepers to feed their animals conveniently as per the programmed feeding regimen, and hence, proper nutrition. With the efficient use of mangers, animal fodder intake has increased considerably. The manger has reduced the wastage of the precious fodder that women farmers fetch from very difficult hilly terrain and thus, saves her precious time and energy. Stall feeding with the manger saves about 12 percent of fodder getting spoiled. There is reduced livestock pressure on the fragile land because of the lesser time of open grazing. Stall feeding has also helped monitor the breeding of their animals as they can observe their animals in heat and can inseminate them in time with a better conception rate. This has also helped in proper health care management of the animals resulting in better economic returns.

Table 99: Beneficiary feedback of Manger use

Manger use characteristics	**Results**
Manger used (days in a month)	25
Manger (Months in a year)	9.9
Manger constructed with shed/shelter	61.5 %
Saving in labour cost by manger	4874 Rs./ year
Percentage of beneficiaries finding it useful	100 %
Fodder savings in %	12%

Animal Chari

The project has provided Animal Chari in the targeted villages to provide clean and hygienic drinking water to the animals. The project has constructed 3522 nos. of such Charis of the dimension 2.5 x 0.7 x 0.6 sq. m. (LxWxH). These Animal Chari are connected with running water sources, with pipelines and provide clean drinking water to the animals at strategic water-scarce locations.

During group discussion, it was noted that these Animal Chari are very useful, in storing and making available clean drinking water to animals, especially during the summer when water is scarce everywhere in the hills. It saves many animal lives, which otherwise are lost due to unavailability water during summer, incurring economic loss to the farmers. From the discussion, it was estimated that with the construction of Animal Chari there is an average of 0.5-1 hrs of time saved per day, which the farmers had to spend in carrying water from distantly placed water sources and hence, reducing the drudgery considerably.

Livestock-based income generation activities

Nearly half of the arable farming in Uttarakhand takes place in the hill slopes, on tiny, terraced plots of land (subsistence farm), almost all of it rainfed. Arable farming in the hills depend entirely on the small nondescript work bullocks for farm power and no mechanization of agriculture in this area is possible in the foreseeable future. Under such circumstances, Animal Husbandry can emerge as a supplementary and sound source of livelihood in the rural villages, as demand for livestock products in the state is high and none of the products have reached their per capita consumption potential. All livestock products are price elastic and the increasing incomes of consumers is likely to push up demand in urban and rural areas in the state.

Taking this into cognizance, the project has initiated Livestock including fishery-based income generation activities at a very large scale targeting especially the vulnerable group, marginal farmers and socially backward population, who have been left out of the mainstream of development. The beneficiaries for livestock-based income generation activities were selected from among the vulnerable sections of the society, categorized as 'C-category' individuals and groups during PRA at the very inception of the project. The purpose of these initiatives is to promote social equity and assist the most vulnerable groups in the community by empowering them with skills, knowledge and other benefits and get them involved in gainful employment. Under livestock-based income generation activities, the project has aided the targeted households to get involved mainly in the field of dairy, goatery, poultry. Fishery activities for income generation have also been undertaken at a pilot stage.

Table 100: Details of livestock units under VGF

Livestock	Individual units	Group Units
Cow/Buffalo	1009	57
Goatery	1939	41
Poultry	253	53
Sheep	9	-
Bull	10	-

Poultry Production:

Poultry farming is one of the best alternatives for diversification from agriculture and is well capable of counteracting poverty and hunger as it is the source of food, fertilizer, wealth and revenue. There are two separate components in income generation activities under poultry production initiatives. One is the establishment of Poultry Mother Unit (Brooder Unit), which serves to supply brooded month old chick (MOC) to the VG households for backyard poultry production with indigenous breeds like Kadaknath, Vanraja, Giriraja, Kuroiler and Chabro breed and also function as a market channel for the surplus poultry produced in the field. Owing to the high mortality rate of DOC at VG household level and unscientific methods of rearing the backyard poultry always considered as an auxiliary core rather than a profit-making enterprise and hence, the project felt the need of assisting the development of mother units, which apart from providing MOC and market channel would also serve to demonstrate the scientific practices to run the poultry unit on commercially viable lines. The development of Mother units has provided further impetus to move from the subsistence backyard poultry to the enterprise model of village poultry production. These mother units are mostly run by the entrepreneur youths who had migrated to their villages during the pandemic. Specialized trainings were organized for the beneficiaries of the Mother unit in convergence with the Animal Husbandry department to help them run the enterprise sustainably on commercially viable lines.

The project assisted the beneficiaries of the mother unit, generally in groups or sometimes individual beneficiaries with grants to purchase day-old chick worth Rs. 70,000, 750 sq. ft. shed costing Rs. 1.5 lakh and Rs. 35,000 towards purchasing poultry feed for two months. Beneficiary's contribution is 10 percent of the project cost of the mother unit, in terms of cash or labour.

The other component focuses on assisting VG households to establish backyard poultry units to supplement their household incomes. Under this arrangement, the project has provided assistance to the VG household in groups or at an individual level in terms of 100 nos. of month-old chick, Rs. 10,000 worth of materials for building litter and netting to protect the chicks from predators. The units have also been supported with a 135 sq. ft. prefabricated shed (enclosure) costing Rs. 30,000 as a night shelter. Most of such units follow semi-intensive methods of rearing, except for a few poultry units established with commercial Broiler birds and are in intensive methods of farming.

As many as 316 VG members (261 beneficiaries under individual activity and 55 beneficiaries under group activity) received grants under the VG/Pilot funds to establish poultry units in the total project area.

Pilot Project on Kadaknath Mother Unit in Rudraprayag Division, A Case Study-
The Mother unit was established in GP and RV Deva & Shihoo to enhance the livestock livelihoods in Rudraprayag by encouraging Kadaknath, an indigenous poultry breed, under ''backyard poultry farming'' among the unorganized sector of marginal farmers, women and socially backward population of the district. The total project cost was Rs. 5,00,000.

An 18-month cycle of production of Kadaknath and business flow with 400 chicks earned Rs. 381600 in rearing 4 lots from the sale of chicks. Gross income from the sale of chicks is Rs. 142200, Rs. 92400, Rs. 81,600 and Rs. 65400 from 1st, 2nd, 3rd and 4th lots respectively. Total expenses of purchasing DOC, feed and other required consumables in the 18 months cycle for all 4 lots were Rs. 122000. The enterprise earned Rs. 259600 as net income in an 18-month cycle with an average monthly income of Rs. 15000.

Economic Analysis of 100 Bird (Kadaknath) Unit Micro-enterprise run under VG Activity.
Shri Kishan Chand, a resident of village Bhaidgaav under Kandali Nadi Unit in Pauri Division was selected as one of the beneficiaries under vulnerable group for income generation activity in backyard poultry production. He established a Kadaknath poultry unit under the free-range method of rearing as a micro-enterprise with financial assistance from the project to supplement their household incomes. The project provided her Rs. 40,000 financial assistance to construct 135-150 Ssq ft. prefabricated shed (enclosure), purchase 100 nos. of month-old Kadaknath chicks from mother unit, purchase of commercial poultry feed for two months and materials for building litters etc.

Based on the interview with the beneficiary household, the study team has conducted the Cost-Benefit Analysis of Kadaknath bird rearing micro-enterprise unit (100 birds).

Table 101: Economic Analysis of Backyard Poultry with 100 Kadaknath Birds

Capital Investment	
Cost of poultry shed (150 sq. ft. @ Rs. 130/sq. ft.)	Rs. 19500
Poultry equipment (feeder tray, water, etc)	Rs. 2000
Total Investment	**Rs. 21,500**

Table 101: Economic Analysis of Backyard Poultry with 100 Kadaknath Birds	
Recurring Expenditure	
Cost of 100 chicks (4 -6 week old) @ Rs 75/chick including transport	Rs. 7500
Cost of poultry feed (3 kg/bird) @Rs. 25/kg (100*3*25)	Rs. 7500
Local feed/broken cereals & pulses	Rs. 4500
Medicines & vaccination @Rs. 3/bird	Rs. 300
Total Recurring Costs	**Rs. 19,800**
Income	
Mortality of Birds 13 percent	
Sale of 25 male birds at the age of 20 weeks (Av. Live body wt. 1.50 Kg X 25 @ Rs. 200/Kg)	Rs. 7500
Sale of 20 male birds at the age of 28 weeks (Av. Live body wt. 1.80 Kg X 20 @ Rs. 200/Kg)	Rs. 7200
Sale of 42 hens after one year (Av. Live body wt. 1.50 Kg X 42 @ Rs. 200/Kg)	Rs. 12600
Sale of eggs from 42 hens in one year (105 eggs/bird @ Rs. 6 per egg)	Rs. 26460
Total Income	**Rs. 53760**

Table 102: Economic Indicators of Backyard Poultry with 100 Kadaknath Birds[@]		
Indicator	**10 Years**	**5 Years**
Net present value (NPV) in Rs.	170,382	100,918
Benefit-Cost ratio (BC ratio)	2.28	2.09
Pay-back period (Years)	0.40	0.40
Internal rate of return (IRR) in percentage	130	129

@ Interest rate (opportunity cost) assumed 12% pa

Family poultry (backyard) is rarely the sole means of livelihood for the family but is one of the numbers of integrated and complementary farming activities contributing to the overall well-being of the household. Poultry activity has provided a major income-generating activity from the sale of birds and eggs. Eggs provide a regular, albeit small, income while the sale of live birds has given a more flexible source of cash as required. Occasional consumption of meat and egg has augmented as a valuable source of protein in the diet of the family. As poultry-keeping uses family labour, and women (who often own as well as look after the family flock) are the major beneficiaries, this activity has helped in social empowerment and equity.

Goat Rearing

Since the project area is predominantly an agriculture belt, mostly under the rainfed condition with none to low industrial base, only seasonal employment is available to the marginal farmers and landless labourers. In a situation like this, goat rearing would be one of the most preferred livelihood options and source of gainful employment. The goat is a multi-functional animal and plays a significant role in the economy and nutrition of landless, small and marginal farmers. Goats are prolific breeders and achieve sexual maturity at the age of 10-12 months. The gestation period in goats is short and it starts giving milk at the age of 16-17 months. Twinning is very common, and triplets and quadruplets are rare. Because of all these reasons, goat is considered as the ready cash always available with the owner of the herd.

Realizing the importance of goats in the agrarian economy, Gramya II emphasized goat rearing as an income-generating activity for vulnerable groups, both as an individual and group activity. However, the local goat

varieties have low fecundity and high FCR in terms of weight gain. They could hardly attain the body weights of 15-20 kg which failed to fetch enough profits for the people because of the low genetic potential of these animals. The project decided to improve the genetic potential of local goat variety by providing the improved buck in the field under the NBC scheme. The project promoted VG groups to take goat rearing as a source of additional income.

Most of the units that the project supported, comprise better performing indigenous breeds like Beetal, Barbary and Sirohi known for their high proliferation rate and vigorous growth to attain maturity in quicker time. Each goatery unit has been provided with 4 doe and 1 buck worth Rs. 30,000 where the stud buck not only serves the adult doe in the unit but is also utilized for breeding and improvement in the genetic potentials of the local nondescript low producing goats in the area. However, goat rearing as a group income generation activity was provided with a grant of Rs. 100000 per group. Though the goat rearing activity has developed well across all divisions, it has shown exemplary success in Pauri, Almora and Thatyur divisions.

A total of 2129 VG members (2081 beneficiaries under individual activity and 48 beneficiaries under group activity) received funds under the VG fund for Goatery in the project area. The upkeep of goats is relatively easy as compared to other livestock, and thus goatery is looked at as a great economic value to the farmers.

Mrs *Parvati Devi* is a single mother of three minor children from Dhaspad village in Almora division. Her husband is missing for 8-9 years and due to poverty, she was working as a daily labourer. She was chosen by the project staff for a VG grant of Rs. 30,000 from the project which she utilized for the purchase of 4 does and a buck of local breed. The result of this endeavour was that she has now adopted goat rearing as her livelihood. She currently possesses a herd of 15 goats and has sold 15 goats until now @ Rs. 4000- 5000 each. Encouraged by her steady earnings, she later demanded a buck of *Sirohi* breed for breed improvement of her herd and was provided with the same under the Natural Breeding Centre initiative. She is now happy and confident in sharing her life experiences. On a recent visit of the District Magistrate of Almora, she stated - "*Goat rearing has emancipated me from the daily labourer's work and now I can sustain on the steady earnings from my goats.*".

Goat rearing as IG activity for VG groups has created employment for the rural poor besides effectively utilizing unpaid family labour. There is ample scope for establishing cottage industries based on goat meat and milk products.

Dairy

Dairy development is a sustainable and equitable means for achieving economic growth, food security and poverty reduction because it provides a regular source of income, provide nutritious food, diversifies risk, improves the use of resources, generates on- and off-farm employment opportunities for women (e.g., milk money) and provides financial stability and social standing (e.g., store savings, asset creation).

The project Gramya II has provided Rs. 30,000 for individual VG members and Rs. 100000 for a group activity, for purchasing improved breeds of milch animals under income generation program. A total of 2511 vulnerable groups received benefits under the dairy activity (2453 beneficiaries under individual activity and 58 beneficiaries under group activity).

Smt. Lalita Devi, a resident of village Kapkot under the Bageshwar division belongs to a weaker section of the society. She received financial assistance of Rs. 30,000 from Gramya II initially to start a dairy enterprise under income generation activity for VG members. Later she also got the support of Rs. 35,000 from the project for constructing the cattle shed. With this financial support, she purchased the indigenous Sahiwal breed of cattle and also constructed the cattle shed to house the animal. The average lactation yield was 1200 litres of milk for 280 days lactation period with an average production of 4.2 litres per day. She earned Rs. 36,000 in one year by selling about 900 litres of milk in the local market and kept about 300 litres of milk for home consumption worth Rs. 12,000. Apart from yielding milk, the cow has given birth to 2 improved female calves, one has reached the heifer (pregnant) stage and another one attained the pubertal stage, thus increasing the asset value to the family. As compared to the non-descript breed of cattle, which she used to keep earlier, the

improved Sahiwal cow has given additional income of about Rs. 1200 to Rs. 1500 per month per cow in terms 6-8 times more milk, reduce the age at first calving from 10-15 months, 4-6 months less dry period etc. apart from yielding improved progenies with better production traits.
Dairy farming with improved breeds of milch animals, as income generation activity for vulnerable group members, has increased women's participation in income-generating activities. Dairy farming has also contributed to reducing the time women spend in low-productive activities. Project's genetic improvement programs through NBC and AI, fodder development and other infrastructural development have developed an ecosystem for better growth of the dairy sector in the targeted villages. With better organization of milk collection and marketing, members especially women can be released from selling small quantities of surplus milk in the informal market, thus better return from this sector.

Fishery:
Gramya II has initiated fish production as a source of livelihood and income generation on a pilot basis across all project divisions. The survey team has studied the fishery project initiated by the Pithoragarh division in detail. Pithoragarh division has started this intervention in 18 ponds developed for augmenting the irrigation in the rainfed area, involving 18 beneficiary farmers from 10 villages during 2017-18-2020-21. The said ponds were stocked with grass carps, common carps including Rohu in July 2017 in convergence with the department of fisheries, Uttarakhand govt. The fishery initiative has yielded 800 kg of fish during 1st year of intervention, fetching the farmers with a total income of Rs. 1,80,000 at a selling price of Rs. 225 per kg. In the subsequent two years, the production was 1960 kg and 1680 kg with an income of Rs. 491500 and Rs. 446500 respectively at the selling price ranging from Rs. 250-300 per kg.

The economic and other benefits from the fishery activity have motivated several other farmers in the nearby villages to undertake fishery as an income generation activity. The project has also established convergence with the Fisheries Department for the farmers to procure fish fingerlings and other facilities.

13.2 Impacts

Change in animal ownership

The project has been very successful in demonstrating the benefits of keeping livestock through integrated interventions in terms of increased milk and meat production. Moreover, a sizeable growth of improved breeds of livestock resulting out of the project's genetic improvement program has put further impetus in the change in ownership of livestock, as is reflected from the HH survey data reflected from the Table 104 given below.

Table 103: Asset ownership- cattle

The average number of cattle owned						
Overall	**Baseline**		**Midterm**		**Endline**	
	Project	**Control**	**Project**	**Control**	Project	Control
Improved Variety	2	1	4	1	5	3
Indigenous Variety	4	4	5	4	4	4

Change in milk yield

Genetic improvement of milch animals, increased availability of nutritious green fodder coupled with better health care management and other general management has started manifested in terms of increased milk production across all milch animals, whether improved or indigenous, as is reflected from the Table 105 given below.

Table 104: Impact on milk productivity

	Baseline	**Endline**	**Incremental difference**
Average milk production all cows & Buffalo, Indigenous (in litres per day)	1.6	2.25	0.65
Average milk production all cows & Buffalo, high yielding variety (in litres per day)	NA*	7.04	7.04

*improved breeds of cattle were not assessed at the baseline level

Economic benefits from animal husbandry

While interacting with the villagers, the team observed that the Animal Chari are of great importance, especially during the summer when the water source dries off and it costs the lives of many animals incurring huge economic loss to the farmers. It was estimated during the discussion that the facility of drinking water storage has helped save on an average of 1 hr. of time per day for about 360 days a year, which otherwise they would have spent in fetching drinking water from distant sources.

Regarding the use of mangers, it was observed that fodder intake of animals is being managed and wastage has reduced considerably saving precious fodder that they fetch from very difficult hilly terrain and thus saving the labour. As per an estimate, livestock owner saves about 2 bundles of hay worth Rs. 5 per day which otherwise would get spoiled.

Availability of fodder in nearby fields has reduced the time spent on fodder collection from the forest by women and other members of the family due to which they can save 1 hrs. per day for about 200 days in a year. This has not only resulted in a reduction in hill women's drudgery but has helped them to engage themselves in other gainful activities.

Table 105: Beneficiary feedback on the use of manger	
Satisfied with the manger provided	86.40%
Women find it convenient now to provide fodder and take care of animals	87.30%

Table 106: Beneficiary feedback on the use of chaff cutter	
Very satisfied	54.20%
Somewhat satisfied	34.70%
Not satisfied	11.10%

Reduction in drudgery

Napier plantation and the mini kit has not only attributed to the increase of milk productivity (12-15 percent), but it has also decreased the dependency of livestock owners on the forest for fodder collection. Because of the availability of fodder on the farm or in nearby locations, time spent on fodder collection from the forest was saved in the range of 1 hrs. per day for 200 days in a year.

Table 107: Impact of stall feeding							
Time consumed for fodder collection has been reduced for women and other family members				**More families are doing stall feeding now and not depending on forest**			
High	Moderate	No Impact	Total	High	Moderate	No Impact	Total
40.5%	52.6%	6.8%	100.0%	41.1%	52.6%	6.3%	100.0%

Nutritional benefits

Protein intake of beneficiaries

The protein intake of beneficiaries who have milch cows and buffaloes at home is observed to be more than those not owning the livestock. These protein rich products include eggs, goat meat, chicken meat, milk and dairy products which have been made more accessible to the beneficiaries through the various animal husbandry activities of the project. 28 percent of households owning livestock consume protein in their meals three times a day as against 13 percent of households who do not own any. 25 percent of households owning milch buffalos consume protein in all three meals. The proportion is lower as buffaloes are mostly reared for commercial dairy and home consumption is higher for cow's milk than for buffaloes.

Table 108: Frequency of protein intake (Milk) among HH owning livestock			
Overall	**Once in a day**	**Twice a day**	**Thrice in a day**
percent households (owning livestock)	11.2	60.1	28.7
Percentage households (not owning livestock)	35.6	51.3	13.1

Additionally, 24 percent of the beneficiaries have also reported that there has been an increase in their milk consumption in the last five years owing to more milk availability.

13.3 Conclusion

The project has taken an integrated approach to livestock development, which includes controlled breeding, adequate feeding and proper health care along with improved general management to enhance the lifetime productivity of the livestock. These concerted efforts have resulted in the improvement in productivity, health and wellbeing of livestock and thereby improvement in the overall livelihood of the people in the project area.

Breed improvement of local nondescript milch animals including goats, health care services, stall feeding and augmentation of nutritious green fodder are the interventions envisaged under animal husbandry components of the project. Under its livestock breeding program, the project supported activities like (i) Natural breeding through establishing Natural Breeding Centre (NBC) with bulls and bucks of high genetic merits (ii) Artificial Insemination through establishing Paravet Centres run by well trained and equipped Para-veterinarians, who also undertake minor veterinary services in the field and (iii) Mass Artificial Insemination in collaboration with ULDB.

Genetic improvement programs of the project have produced a sizeable number of (9286) improved breedable milch animals, whereas goat breeding through NBCs has yielded 5313 improved progenies in the project area. The success rate of NBCs and Paravet Centres in terms of number of services undertaken and number of offsprings born was remarkable in that they altogether attained 55 percent and higher. Out of total F1 female progenies born 369 have become the first calver and 1255 have attained pregnancy, yielding 5-6 times more milk, reduced 8-10 months age at first calving and less dry period by 4-5 months leading to more profitability from the dairy enterprise, as reported by the farmers during the interviews and group discussions. This indicates the overall success of the breed improvement program in the project area.

Animal health care activity is one of the components envisaged by the project for the enhancement of milk production and to reduce the farmers' losses by want of health care service to their livestock holdings. The project has organized several health camps through the project team (Livestock Extension Officers) and paravet centres established under the project. It was found that there was a reduction in infertility of the livestock across the target villages and increased awareness among cattle owners about the best practices of cattle rearing like proper nutrition and vaccination against contagious diseases. The health camps have helped the livestock owners in keeping the good health of the animals with a better economic return. Deworming, Vaccination, treatment of sub-fertile animals and veterinary aid etc. helped in saving energy, time and money in treating affected animals

The project has also promoted scientific livestock rearing practices and constructed animal sheds/shelters and provided mangers and animal chari on a worthwhile scale. The livestock sheds/shelters were in great demand as they provided hygienic space to keep cattle, protected them from harsh weather conditions and prevented them from getting attacked by predators and being stolen. During the group discussions, it was found that stall feeding through mangers ensures hygienic feeding space for the cattle and were beneficial in reducing the fodder to get spoiled and discouraging the practice of open grazing, partially responsible for soil erosion. Animal Chari providing clean drinking water to animals, especially during water scarce summer months have not only saved the precious animal lives but also saved valuable time of animal owner spent on fetching water from sources situated faraway places.

Augmentation of fodder production was one of the key highlights of the projects which envisaged on-farm fodder production through distribution of fodder minikits, Napier crop Broder Plantation and forage row plantation. Due to the introduction of fodder minikit containing improved fodder grasses for on-farm production and Napier crop on-farm boundaries plantation and uncultivated land as well as forage row plantation availability of green fodder have increased significantly. Availability of fodder has also increased in the form of agriculture waste residues (as more agricultural land has been brought under irrigation) and protection of common land from grazing, forage and pasture development programmes in Van Panchayats and Civil Soyam lands, attributing an increased milk production.

The number of improved breeds of livestock has increased as compared to the baseline level mainly due to breed improvement program of the project and line department as well. The good performance of milch animals amongst the VG groups has also contributed to the increase in the number of improved breeds in the project area. With the integrated livestock development program of the project has not only resulted in the increase of their lifetime production of milk, meat and other livestock products but also has helped the beneficiary in gainful activities of livestock rearing with better economic return, thus enhanced livelihood and increased consumption of animal meat and milk products.

14. Alternate Energy

The two main challenges, climate change and renewable energy are deeply connected, as renewable energy constitutes a significant tool for coping with climate change mostly as a mitigation strategy but also as an adaptation strategy. A significant share of greenhouse gas emissions originates in conventional electricity systems, such as power plants based on fossil fuels. Replacing these systems with alternative energies (i.e., renewable energies) is well known for helping mitigate climate change effects by reducing greenhouse gas emissions into the atmosphere. Unlike conventional electricity systems, renewable energies tend to be more decentralized and operate with diversified capacities, which prevents overall failure in cases of damage to a single facility.

In the hill State of Uttarakhand water, agriculture, forestry and energy are some of the issues, addressing of which is the core strategy for the state's future growth. The project area for Gramya II is characterized by remote locations and consequently a high dependence on natural resources for meeting the household energy (fuel and fire) requirement as well as livelihood needs. The project design included the introduction and promotion of various environmentally sustainable and energy-efficient approaches like IPNM, use of various alternate fuel-based devices, initiatives towards fuel switch, various soil and moisture conservation activities to improve the moisture regime for agriculture. The project encouraged the adoption of environment-friendly energy sources through demonstration and distribution which has eventually resulted in less exploitation of the forest resources and reduced drudgery for women.

At the project planning stage, it was envisaged that there would be various environmentally sustainable and energy-efficient approaches like organic farming, use of various alternate fuel based devices, initiatives towards fuel switch, various soil and moisture conservation activities to improve the moisture regime for agriculture. Under water source sustainability, the promotion of alternate energy sources such as biogas plants, solar cookers, water mills and pine briquette production to reduce dependence on forest fuelwood and promotion of energy conservation was planned.

As a result of the planning process in the community and based on their demand incorporated through the GPWDP plan, the project encouraged and implemented the adoption of environment-friendly energy sources such as biogas plants, solar power (lantern, street lights, solar-powered lift irrigation), gharat and pine briquette making. Such alternate energy sources meant less exploitation of the forest resources and reduced drudgery for women. The alternate energy component was incorporated as per the learnings from Gramya, feedback from project functionaries, community members and the suggestions from PRI members, field studies and feedback from Consultation Workshop with stakeholders. Some of the key considerations during the planning process towards the incorporation of alternate energy in the Project were,

- Conserving the adjoining forests and providing to meet the needs of the people
- Installation of energy-saving devices to share the labour put in by womenfolk to collect fuelwood.
- Ensuring that the installed bio-gas plant is of good quality standards and leakproof to avoid accidents due to leakage of methane.
- Focussing on capacity building for the proper use of alternate energy measures.
- Charring in pine briquette making to be done under fully covered pit or tighten quill to reduce harmful smoke.
- Components of waste/unused batteries of solar equipment are hazardous to health and hence their safe disposal should be ensured.

The implementation of these activities was through individual beneficiaries and groups. While biogas, solar lanterns were assisted to individuals, solar street panels, solar-powered lift irrigation, gharat and pine briquetting were group-based/community-level and hence maintenance of alternate energy equipment, machines and tools have been the responsibility of the concerned individual/ User Groups/VGs. Monitoring of safeguard applications at the village level was done by the WWMC. The Project has ensured the training and capacity building, monitoring, and application in planning, implementation and management of project activities. Alternate energy measures were also monitored by third-party monitoring on a sample basis using prepared questionnaires and assessment modules conducted at Mid-Term Evaluationand Final Assessment.

14.1 Interventions Undertaken

The following Table 110 details the component-wise activity and achievement. It is interesting to observe that the achievements have surpassed the initially planned interventions as per the GPWDP plan. This is because the interventions were demand-driven, prioritization of the same and increased awareness among the community regarding the use of alternate energy resources thus contributing to a clean environment.

Table 109: Progress of Energy conservation intervention		
Component Activity	**Unit**	**Progress till Endline**
Energy conservation		
Biogas Plant	No.	87
Solar Lantern	No.	7758
Community Solar Street Panel	No.	7083
Pine Briquette Machine	No.	22
Solar Cooker/Pressure cooker	No.	1634
Renovation of Water Mills (Gharat)	No.	29
Solar Lift Irrigation	No.	24

Biogas

Biogas is a clean, environment-friendly fuel obtained by anaerobic digestion of animal residues and domestic and farm wastes, abundantly available in rural areas. Biogas is a renewable energy resource that comprises 55-65 percent methane, 35-45 percent carbon dioxide, 0.5-1.0 percent hydrogen sulphide and traces of water vapour. With an average calorific value of 20 MJ/cum (4713 kcal/cum). The biogas generated from cow dung replaces fuels that are currently used for domestic energy needs such as firewood, kerosene or LPG cylinders. The slurry from the biogas is a high source of nutrients for the soil and is used as such. In areas of high-intensity livestock farming biogas plants also help in reduction in ammonia emissions, preventing build-up of nitrates, which then leached, become a major groundwater and surface-water pollutant

The benefits of the adoption of biogas include,

a. better utilization of farm& livestock residues, a renewable energy resource
b. efficient bio-resource for soil quality improvement
c. recycling phosphate and fertilizer production.

Gramya II was successful in the installation of 86 Biogas plants (plants of 3 cubic m. capacity at Rs. 42,000 per unit cost). During the initial phase of establishment, it was observed that the feedstock for the biogas digester was relatively low, resulting in a low rate of gas generation per unit mass of dung, and a long reaction time of about 40-45 days. Thereafter the distribution of biogas units was limited to households that had a sizable number of animals.

The use of these biogas plants is adding further local benefits and helping to reduce the consumption of wood as a fuel. It’s just not the emissions that are being reduced; the project's benefits are, a substantial decrease in deforestation in and around the project area and an increase in carbon sequestration. The by-product slurry (as against the undecomposed farmyard manure) from the biogas plant serves as better nutriment to crop husbandry resulting in improved farm productivity

Table 110: Beneficiary feedback on the use of biogas	
Feedback parameter	**% households in agreement**
Availability of better and more economical fuel for cooking, lighting and power generation	91
Availability of good quality enriched manure to improve soil fertility	72
Helps maintain hygienic conditions on the farm and near the homes	64
Enables environmental benefits such as reducing the burden on forest	81
Enables social benefits such as reduction in drudgery of women	78
Reduced time spent on collecting wood	84

Of the beneficiaries who have received biogas units, 80 percent beneficiaries have agreed that biogas has saved them money by reducing the need for purchased fuel such as kerosene, LPG, etc., saved effort by reducing the fuelwood requirement from forests and also helped maintain health and hygiene for them and their livestock.

Solar lanterns

Solar lanterns are a simple application of solar photovoltaic technology, which has found good acceptance among the targeted community where the power supply is irregular and scarce. The lanterns are made of three main components - the solar PV panel, the storage battery and the lamp with simple operation. The solar energy is converted to electrical energy by the SPV panel and stored in a sealed maintenance-free battery for use during the night hours or as required. A single charge operates the lamp for about 4-5 hours.

A small study was carried out with 120 beneficiaries, selected purposively, to assess the awareness of the respondents regarding solar energy, solar lighting, its availability, benefits and important facts about solar lighting gadgets. The awareness of rural people regarding solar light was measured based on an awareness scale. All the responses received were categorized and analysed using both descriptive and rational statistics including frequency, percentage and Chi-square test.

Table 111: Awareness level of respondents regarding solar-powered lights

	% of beneficiaries	
Awareness Parameters	**Aware**	**Not aware**
About solar energy	78.3	21.7
Solar energy is used for lighting purposes	93.3	6.7
Solar energy is converted into electrical energy	71.7	28.3
About solar lantern	90.4	9.6
About solar home lighting system	85.0	15.0
About solar torch	95.8	4.2
Solar energy gadgets available in market	85.0	15.0
Solar lantern is portable and lightweight	80.8	19.2
Solar lantern does not require electrical wiring	78.3	21.7
After the initial one time investment in the solar lighting system, the power is free	93.3	6.7
Solar lighting saves your electricity bills	90.0	10.0
Solar light is 100% safe and 100% pollution-free	97.5	2.5
Solar light reduces the risk of fire accidents	92.8	7.2
Using solar energy resources would decrease the use of fossil fuels	82.0	18.0
Using solar energy resources would remove the negative effects of the greenhouse gasses	81.7	18.3
Solar energy is stored in a sealed and maintenance-free battery	88.3	11.7

It was found that more than 75 percent of respondents were aware of solar energy, solar lighting, its availability, benefits and subsidy on it and important facts about solar lighting gadgets. Only about 28 percent of respondents were not aware of the fact that solar light is converted into electricity. From the whole, it was concluded that the majority of people were aware of solar energy and solar lighting, especially in lower and middle income groups. This can be attributed to awareness and initiatives under Gramya II for the promotion of solar lighting.

Economics of Solar Lantern usage

The project has distributed 7758 mobile solar lanterns at a per-unit cost of Rs. 2550. The lanterns have a 9W LED light bulb and a USB power outlet that can charge mobile and other USB charged electronic devices. The light bulbs can light up for ~5 hours with one full charge of the battery.

Savings on electricity:
The electricity consumption for a 9W LED bulb running for 5 hours a day for 325 days in a year is 14,625W (9W x hrs x 325 days). Adding an energy loss at 10 percent, the total consumption is equal to 16,608W or 16.1 kWh, i.e., 16 units. Considering the energy tariff of Rs. 5.65 per unit in Uttarakhand the cost of electricity works out Rs. 91 per annum. Thus, the lantern is saving the beneficiaries an electricity bill of up to Rs. 91/ lantern/annum.

For 7758 solar lanterns that have been distributed by the project, the annual savings in electricity is Rs. 7,05,978.

The estimated lifespan of the battery is 4-5 years. Thus, the total returns from the lantern would be Rs. 3.47 million over a period of 5 years.

Community solar panel street lights

The project has installed 7083 solar panel street lights in the project villages. A small assessment study was conducted as part of the final impact assessment, primarily to understand the impact of solar street lights on the socio-economic well-being of the rural community.

Qualitative methods were used in the assessment which included

i) assessment in each village started with interaction with village representatives which gave the overview of the functionality of the systems, the institutional model and impact from the perspective of leaders,
ii) FGD was conducted with the group comprising of men and women with the primary objective to gauge the perception of the users on various aspects associated with solar street lights,
iii) an observation of the village streets where solar street lights were placed, and
iv) the individuals' perception was mapped.

Results of the assessment of solar street lights

Mobility:
About 96 percent of the respondents mentioned that they find it easy to walk during the evening and night hours in the village street due to better illumination.

Safety:
About 88 percent of the respondents mentioned that their movements during evening hours on rainy days have become much easier.
90 percent of the respondents said that they feel safe walking during evening and night times. Before the installation of solar street lights, people were hesitant to walk alone in the streets. Thus the reduction of man-animal conflict can be attributed to this intervention. 86 percent of respondents also feel much safer letting children be outdoors in the evening or go by themselves to the nearby grocery shops after dusk.

Social gathering:
78 percent of the respondents mentioned that the frequency of informal social gatherings outside the household premises has increased after the installation of solar street lights.

The solar street lights are now the source of quality illumination in the villages during power cuts in evening hours. Whenever there are power cuts, the inhabitants depend on the light received from the solar street lights and often gather outside their houses under the light for leisure time. The lights have also helped to organize meetings and trainings during evening hours which was rarely possible earlier. The respondents also mentioned that they feel safe for their children now and allow their kids to play outside during evening hours. After the installation of solar street lights, there is reduced fear of snake and animal attacks.

Economics of Solar Street Lights

Unlike the Solar lanterns which helped the individual households, this intervention is a community intervention aimed to illuminate the streets which were hitherto not provided with street lights.

Savings on electricity:

The project has installed 7,083 community solar panels and street lights in the project area at a per-unit cost of Rs. 14,435. The unit consists of a battery (either lead-acid battery or lithium phosphate battery included with a 3-year warranty), solar panel, and 24W LED light erected over a GI pole with concrete footing.

The electricity consumption for a 24W LED bulb lit for 12 hours a day for 325 days in a year is 93,600 W. (24W x 12 hrs x 325 days). Adding an energy loss at 10 percent, the total consumption is equal to 1,02,960 watts or 102.96 kWh, i.e., 103 units of electricity. Considering the energy tariff of Rs. 5.65/unit in Uttarakhand the energy cost works out Rs. 581.95 per annum per street light unit.

For 7083 solar street lights installed by the project, the annual savings in electricity is Rs. 41,21,952 (Rs. 4.12 million).

Considering a battery life of 3 years, the total savings from the installation over the life period will be Rs. 11.8 million.

The installation package has a 3-year warranty included and the only cost incurred by the beneficiaries is the time to time topping up of distilled water for the street lights installed with lead-acid batteries. This additional expenditure does not apply to those installations with Lithium phosphate batteries. Another benefit of this unit is the saving of cost for the installation of poles and wiring that is required for the street lighting poles which are connected to the power grid.

The larger benefits of installing solar street lights accrue from
a) the savings in bringing in electricity by installing poles and cables in locations not covered earlier and,
b) improved reliability in solar power as compared to electricity lines during monsoons/landslides etc.

With the advancements in technology, the lifespan of the batteries used in Solar street lighting systems are bound to increase, making it a worthwhile investment option

Solar cooker/pressure cooker

The project has distributed 1634 units of cookers for reducing the cooking fuel requirements. The solar cookers work on the principle of using solar energy for cooking food by converting UV light rays into longer infrared light rays that generate heat and cook the food.

Following are some of the utilities of the solar cooker as articulated by beneficiaries on discussion;

a. Reduced requirement of cooking gas, kerosene, electricity, coal or wood.
b. Reduced expenditure on fuel, as solar energy is available free.
c. Solar cooking is pollution-free and thus safe for the users (no smoke as in the case of firewood chulhas)
d. There are government schemes that offer subsidies to purchase solar cookers too

Solar-powered lift irrigation systems

Hill farming, especially in the state of Uttarakhand is mainly dependent on rainfall. Farmers cultivate crops in the Kharif season and rabi season is either fallow or for growing vegetables which can be sustained on

limited water availability. While middle and valley villages can harness the many traditional streams for water, villages in the higher altitudes go dry because of limitations in carrying water uphill. The project envisaged a pilot intervention to address this issue by providing solar-powered water lifting systems to provide water for villages in the higher altitudes by carrying water from lower rivers and streams into a storage tank at the village level.

The solar-powered system lifts water from rivers, transports it up unbelievably steep slopes to rural communities where it feeds into a multi-use water system. These systems then provide clean water for irrigation and farming, and when excess water is available, for livestock and other household needs as well as has increased the cropping intensity to 161 percent in rainfed agriculture. Under the project, 24 solar-powered lift irrigation systems have been established which have helped irrigate 241.68 ha area.

The advantages of using Solar Powered Lift Irrigation include;

a. It is pollution-free and causes no greenhouse gases to be emitted after installation
b. Reduced dependence on oil and fossil fuels
c. Renewable clean power that is available around the year
d. Return on investment unlike paying for utility bills
e. Long-term lower costs, when compared with diesel or electrically (thermal) powered pumps.
f. Virtually no maintenance as solar panels have a good life span
g. Conversion of rainfed and fallow land under irrigation

A typical system configuration includes a Photo Voltaic array, a motor and pump, and a water storage tank to collect the pumped water. Solar panels used in these systems last around 25 years, requiring little maintenance throughout this time. Solar water lifting systems have proven to be operationally, financially, and environmentally sustainable in comparison to diesel or electric-powered pumps.

A typical system configuration includes a Photo Voltaic array (PV), a motor and pump, and a water storage tank to collect the pumped water. Economic analysis of the system was carried out to test the feasibility of the system. Following assumptions were made to carry out the economic analysis of the system – The operating life of the PV panels was assumed to be 25 years and the life of the diesel engine was assumed to be as 10 years.

PV system requires little maintenance throughout its lifetime. However, the maintenance cost of the PV system is assumed to be 0.1 percent of total capital cost as against 10 percent per annum of the capital cost for diesel engine over 20 years period.

It is assumed that the PV system would be operated for 240 days in a year and the average sunshine hours are considered to be 8 hours per day.

The capital cost of a system includes the initial capital expense for equipment, system design, engineering, and installation. The energy cost of a system is the sum of the yearly fuel cost. Replacement cost is the replacement cost anticipated over the life of the system. The life cycle cost analysis of PV system vis a vis Diesel engine are presented in the Table 113 below;

Table 112: Effectiveness of the Solar lift irrigation pump

Particulars	PV System	Diesel Engine
Capital cost	851,650	40,000
Maintenance cost	17,033	80,000
Fuel/energy cost	0	3,993,600
Replacement cost	0	40,000
Total Life cycle cost	868,683	4,153,600

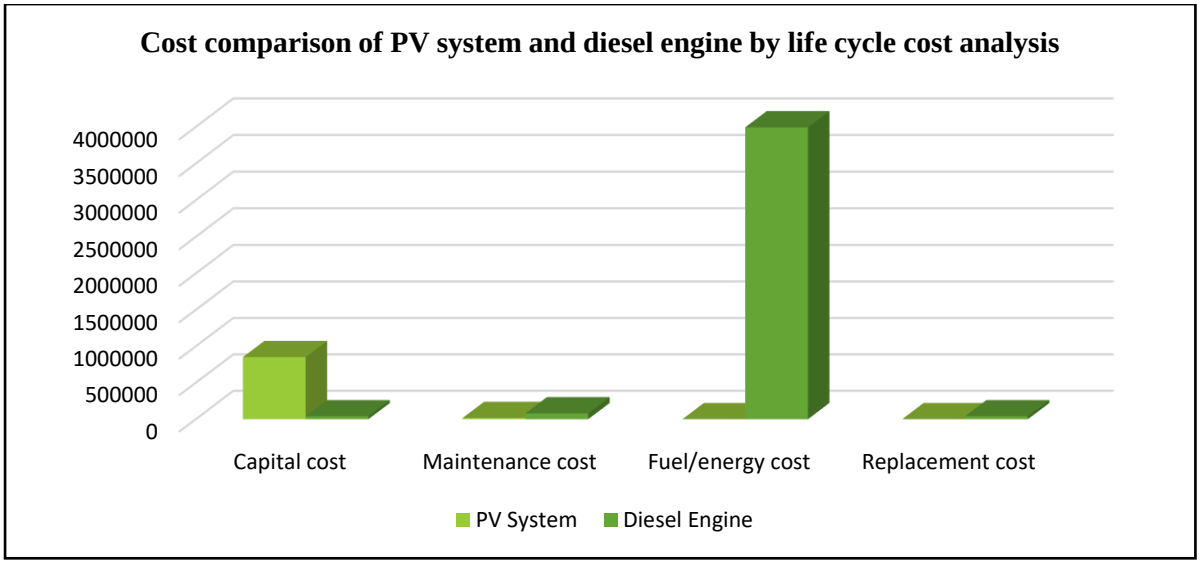


Figure 19: Cost comparison of PV system and diesel engine by life cycle cost analysis

Properly designed and installed solar-powered water pumping systems are relatively simple to operate and maintain and can last decades. Direct drive solar-powered pumps can deliver power for a much cheaper rate, as opposed to diesel water pumps which cost nearly triple to operate. They are also more dependable as there here is no need for manual operation and no fuel costs. It can be seen from the above Table 113 and Figure 19 that the initial capital cost (investment) in a PV system is higher (almost double) compared to a diesel engine. However, the maintenance cost of the PV system is negligible (Rs. 17,033) whereas, maintenance cost (Rs. 80,000) and fuel cost (Rs. 39,93,600) is huge in the case of diesel engine. The cost-benefit ratio was found to be 2.39 with a payback period of little more than 4 years (4.20 years) with expected lifetimes of over 25 years. The IRR works out 15 percent with a net present value (NPV) of Rs. 1.194 million. The Photovoltaic Water pumping (PVWP) market in India and most developing countries is nascent and the potential need for these systems is huge given the millions of small farmers with a tremendous need for affordable water pumping to improve their lives.

Renovation of watermills (gharat)

The traditional Himalayan water mills or gharat are mills that run on hydropower. A channel is dug along the river to carry the water up to the mill-house where a vertical shaft type motor operates the mill. These gharats are constructed from locally available materials such as wood, stones, bamboo, and reeds. Many such gharat are present in villages however, many lie defunct due to the lack of maintenance. As part of the project, the renovation of the gharat was undertaken to provide farmers with a cheap milling option locally. Advantages inherent in using the indigenous watermill technology include,

a. Operation is simple and non-cumbersome
b. Designed and built locally, thus requires low maintenance
c. There are almost no running costs as the hydropower is free

Apart from the technological aspects, the gharat also have an important sociological dimension. Socially, they have been the meeting points for villagers to get together. A focused group discussion with the beneficiaries in the areas where gharat have been renovated concluded that gharat have been utilized most in villages where there are no other milling options available locally. Under the Project intervention, 24 gharat has been renovated. The benefits have been two-fold, first, the traditional heritage of "gharat" which has been a backbone of the milling system of the hills for centuries (it finds a mention in the book of V.A. Stoewll, Deputy Commissioner of Garhwal in 1953) has been being revived and secondly, it ensures additional nutritional benefits (use of two stones to grind wheat kernels produces flour rich in vitamins, minerals, fibres and antioxidants) for the consumers.

Pine briquette making machines

A large part of Uttarakhand is covered in pine forests. The project area has very few regions dominant in pine forests. Pine needles are highly flammable; thus the fires are often a source of extensive forest fires and also fire-related accidents, causing immense threat to the environment, forest biodiversity as well as local population. On the other side, people of the hill areas often suffer from problems of meeting their cooking, heating and other energy demands for which they are largely dependent on forests. To address both these issues, pine briquette making has been offered as a solution.

Pine briquette making machines have been assisted in areas where the pine forests are in abundance. The objective of this is to utilize the pine needles for making pine briquettes instead of lighting fire to them. The pine briquettes can be used for the energy requirements of the population and sold for income. Under the project, 22 Pine briquette machines were assisted.

The pine briquettes making activity have contributed, albeit minimally, to address the problems of deforestation and environmental degradation which are becoming very acute with a rise in fuel prices. The use of pine briquettes helps to meet the demand for energy as they have high calorific value, resolve the problem of forest fires and generate employment to strengthen livelihood options for women and local youth. The other salient benefits from these Pine briquettes include;

a. Low Sulphur content thereby having a positive environmental impact.
b. Reduces CO2 and CH4 emission thus reducing greenhouse gases and associated climate change.
c. 3 kg of pine briquettes emit heat equivalent to 10 kg of conventional fuelwood emits (according to the heating value). (Source: IIT, Mandi)

14.2 Impacts

Overall, it can be concluded that the project has been able to promote the use of alternate energy sources such as biogas plants, solar cookers, water mills, pine briquette production and solar lift irrigation to reduce dependence on forest fuelwood and promote energy conservation by achieving more than the intended target.

Less exploitation of forest resources

The use of biogas for cooking fuel has indicated that there is less exploitation of forest resources for firewood 48 percent of respondents have a dependence on forests for fodder and fuelwood as compared to 66 percent in the baseline assessment. The emissions of firewood are also higher than biogas, thus it has also impacted the health of the women who work in the kitchens and overall air pollution levels. The results have shown a substantial decrease in deforestation in and around the project area and an increase in carbon sequestration.

Reduced drudgery for women

The interventions under alternate energy have helped to reduce the drudgery of women in a great way. Women have reported that they spend less time collecting fuelwood from the forests due to the availability of biogas, use of pressure cookers and use of pine briquettes forest resources. Approximately, 2 hrs time reduced daily for collection of fuelwood from forests. Availability of water with the installation of solar power water lifting pumps has made life easier for women in these villages. Previously, water was brought from far away sources, spending 2-3 hrs daily. With the advent of water in the villages and no restriction on its volume or use, the water lifted has been directed to multiple tanks for use for not just agriculture needs but also livestock and household needs.

Reduction in pollution

The by-product from biogas, slurry, is used as a fertilizer in the farms (as against the undecomposed farmyard manure). The slurry is high in nutrient value and also helped to divert the use of chemicals in the farms. The use of biogas for cooking is more environmentally friendly than the use of firewood. Additionally, solar power is inherently a non-polluting source of energy and using it for lighting and pumping needs has helped replace the polluting fuels like diesel and electricity in the areas of implementation.

Socio-economic support

The majority of the interventions and their benefits are coming to the beneficiaries at little to no cost. The economic benefits from the use of biogas (replacing LPG, firewood), use of solar power for street and

household lighting, for pumping of water, have been previously discussed. Additionally, the water mills and pine briquette making machines have emerged as income-generating activities, especially for women and local unemployed youth.

14.2 Conclusion

Across all interventions, successfully, significant changes were made to the initially proposed project design for alternate energy interventions. These adaptations included technical changes, approaches or management systems. The modifications were possible because the Project was flexible enough to adapt to practical needs which arose during the implementation and afterwards. In order to sustain the systems, the availability of maintenance and repair services for the implemented technology was vital. In cases wherever required, maintenance and repair services were an integral part that came along with the installation.

It was recognized that two factors were effective in the sustainability of the component: the sense of ownership, referring to the commitment of the beneficiaries to the project and/or the technology, and the satisfaction level of the users were with the technology in terms of energy supply, reliability and the daily operation of the systems. These are in line with the existing literature on sustainable energy interventions, identifying ownership as one of the factors that contribute to the sustainability of rural projects. The intervention provided evidence that ownership was not a problem if individual households were the owners and took responsibility for the technology, as in the case of the solar lantern, solar street light or solar cookers. Similarly, other interventions had ownership of community-based organizations.

The Project is based on various environmentally sustainable and energy-efficient approaches in form of alternate fuel-based devices, initiatives towards fuel switch to mention a few among others. The project encouraged and ensured the adoption of environment-friendly energy sources which eventually results in less exploitation of the forest resources (48 percent of respondents have a dependence on forests for fodder and fuelwood as compared to 66 percent in the baseline) and reduced drudgery for women (decreased time by 2 hrs for collection of fuelwood from forests). Thus the stage is now set for the community and community-based organizations to carry the interventions forward Overall, it can be effectively concluded that interventions on alternate energy not only has made life easier for

15. Environmental and Social Safeguards

The project as part of its various components is ensuring social and environmental safeguards through interventions such as afforestation, silvipasture, fuelwood plantation, agricultural diversification, introduction of high yielding varieties and social mobilization to name a few. Several of these interventions would have an impact on the environmental and social setting in the areas of influence. This chapter provides an overview of the environmental and social safeguards that are triggered by the project in the context of the interventions planned, institutional arrangements that are in place for implementation of safeguards, key environmental and social results and appropriate suggestions.

The Environmental and Social Code of Practices for Gramya Phase II was developed by modifying the Environmental and Social Management Framework (ESMF) of Gramya I. The modifications have been done by incorporating the experience of the first phase, feedback from project functionaries, community members and suggestions from PRI members, field studies and feedback from Consultation Workshop with stakeholders. The approval to Draft GPWDP of WWMC of GP and action plan for transhumant was granted after its proper review by Project to ensure that it conforms to provisions of ESA. During the process, if the draft GPWDP of WWMC and action plan for transhumant is found to not- conform to ESMF guidelines the Plan was referred back to WWMC/MDT with observations and suggestions for review following the Environmental and Social parameters envisaged, their review and subsequent finalization.

The environmental and social guidelines were made an integral part of the project planning process. Several plans are being developed as part of the project including the Revenue Village Committee (RVC) Plans, the Gram Panchayat Watershed Development Plans (GPWDP) and the Transhumant Action Plans (TAP). Capacities of stakeholders responsible for the development of these plans including community members were developed on environmental and social guidelines to ensure that the plans that they developed met the basic requirements. The RVC proposals and TAP, therefore, follow the ESMF and conform to the ESG

The environment and social aspects were implemented and monitored by Project in four stages from the preparation of Gram Panchayat Watershed Development Plan (GPWDP) and the action plan for the transhumant population to the execution of project activities as follows;

- Stage 1 included sensitization of project staff, villagers (including settled tribes) and transhumant regarding the environment and socialissues to be considered in the project.
- Stage 2 focused on the selection of sub-projects / activities at the Revenue village level with the help of ESG included in the RVC Proposals and the action plan for transhumant and Social Assessment (ESA) for activities proposed by RVC at the Gram Panchayat level (WWMC).
- Stage 3 dealt with **a** review of Draft GPWDP and action plan for transhumant through field appraisal by DPD and partner NGO (PNGO).
- Finally, Stage 4 looked into the Implementation, Monitoring and Learning of GPWDP and action plan for transhumant.

ESMF safeguard application and monitoring in a phase-wise manner has been the responsibility of all project stakeholders. The ESMF application monitoring has helped the communities as well as the project team to understand the visible impacts of the interventions, mitigation measures and local environmental solutions taken in accordance with ESMF.

Monitoring of ESMF safeguard application at the village level was done by the WWMC. Participatory monitoring was also done by the PME team. Internal monitoring of the Environmental and Social safeguards mentioned in ESMF was done by Deputy Project Director, Regional Project Directors and WMD in accordance with the monitoring indicators focused on half-yearly/yearly reporting on ESMF safeguard application for the proposed activities. The Project has ensured the training and capacity building, monitoring, and Application of ESMF in the planning, implementation and management of project activities. ESMF safeguard application was also monitored by third-party monitoring on a sample basis using prepared questionnaire and assessment modules conducted at Mid-Term Evaluation and Final Assessment.

Thus considering the fragile bio-physical and socio-economic fabric of the region, the Environmental and Social Management Framework (ESMF) was developed which provided for mitigation measures developed based on experience from previous projects. The overall purpose of the development and application of ESMF has been to ensure that the impacts of project interventions are environment-friendly, socially acceptable, economically feasible and sustainable.

15.1 Safeguard policies & their applicability

The Gramya II ESMF builds on the framework of the previous phase. There was a high level of awareness about ESMF in the previous phase, and all GPWDP complied with the ESMF. In the Gramya II ESMF, the major changes included a follow-up procedure for chance finds in physical cultural resources, a structured reporting system for implementing mitigation/management measures for each type of activity and reinforcement of a grievance redress mechanism.

The proposed project has been inclusive of vulnerable groups, such as women, landless, SC, and ST (including transhumant) with their participation in GPWDP development. The project has supported income generation activities, including increased labour availability in constructing water harvest structures. The transhumant action plan has enhanced monitoring and sustainable livestock and health service provision. The Project has enhanced social accountability through participatory monitoring and evaluation (PME).

Environmental assessment, natural habitats pest management, forests, physical cultural resources and indigenous peoples have been triggered. These are unchanged from the previous phase, except for the physical cultural resources to ensure follow up of chance find.

The Project had not envisaged any significant, irreversible impacts due to the safeguard measures built-in into the Project. The interventions have yielded positive environmental and social impacts since it was planned, implemented and designed with environmentally and socially sound practices. The environmental and social safeguards policies and their applicability for the Project has been detailed in the Table 114 below;

Table 113: Safeguard policies and applicability

Safeguard Policies	Description	Applicability
Environmental Assessment (OP 4.01)	Environmental Assessment (EA) evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation.	EA has taken into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources). Participatory planning through traditional local knowledge along with technical inputs of Project members and site-specific designs have been used for the implementation of watershed-related interventions to reduce any adverse impact on the hydraulic and geological regime in the area. Mitigation measures have also been taken up to prevent long-term slope instability, changes in surface water flow, improper disposal of debris or changes in water availability
Natural Habitats (OP 4.04)	Bank's economic and sector work includes identification of (a) natural habitat issues and special needs for natural habitat conservation, including the degree of threat to identified natural habitats (particularly critical natural	This has been applicable as the project has included silvipasture activities which affect habitats and/or important species. The soil and moisture conservation activities, maintenance and rejuvenation of water sources, protection activities like Oak

	habitats) and (b) measures for protecting such areas in the context of country's development strategy	ANR and rehabilitation of slopes through vegetative treatment along with forage row plantation have had a positive impact on natural habitats and their functions. No significant disturbance has been observed to the natural habitats and/or local species of flora and fauna in the treatment areas.
Pest Management (OP 4.09)	The objective of this policy is to promote the use of biological or environmental control methods and reduce reliance on chemical pesticides	Integrated Pest & Disease Management (IPDM) has been an integral part of the project's Integrated Crop Management (ICM) approach. IPDM, a tool for pests and disease management, wherein mechanical, cultural, biological, chemical, use of resistant varieties, and quarantine methods are carefully combined to keep pest & diseases at below economic injury levels to obtain optimum crop yields has been practised
Physical Cultural Resources (OP/BP 4.11)	Physical cultural resources component includes (a) an investigation and inventory of physical cultural resources likely to be affected by the project; (b) documentation of significance of physical cultural resources; and (c) assessment of nature and extent of potential impacts on these resources.	In accordance with the criteria for exclusion of sub-projects/activities under Project, activities which may cause damage to cultural property, places of religious importance and restricted historical monuments viz. resources of archaeological, paleontological, historical, architectural, religious (including graveyards and burial sites), aesthetic, or other cultural significance has been followed.
Indigenous Peoples (OP/BP 4.10)	This policy refers to distinct, vulnerable, social and cultural groups such as Scheduled Tribes or Tribal Folks. People who have lost collective attachment to geographically distinct habitats or ancestral territories in project areas because of forced severance remain eligible for coverage under this policy. The majority of tribal are socially and economically weak, prone to vulnerability and often feel excluded from development initiatives.	The project fosters full respect for indigenous peoples' dignity, human rights, and cultural uniqueness so that they receive culturally compatible social and economic benefits, and do not suffer adverse effects during the implementation of project activities. Under the Project, a strategy has been implemented for traversing and semi-sedentary transhumant population (Transhumant Action Plan- TAP) to assist them in an attempt to improve their quality of life through project interventions.
Forest (OP 4.36)	The objective of this policy is to assist borrowers to harness the potential of forests to reduce poverty sustainably, integrate forests effectively into sustainable economic development, and protect the vital local and global environmental services and values of forests.	All the NRM related activities in reserved and protected forests under the project area have been planned per the Forest Working Plan with the approval of the Divisional Forest Officer. The activities are being implemented through Van Panchayats along with technical inputs of the Project to enhance the health and quality of forests. Afforestation measures have been done taking into account fuel, fodder and timber needs to integrate them effectively into sustainable economic development, and protect the vital local values of forests.

15.2 Mitigation measures adopted at the Project Planning stage

The project activities undertaken across the different sectors and the recommended practices are driven by the environment and social framework devised by the project. At the planning phase, the possible negative impact of the proposed activities was considered during PRA exercises. If the WWMC proposal had any activity in their GPWDP that would have a negative environmental or social impact, it was ensured that the mitigation measures for the possible negative impacts were proposed prior to implementation. The assessment was conducted and some of the changes in parameters are reflected in the Table 115 below;

Table 114: Mitigation measures adopted at the Planning stage

Subprojects/activities	Negative Impacts	Mitigation Measures Adopted
Forestry	• Conflict among users over resource sharing	• Equal sharing of resources among users by establishing mutual rules/regulations.
Agriculture	• Loss in soil moisture. • Increased water demand for irrigation and competing demands on surviving/existing sources which are used for drinking. • Due to monoculture chances of crop failure due to frost/fog, insect/pest and diseases.	• Maintaining soil fertility, crop rotation and bringing the cultivated land under leguminous crops (pea, lentil etc.) is practised. • Selection of low water demanding (high efficiency in water utilization) HYV crops is given preference. Protected cultivation (use of polyhouse, polytunnel, etc.) to reduce the input requirements. Source sustainability measures are also adopted to reduce dependence on just a few sources. • Promoting crop rotation and intercropping to decrease the resistance of crops to certain pests and diseases. Use of climate-resilient improved varieties.
Horticulture	• Increase in water consumption, therefore depletion in water resources.	• Selection of low water demanding (high efficiency in water utilization) crops are given preference. Source sustainability measures are also adopted to reduce dependence on just a few sources. Promoting drip irrigation for water use efficiency.
Water Harvesting	• Difficult on the part of villagers to maintain / repair pipelines.	• For the operation and maintenance, user groups have been formed
Livestock	• Hybrid animals are more prone to diseases. • Hybrid animals require more provisions for healthcare.	• Diversified Livestock farming has reduced the spread of diseases • Animal health camps are organized under the supervision of technical experts.
Construction/ Infrastructure Induced Degradation (Need-Based Infrastructure Development)	• Soil loss during the construction of engineering structures and quarrying for stone and other materials	• Treatment of the destabilized sites through vegetative measures, etc.

Agribusiness	• Increase in use of chemical pesticides/ insecticides.	• The use of hardy local improved varieties for cultivation reduced the use of chemical fertilizers and pesticides. Promotion of bio-pesticides and bio-fertilizers
Alternate Energy Sources	• Pollution and health hazards through components of waste/unused batteries of solar equipment.	• Components of waste/unused batteries of solar equipment are hazardous to health so their safe disposal is ensured.

15.3 Principles adopted and Achievements

Certain core principles have been followed while addressing various social and environmental issues arising as part of the project. The achievements of the Project as per initiatives undertaken in accordance with the principles are summarized in the following Table 116[14].

Table 115: Principles adopted and achievements

Principle	Achievements
Environment	
Best indigenous practices to be taken for resources management to foster the local skill, employment generation and also to protect the aesthetic values	Efforts have been made to use indigenous practices so that local skills are protected and promoted and employment generated. In this regard promotion of traditional bamboo basket making (ringal), choliya dance form through assistance under the VGA component of the Project has been promoted to a large extent.
To ensure the availability of water for domestic as well as irrigational use, source sustainability measures should be given top priority over any other resource development and management activity.	Emphasis has been laid on ensuring source sustainability so that there is assured availability of water through measures of developing recharge pits, digging of trenches, renovation of existing Tal/Naula/ Khaula and village pond / Dugout ponds, vegetative structures and other soil conservation structures. With the help of water conservation practices, some of the major springs available in the micro watersheds were augmented to put in use for the community. Discharge of about 1485 water sources was monitored for 4 years for pre-monsoon and post-monsoon discharges. Pre-monsoon discharge has increased to a range of 13.3 percent to 25.0 percent. The percentage increment in the post-monsoon period is ranging from 13.8 percent to 33.7 percent. This water is used by the community for domestic, animal drinking and water for people passing through the difficult hilly terrain along with filling the irrigation tanks other water storage facilities in the area.
In traditional water sources, repairs should be done by using traditional wisdom (mud and stone) only.	Repairs of traditional water sources (Naula) have been done using traditional methods only so that their capillaries do not get sealed. Similarly, renovation of Traditional water mills using locally available resources have been promoted under Energy conservation
According to preference to local endemic species	Local endemic species serving multiple purposes (fodder, fuelwood, fibre, fruits and fertilizer) have been given preference over exotic species. Some of the species include Deodar (Cedrus deodara), Oak (Quercus leucotrichophora), Kachnar (Bauhinia variegate) or Orchid, Chir Pine (Pinus roxburghii), Sal (Shorea robusta), Bakain (Melia azedarach), Bheemal (Grewia optiva), Shisham (Dalbergia sissoo), Kesia (Cassia fistula), Khaural (Bauhinia variegasa), Khair (Acacia catechu), Angu (Fraxinus micrantha)

[14] Gramya II- ESMF

Table 115: Principles adopted and achievements	
Reducing man-animal conflict	Wild fruit plants and local shrubs and grasses have been given preference for plantation as part of forestry activities to reduce man-animal conflict. (e.g. Amla for monkeys) Chain link fencing was adopted by the Project as a solution to reduce man-animal conflict with the advantage of securing crop safety, ensuring human-animal safety as it does not have electric current and hence does not physically harm the humans or animals. It has ensured animal safety as it has a lower risk of animals getting entrapped or injured.
Any modern technological interventions (e.g. water lifting pumps, ropeway etc.) must be installed only after proper assessment of environmental friendliness of the intervention and cost-benefit (effectiveness) study for its sustainability.	Most of the technologies including soil moisture conservation (Poly Mulching, mix Cropping, Organic Mulch) and Crop production technologies (Seed Treatment, Line Sowing, Vermicompost, Bio Fertilizer, Insect Trap, Bio-compost, Yellow Strip & Bio Pesticides have been introduced only after an assessment of their environment friendliness, effectiveness and sustainability. The Project has addressed the issue of climate resilience by promoting weeding practices that reduce soil water losses from the plant through transpiration. The cover reduces soil erosion by increasing soil organic matter, water, air, and nutrient availability. Harrowing (breaking the soil into small fragments) has prevented the loss of land moisture by evaporation. Covering the soil with crop residues (mulching) in combination with no-tillage reduces the exposure of crops to heat-stress conditions. It also increases soil moisture by reducing direct soil evaporation. Installation of solar lift irrigation system has been pioneered by the Project which is very economical as compared to power pumps dependent on fossil fuels and reduces the emission levels considerably. At the same time, there has been increased water-use efficiency by providing sufficient water according to the crop. Promoting irrigation at dawn and dusk has reduced direct soil evaporation, making better use of water resources. Similarly, the establishment of ropeway has taken into consideration the environmental assessment before its initiation. The gravity ropeway does not use any form of fuel energy thus reducing carbon footprint.
The use of alternative energy sources such as Bio-gas, solar devices, gharat etc. should be promoted to reduce dependence on forests for fuelwood.	Climate change and alternate energy are deeply connected, as the latter constitutes a significant tool for coping with climate change not only as a mitigation strategy but also as an adaptation strategy. A significant share of greenhouse gas emissions originates in conventional electricity systems, such as power plants based on fossil fuels. Replacing these systems with alternative energies is helping mitigate climate change effects by reducing greenhouse gas emissions into the atmosphere. At the same time, alternate energies have been employed in climate change adaptation efforts as these tend to be more decentralized and operate with diversified capacities, which prevents overall failure in cases of damage to a single facility. In order to mitigate the effects of climate change and to reduce dependence on forests for fuelwood, alternative sources such as biogas, solar devices, gharat solar lift irrigation have been promoted. This has been a cost-saving, environment-friendly initiative. There has been an efficient use of bio-resources reducing the dependence on forest fuelwood. It has contributed to overall safety & security, social cohesiveness (community street solar panels), reduction in drudgery of women,

Table 115: Principles adopted and achievements	
	saving time & effort and more importantly reducing pressure on forests
For Drainage Line Treatment, the engineering structures should be constructed through loose bolder/stones lying alongside the drainage line. Quarrying for stones before the construction of any structure on a site should be strictly prohibited.	Quarrying of stones prior to the construction of any structure is prohibited. Drainage line treatment engineering structures have been constructed through boulders/stones lying alongside the line. Most of the DLT structures have been ensured through this process
Social	
The weaker section and SC/ST groups should be consulted/informed about the project activities so that their livelihood opportunities are enhanced and safeguarded (Consulting with vulnerable groups)	Members of vulnerable groups have been consulted regarding project activities so that their livelihoods are safeguarded and promoted. Special considerations have been taken into account to reach out to the Category C beneficiaries identified through the PME process in the community and take them up through VGA activities.
Accord important role to women	Women play a pivotal role in natural resource management and therefore have been given a key role in planning, implementation and monitoring processes. A related aspect has been ensured through Women Aam Sabhas formed and their proposals are appropriately included in the GPWDP. The elevation of 311 women as elected representatives of PRI has been achieved.
Drudgery reduction intervention should be promoted to womenfolk.	Time saved due to the lower frequency of fodder collection has reduced to 2 hours and also the number of members involved in fodder collection is 1 or 2. This has amounted to a savings of almost 14 person-days of work each month. Time saved due to Stall feeding of animals reported by 87 percent of the women farmers as they find it convenient to provide fodder and take care of animals as there is less effort and time involved thus reducing drudgery. Time saved due to water availability was reported by 55 percent of respondents who articulated that they do not spend any time bringing drinking water to their household as water is available at or near their house. Napier plantation and mini kit: Because of the availability of the fodder on-farm or in nearby locations, time spent on fodder collection from the forest was saved in the range of 1.5-2 hrs per day, thus saving about 6-7 wage days per month. Farm mechanization under the Project has involved improved farm tools and equipment assisted by the Project as well as the adoption of improved agricultural & soil conservation practices (Seed treatment, Bio-compost, Vermicompost, Mulching, IPM measures like bio-pesticides, yellow strip, insect trap, Deep ploughing, zero tillage, Line sowing, and INM measures like organic manure, cow urine, biofertilizer) by farmers through capacity building initiatives which have been effective in drudgery reduction, especially of the womenfolk, has enhanced the cropping intensity, increased the precision and timeliness of efficiency of utilization of various crop inputs and reduced the losses at different stages of crop production. Farm mechanization has enhanced the overall productivity and production with the lowest cost of production.

Table 115: Principles adopted and achievements	
	Overall, drudgery reduction has led to the participation of women as individuals as well as in groups in non-farm activities thus enabling them to work towards additional income for sustaining their livelihoods. More importantly, drudgery reduction has led to better participation of women in community-based organizations (WAS) & Panchayati Raj Institutions (PRIs) for development and increased participation in social gatherings. This is evident from the number of women elected in PRI's from the Project who will carry forward the development initiatives forward.
Formation of Women Aam Sabhas and inclusion of their proposals in GPWDP should be ensured.	Increased participation of women in Gram Sabha meetings due to WAS has been observed. WAS has brought a significant change among women in the space where they had limited roles to play. The suggestions of WAS are getting due importance, there has been open discussions on the suggestions of WAS and are incorporated in the plans. Out of the 15889 issues raised by WAS, 8776 have been incorporated in the GPWDP plan while the rest have been implemented through convergence and other sources/schemes.
Obtaining consent for land use	Individual or community land has been used for construction purposes with the consent of beneficiaries/ Gram Panchayat. The land was not donated to the project and ownership was retained with beneficiaries/ Gram Panchayat. This has been followed in several instances of community-based intervention
Implementing Transhumant Action Plans (TAP)	TAP has been developed as part of the project and this aims to improve the quality of life of transhumant and also improve livestock. Assistance to Transhumant as a part of this plan has been implemented with interventions such as health camps organized for both the humans (1351 individuals) as well as their livestock (over 60,000) towards improving their health by identifying and addressing the disease and administering curative as well as preventive measures. Transhumant populations within the State encompass two nomadic groups Bhotiya/Anwal and Gujjars which travel through the project target area. A transhumant action plan has been developed, which will support livelihoods improvement, in particular, livestock health and extension services and assist them to improve their quality of life through project interventions. The institutional arrangement to implement the transhumant action plan includes the project staff with the support of social development facilitators. The plan also promotes cohesion with the target GPs by increasing project awareness.
Organic cultivation promoted.	Organic farming is the manifestation of the traditional environment stewardship of the people of Uttarakhand, providing a meaningful expression in the form of economic growth. Most of the farmers in Uttarakhand practice organic farming by default in rainfed conditions. This practice has been the source of food security for small and marginal farmers in terms of safe, multiple and nutritious food. Accordingly, the project has been focussing and promoting organic farming practices through continuous sensitization, assistance for adoption regarding IPM and IPNM. There has been a shift of farmers towards the adoption of organic farming as is evident from the survey of INM/IPNM. The State government has declared Rudraprayag as by default organic. The farmers involved in high yielding agricultural crops (cereals, pulses, millets etc.) in Project villages have adopted organic farming practices to produce the crops that are being used for self-

Table 115: Principles adopted and achievements	
	consumption. These farmers plan to increase the area under organic farming after realizing the cost-benefit of organic farm produce based on conventional market price. Bio composting technique has facilitated the spread of health-consciousness among the farming community. Organic farming is also contributing to a nutrient-rich diet for the farmers thus allowing a healthier lifestyle. Seed federation constituted under Gramya II in Almora division is undertaking certified seed production which is not treated chemically with any agents or colouring agents and are sold in packaging based on the recommended seed rate of each crop

15.4 Grievance Redressal Mechanism

Participatory Monitoring and Evaluation (PME), has been an effective tool in the assessment of the changes brought about by the implementation of Project activities and aims at involving the village community in the process of project implementation and social audit of these activities. Generally, this process is performed by involving external experts/agencies in the project against set indicators. But to adopt a complete participatory approach, this process has been introduced to involve the community in tracking, monitoring and evaluating the project activities. Participatory Monitoring & Evaluation is the process of social audit, which involved project beneficiaries and other stakeholders in the monitoring and evaluation of the project activities.

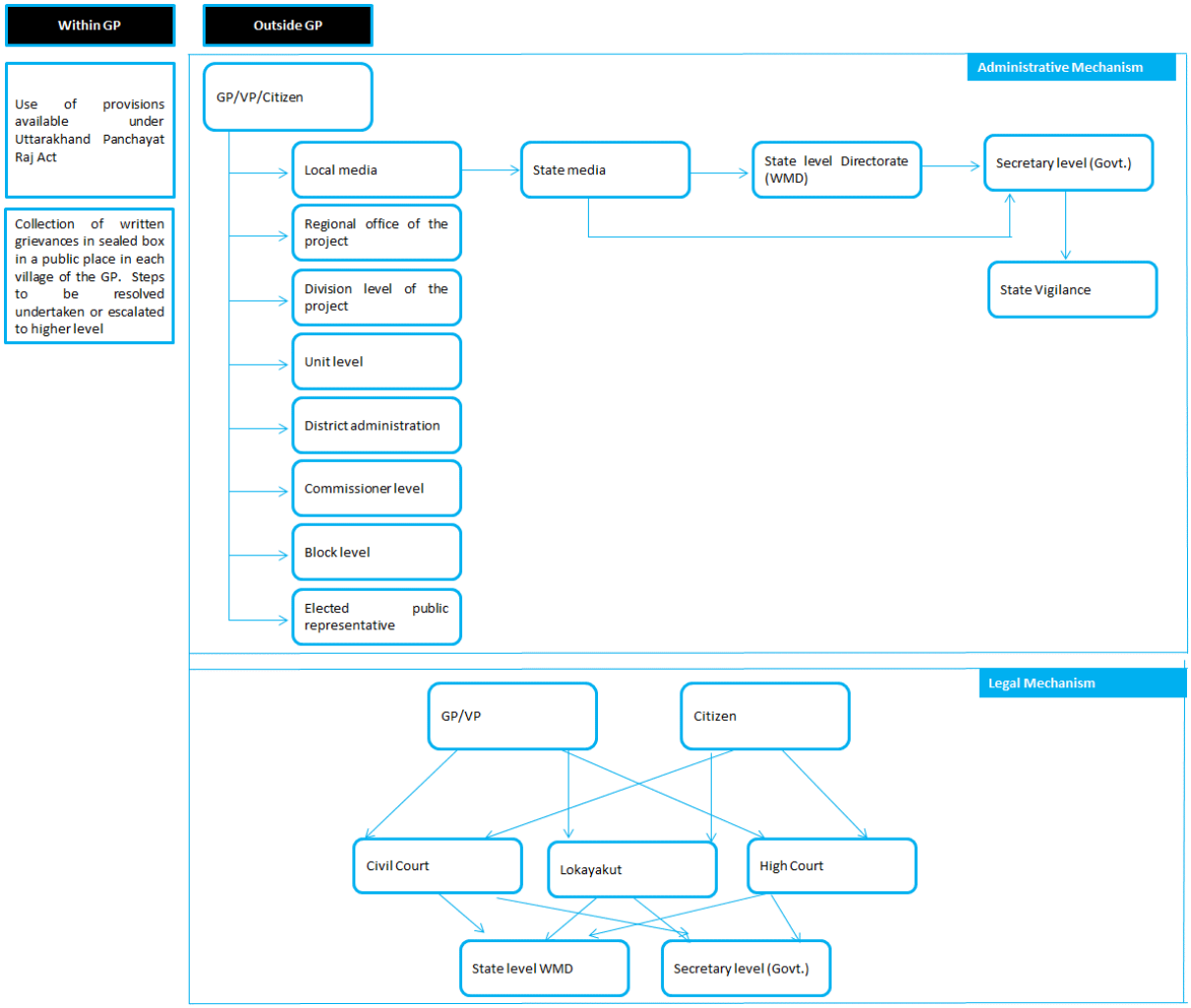
All proceedings and records of the project were accessible to all community people. All transactions were recorded immediately. Both these requirements ensured a high level of trust among the community members for each other. Some specific provisions to ensure complete transparency were the display of the annual physical and financial achievements GPWDP through wall paintings in a public place accessible to all and presentation of the accounts of the project to the Gram Sabha at least once in a quarter. The process of PME involves Gram Pradhan of every GP presenting the records of GPs in front of Gram Sabha for their information and assessment. The account assistants of each Gram Panchayat presents the progress of works undertaken against the AWPs during the last quarter of the PME along with the Audit report for that financial year. Thereafter, the accounts assistant presents the records regarding Project GPs and explains their importance. He also elaborates on the utility of a report of the Activity-wise monthly abstract of expenditure based on Integrated Activity Register as well as a monthly Beneficiary Contribution Statement. It is based on the Beneficiary Contribution Register of the Gram Panchayat. Project Cash Book, Bank Pass Books, Sanction Registers, etc. are displayed to the community for their scrutiny. PME is conducted on a half-yearly basis in all project GPs. The Action Required Checklist (ARCs) with corrective measures to be compiled and a report is generated. All the queries that were raised during PME Exercise were addressed at GP Level.

Table 116: Issues, Confusions, Queries Raised during PME Exercise at GP Level		
PME Rounds	**Queries Raised**	**Queries satisfactorily addressed**
Round 1	349	349
Round 2	293	293
Round 3	311	311
Round 4	237	237
Round 5	253	253
Round 6	260	260
Total	**1703**	**1703**

The project placed special emphasis on transparency, accountability, openness and disclosure of information to the community through wall writings, paintings, awareness generation campaigns, radio programmes, publications, village-level workshops and Samvad. For each GP, a detailed Annual Work Plan (AWP) was prepared based on approved GPWDP which contained details of activities to be funded and implemented,

implementers, beneficiaries and their contribution, and the cost to be incurred on each activity. On basis of this, a detailed Annual Procurement Plan was prepared and subdivided into quarterly plans, corresponding with the AWP. The Procurement Plans were also prepared which was approved along with the AWP. The Annual Works Plan shall be prepared based on Gram Panchayat Watershed Development Plan. In keeping with the above principles, widespread disclosure of information through IEC initiatives have been carried out. Besides the above, the website- www.wmduk.gov.in and have been developed for information dissemination regarding the project.

Citizen charter for WMD has been prepared and as per the RTI Act, the Public Information Officer at State, Division, Unit and Gram Panchayat Level have been designated and information displayed. At the block level and district level, information regarding the areas/ Gram Panchayats selected under the project has been widely displayed. In keeping with the guiding principles of transparency, accountability and openness, a grievance redressal mechanism in Gramya-II has been put in place. Since the Gram Panchayat will be the project implementing agency, a grievance redressal mechanism both within and outside Gram Panchayat has been adopted. The grievance redress process is continuous, transparent and participatory and is an integral part of the project's accountability and governance agenda. The institutional arrangements designed for recording and resolution of grievances under Gramya II are depicted in the following exhibit.



Adequate steps have been taken up right from the Gram Panchayat level where the Zilla Jalagam Samiti headed by the elected Chairman of Zilla Parishad had been constituted to look into the grievance. Currently, District Watershed Convergence Committee headed by District Magistrate looks into the grievances. Apart from that in case of escalation, there is a four-level redressal mechanism put in place, L1 (Deputy Project

Director). L2 (Project Director at Division level), L3 (Project Director WMD), L4 (Chief Project Director). The escalation time to address the grievance at each level is 7 days.

Apart from all these redressal mechanisms under the Project, if an individual feels that his grievance has not been adequately addressed then he can approach the Chief Minister Helpline which is an independent grievance redressal mechanism cutting across all government departments of the State. The CM Helpline is a two-way communication platform for citizens to register their grievances and get them resolved in one place, conveniently. They can file their grievance(s) anytime and from anywhere, track their grievance(s) and see the status, ask questions, provide suggestions for improvement and see announcements from the CM. To make the above services widely accessible to the citizens, this service is being delivered via multiple channels – helpline number, web portal, mobile app, email, and post. Grievances filed by any of these methods get routed to the responsible government office. This is being done to make the grievance redressal process integrated and inclusive, thus benefiting citizens through a speedy resolution of their grievance(s).

Grievance Redressal Mechanism (GRM) has been one of the important tools for project management which helps record and address the key issues faced by the community and other project stakeholders. The grievance redress process has been continuous, transparent and participatory and is an integral part of the project's accountability and governance agenda. The institutional arrangements designed for recording and resolution of grievances under Gramya II have been effective in resolving issues of conflict right at the Gram Panchayat / Division level.

The various trainings and capacity building exercises conducted as part of the project have been effective and have resulted in heightened participation of community members. They have started using various forums such as meetings to discuss activities and plans in a threadbare manner and discuss anticipated issues and concerns. This has a positive impact on the overall satisfaction level with the project as community involvement at all stages has ensured that there is less chance for complaints and grievances.

15.5 Building Climate resilience through Integrated Crop Management

The capacity building on INM/IPM was conducted via interactive lectures, group work exercises, experience sharing by experts, field visits and hands-on training with practical exercises. For increased participation, the participants were required to present results/ findings from their working group exercises to trainers and other participants for feedback to enhance their learnings. It was important to provide a solid theoretical foundation for the different components of the courses. This was implemented via lectures (visual presentations, videos, case studies). Working group exercises were executed under the guidance of resource experts.

From the capacity building undertaken under Gramya as articulated in the survey, about 83.2 percent of participants were trained under INM/IPM and 34 percent of them were women participants. There has been an average increase of 45 percent of the participants undergoing capacity building under IPM techniques and 36 percent of them adopting IPM techniques. Similarly, 38 percent of the participants have undergone training on INM with an adoption rate of 88 percent of any INM/IPM technologies.

87.5 percent of respondents were satisfied with the training content and 17.3 percent of respondents articulated that expenditure on plant protection measures have decreased while 67 percent expresses that it has remained the same. 31 percent of farmers affirmed that they will continue to use IPM technologies in near future. An interesting observation under the Project is the ripple effect of IPM/INM in the field with 21.3 percent of farmers stating that there is an increased use of IPM/INM practice by fellow farmers. The following Table 118 depicts the results from the field survey on INM/IPM including the adoption of practices.

Table 117: Capacity building details on INM/IPM			
Particulars	**Baseline (%)**	**Endline(%)**	**Change (%)**
Received any training in Integrated Pest Management (IPM) methods	5.4	83.2	77.8
Women members in the family who have received training –One member at least	1.1	34	32.9
IPM Techniques* under which you have undergone Training			
1=Cultural	23.3	73.3	50
2=Biological Controls	15.2	65.1	49.9
3=Mechanical/physical	13.1	73.3	60.2
4=Pesticide controls	13.4	33.3	19.9
INM Techniques under which you have undergone Training under the Gramya Project			
1=Vermi-compost,	21.1	81.1	60
2=Farmyard manures,	28.6	78.6	50
3=Bio- fertilizers/ soil amendments	6.8	66.8	60
4=Crop residues and farm wastes	2.1	22.1	20
5=Agroforestry and tillage practices,	3.1	72.1	69
6=Leguminous crops,	9.8	19.8	10
7=Intercropping,	11.3	44.3	33
8=Crop rotations,	19.3	69.3	50
9=Fallows, irrigation, drainage	2.3	12.5	10.2
10=Chemical fertilizer	2.7	22.9	20.2
Techniques adopted in farm – IPM			
1=Cultural	9.3	53.4	44.1
2=Biological Controls	5.2	35.2	30
3=Mechanical/physical	3.6	53.3	49.7
4=Pesticide controls	3.1	22.3	19.2
Satisfied with the Training content	0.4	87.5	87.1
Adopted any of the IPM/INM Technique	11.3	99.4	88.1
Expenditure on plant protection			
Decreased	0.2	17.3	17.1
Remained same	9.8	67.0	57.2
Continue using the IPM method shortly	2.1	33.3	31.2
Increased use of practice by Fellow farmers in INM/IPM increasing	0.9	21.3	20.4

1=Cultural Controls (crop rotation, growing bait crops, mixed cropping, tolerant variety, deep summer ploughing, correct time of sowing)
2=Biological Controls (Predator insects: Parasitic insects: Biological pathogens, Baveria)
3=Mechanical/physical (Use mulch, hoeing or pulling weeds before they establish roots; Place collars in the soil around susceptible vegetable stems; netting; mechanical traps; Hand-pick pests off plants)
4=Pesticide controls (Traditional or synthetic pesticides; Natural or non-synthetic pesticides; Preventive pesticides)

However, it was important to assess the participants' imbibing of knowledge both in the short-term and long term. It is important to note that uptake/ implementation of learnings from the training program may take time and will depend on other factors (including institutional support). A preliminary way to assess increased understanding of the technical and marketing concepts by the participants is to conduct a short multiple-

choice questionnaire test before the start of each training session. Once the training session is completed, the participants can be given the same test to assess whether there was an improvement of knowledge.

The capacity-building measures have translated into adoption practices. From the sampled survey undertaken at the end term, the following results in Table 119 were observed

Table 118: Adoption of INM/IPNM practices	
Areas of Enquiry	**Response**
Percentage of farmers who undertook seed treatment for any of the crops cultivated	67%
Seed treatment methods undertaken	Treatment with fungicide/antifungal like Trichoderma-75.5% Treatment by soaking in lukewarm water - 13.5% Treatment in cow dung slurry 11%
Visible changes were observed after undertaking seed treatment	Decreased incidence of wilting (yellowness/dryness/disease in germinated plants)-67% Increased Germination-33%
Use of Bio-compost in any crop in the last cropping season	11%
• Quantity of bio-compost used?	12 quintals /Ha
• Area in which bio-compost is used now?	1-2 nali/farmer
• Area covered under bio-compost earlier (5 years back)?	0-1 nali/farmer
Use of vermicompost in any crop in the last cropping season?	48%
• Quantity of Vermicompost used	12-15 quintals/ha
• Area in which vermicompost is used	3-4 nali/farmer
• Area covered under vermicompost earlier (5 years back	1 nali/farmer
Use of Organic mulch (crop residue etc.) in any of the crops in the last cropping season	48%
• Area covered with organic mulch now in last cropping season	1.5 nali/farmer
• How much area is covered with plastic mulch now/ last cropping season?	0.5 nali/farmer
Use of bio-pesticide & botanical extracts in any of the crops in the last cropping season	72%
• Area covered under bio-pesticide now/last cropping season	5 nali
• Quantity of bio-pesticide used	4 litres (extended to 30 litres)
• The area was covered under bio-pesticide earlier (5 years back)	1 nali

15.6 Handling of Pesticides and Fertilizers

Pesticides are toxic to pests as well as humans. However, they need not be hazardous to humans and non-target animal species if suitable precautions are taken. Most pesticides cause adverse effects if intentionally or accidentally ingested or if they are in contact with the skin for a long time. Pesticide particles may be inhaled with the air while they are being sprayed. An additional risk is the contamination of drinking water, food or soil. So the thrust was to implement such activities which not only minimize the negative environmental and social impacts but also enhance the positive impacts. To ensure it, the Environmental and Social code of Practices was developed and all the activities under the project were in accordance with these codes of practices. The focus was laid upon not using banned pesticides as per WHO guidelines in the project. Agricultural activities.

From the survey data, it is observed that almost 19 percent of the farmers use precautions. This includes wearing protective gloves, protective shoes and using long sleeve shirts full trousers when mixing or applying pesticides, usage of nose mask while applying pesticides, washing hands, face and other body parts

with soap after pesticide application as well as washing all protective clothing at the end of every working day in soap and water.

Special precautions are taken during transport, storage and handling. Storing of pesticides are done in a place that is locked and is not accessible to unauthorized people or children; they are never to be kept in a place where they might be mistaken for food or drink. 17.7 percent of the respondents are storing pesticides in original containers with clearly identifiable labels away from children, water source and in well ventilated place

The reuse of pesticide containers is risky and not recommended. However, in a rural context with limited resources pesticide containers may be considered too valuable to be thrown away after use. Whether containers are suitable for cleaning and reuse depends on the material they are made of and what they contained. Under conditions, containers of pesticide formulations classified as slightly hazardous or unlikely to present acute hazard in normal use can be reused for purposes other than the storage of food, drink or animal feed. Pesticide containers are to be rinsed as soon as they are empty, filled with water, and allowed to stand for 24 hours. They should then be emptied, and the process repeated twice. From the survey, 18.6 percent of the respondents articulated that disposal of pesticides is done at the end of the day's work, the inside of the spray pump washed and any residual pesticides flushed.

The following Table 120 depicts the adoption practices of handling of pesticides and fertilizers under Project intervention.

Table 119: Adoption practices of handling of pesticides and fertilizers

Particulars	Baseline (%)	Endline (%)	Increased adoption (%)
Wearing protective gloves	0.7	20.6	19.9
Wearing protective shoes	0.6	19.0	18.4
Wearing long-sleeved shirts	1.2	19.1	17.9
Wear full trousers when mixing or applying pesticides	1.1	20.3	19.2
Using nose mask while applying	2.7	22.3	19.6
Washing hands, face and other body parts with soap after pesticide application	3.5	23.1	19.6
Washing all protective clothing at the end of every working day in soap and water	1.1	19.4	18.3
Storing pesticides in original containers with clearly identifiable labels away from children, water source and in well ventilated place	0.9	18.6	17.7
Disposal of pesticides done at the end of the day's work, the inside of the spray pump washed and any residual pesticides flushed	0.2	18.8	18.6

The biopesticides and bioagents assisted among the farming community as a part of its IPNM practices are as follows;

Table 120: Details of IPNM Measures

Division	Bio-Fertilizers Super Gold, Nutra Mx, Nutra Masterzime,	Phosphate rich organic manure	Organic Foliar Spray	Beauveria Bassiana	Neem Khali	Neem Mix manure	Vermicompost	Manure Compost	Bio Pesticide						Bio-Agent		Solar light Trap	Yellow Trap Sticker	Pheromone trap
									Neem oil	Trichoderma	Pseudomonas	Caliber	Agromin	Torment	Plant Bio-Agent	Waste Decomposer			
	qtls	qtls	Lit	qtls	qtls	qtls	qtls	qtls	Lit	qtls	qtls	Lit	qtls	Lit	qtls	Lit	Nos.	Nos.	Nos.
Tehri	96								156	7		50		50			100	5640	
Rudraprayag	496.5					49.2	104.7	26.5	1177	1085		1158		932	5.3			1000	
Pauri	158	38			9.5		125		25	25			25				23	2000	
Almora	1251.9					351.				27.4					2.6		90	3200	526
PMU	46.2				157				1640	33					0.6	780		2439	30
Vikasnagar	22.5				265.7	45				8.3	3.3						36		
Uttarkashi	60.3	2.58	60	17	101.6	97.6	612	161.6	500	31.4	11.7						20	4330	
Bageshwar	1224.6									186.8					9.1		62	1000	
Pithoragarh	999.7								6141						425.6		105	2000	
Total	**4355.7**	**40.5**	**60**	**17**	**533.9**	**543.7**	**841.7**	**188.14**	**9639**	**1404**	**15.0**	**1208**	**25**	**982**	**443.3**	**780**	**436**	**21609**	**556**

From the above Table 121, it is evident that the Project has made all-out efforts to promote the usage of biopesticides among the farming community. Biopesticide-driven sustainable agriculture enjoys social acceptability, promotes economic productivity, and engenders environmental stewardship. These three dimensions represent the tripartite concept of sustainable development whose finest concept is currently contained in the United Nations 2030 agenda, popularly known as the Sustainable Development Goals (SDGs).

15.7 Transhumant

The project focuses on the transhumant population which has helped in providing day to day items of need to this population helping improve their quality of life. Transhumant groups such as Gujjars and Bhotiyas are nomadic tribes who are primarily engaged in animal husbandry as they migrate from higher altitudes to lower altitudes during the peak winter months along with their cattle and/or flocks of sheep and goats in search of green pastures. Many such groups camp in the project areas during winters for short durations. These groups live with limited resources and often have to face hardships during transit.

Transhumant Action Plan

Van Gujjars, and Bhotiyas, who keep mixed flocks of sheep and goats for wool, meat and rituals; horses for baggage transport and dogs for protection are the two major nomadic tribes of Uttarakhand. They are one of the many tribes who have lived in deep dependence on wild habitats in India and for whom, “transhumance” (the practice of moving livestock from one grazing ground to another in a seasonal cycle) has been a way of life for centuries. Also, much before the concept of inviolate spaces for wildlife conservation descended onto Indian “environment” policy in the form of the 1972 Wildlife Protection Act. And yet, today, the idea of “home” for Van Gujjars has been made precariously tentative.

However, the project has full regard for the hardships encountered by these transhumant people as a result of the life chosen by them and has a Transhumant Action Plan for such tribal people to provide them with

certain items of day to day use and look after their general welfare. The project fosters full respect for these indigenous peoples' dignity, human rights, and cultural uniqueness and ensures that they; (i) receive culturally compatible social and economic benefits and (ii) do not suffer adverse effects during the implementation of project activities.

A strategy was formulated under the project for traversing and semi-sedentary transhumant population to assist them in an attempt to improve their quality of life through project interventions. The transhumance systems in Garhwal and Kumaon regions are of the vertical type wherein transhumant and livestock inhabit warmer zones during winters, moving upwards as the weather warms during spring until they reach alpine pastures in summers. While Gujjars move with their herds of buffalo and cattle, Bhotiyas keep mixed flocks of sheep and goat for wool, meat and rituals; horses for baggage transport and dogs for protection. A Transhumance Action Plan (TAP) has been prepared for improving the socio-economic condition of transhumant Bhotiya/Anwal and Gujjar communities. The basic objectives of the TAP included the following:

- Sensitization of project stakeholders/partners regarding transhumant issues
- Ensuring the quality of life of the transhumant population in the project area.
- Ensuring that all interventions are culturally compatible
- Boosting epidemiological surveillance and tools for control of major animal diseases associated with transhumance through awareness and preventive measures
- Implementation of mechanisms for supervision of animal movement linked with transhumance practices
- Creation of an environment for harmonizing aim of natural resource management with improvement in quality of life of transhumant in the project area

Transhumant routes in the project area

Table 121: Transhumant Routes in the project area

Transhumant Communities	District	Transit Duration (days)	Route	Type of Migration
Van Gujjars	Dehradun	7	Vikasnagar-Kalsi- Shaiya-Chakrata	Traditional with families
		8	Vikasnagar-Kalsi- Koti-Tuni	
		6	Vikasnagar-Kalsi- Shaiya-Chakrata	
		6	Khothibhandi ko Devvan	
		6	Jokla to Devvan	
	Tehri	9	Vikasnagar-Kalsi-Juddo-Yamunapul-Nainbag-Purola	
	Rudraprayag	7	Mohankhal to Pokhri	Traditional with families
		15	Rudraprayag to Simal bend	
		7	Mohantag to Gangnani	
	Uttarkashi	6	Vikasnagar to Nagtibba	Semi sedentary with families
Bhotiya/ Anwal	Almora	10	Sheraghat-Bhaisiyachana-badichina-lamgada-saharfatak-Ramgarh-Bhawali-Bhimtal-Haldwani	Traditional, migrate without families

Table 121: Transhumant Routes in the project area			
	10	Panar-Dhaydi-Danaya-Badichina- Bhawali- Bhimtal-Haldwani	
	10	Sheraghat-Bhaisiyachana-badichina-lamgada-saharfatak-Ramgarh-Bhawali-Bhimtal-Haldwani	
Pauri	9	Joshimath- Chaudikhal-Thalisain-	
	8	Yamunapul-Nainbag-Damta-Naugaon-Purola	
Dehradun	3 months	Kahanehra to Pikhagram	Semi sedentary with families
Uttarkashi	10	Sahastradhara to Harsil	Traditional with families
	8	Phakot to Harsil	
	8	Shivpuriteg to Harsil	
	8	Raipur to Naugaon	
Champawat	8	Ghat to Champawat	Traditional migrate without families
	8	Ghat to Devidhura	
Pithoragarh	7	Raiagar to Saraghat	
	7	Gangolihat to Panar	

Transhumant Population stay in various Divisions of the Project

Table 122: Transhumant Population stay in various Divisions of the Project			
Division	**Places Where Transhumant Population Stays**	**Departure to Bugiyals (Grasslands)**	**Back to villages**
Vikasnagar, Dehradun	Haripur, Quansi, Chakrata & Sahiya	March/ April	September/ October
Thatyur, Tehri	Nainbagh & Thatyur	March/ April	September/ October
Rudraprayag	Bansbada, Kund & Jakholi	March/ April	September/ October
Uttarkashi	Naugaon-Baghasu & Mori-Sandra	March/ April	September/ October
Pithoragarh	Thal & Nachani- Chinkiya	May/ June	September/ October
Almora	Garunabaz, Kafli and Dodam	Feb/March	September/ October
Bageshwar	Talsar Patiyasar, Munar, Chauda Sthal, Badi Paniyali (Shama), Gogina, Bhanar and Vinayak.	March/April	September/ October

The following Table 124 depicts the Transhumant Census

Table 123: Transhumant Census

District	Transhumant	No. of Transhumant (Individual) staying/ passing through the project area	Details of livestock					
			Cow	Buffalo	Sheep/ goat	Mule/ horse	Other (calves, Dog etc.)	Total
Rudraprayag	Gujjars	200	0	80	4100	60	41	4281
Tehri	Gujjars	112	135	1418	240	45	103	1941
	Gaddi	85	0	0	6218	28	48	6294
Uttarkashi	Gujjars	88	494	992	383	98	140	2107
	Bhotia	73	75	10	867	15	30	997
Dehradun	Gujjars	148	253	1791	242	351	651	3288
Almora	Bhotia	47	0	0	5693	38	21	5752
Bageshwar	Gujjars	210	0	0	10200	60	60	10320
Pithoragarh	Bhotia	140	0	0	16139	124	125	16388
Total		**1103**	**957**	**4291**	**44082**	**819**	**1219**	**51368**

Need Assessment & Benefits under the Project Interventions

Group Discussions, personal interactions conducted by the project MDT with the transhumant groups during their passage through project areas to gain an insight into the community's perception regarding their problems and possible mitigation measures. The major problems identified include:

- Degradation of and reduction in pasture land
- Reduced availability of fresh fodder
- High incidence of diseases in animal
- Lack of veterinary services
- Loss of livestock due to accidents, wild animals, diseases etc.
- High incidence of human diseases
- Low productivity of animal products
- Exploitation by middlemen
- High prevalence of indebtedness
- Lack of education in the transhumant communities
- Information and Communication gap with the outside world.

Under the Transhumant Action Plan, various interventions such as health camps were organized for both the humans (1351 individuals) as well as their livestock (over 60,000) has impacted in improving their health by identifying and addressing the disease and administering curative as well as preventive measures.

Over 20000 units of items such as tarpaulin/poly sheets, tents, feed tubs, blankets, concentrated feed for the cattle, torches/solar lanterns, daris/cow mats, raincoats, umbrellas, buckets, milk/ water cans, shearing scissors, bells for cattle, shoes, socks, pitthu bags, tarpaulin canvas, cookers, cotton mats, first aid kits, etc. were distributed over the project period. These activities have helped to benefit over 1351 humans and above 60000 livestock population at a financial cost of Rs. 44.01 million during the entire project period.

15.8 VGA

Vulnerable groups

The project design allows the community to itself plan and implement the solutions brought about through this project and in order to ensure that these solutions are sustainable and inclusive, measures are outlined in the project's Environment and Social Management Framework (ESMF). The social management framework ensures inclusion and delivering the benefits to all categories of residents in the watershed including those that are landless, marginal and vulnerable. The income generating activities for the vulnerable groups support these individuals through a judicial and inclusive approach.

In the project, the 'C'- category households were identified through the 'Wealth Ranking Exercise' carried out as part of participatory planning during the preparation of GPWDP Plans. Due care was taken to ensure that Divorcee women, widows and specially-abled are included as members of groups for income-generating activities.

The overall quality and distribution of Individual Assets across the divisions appear too satisfactory. There has been equitable distribution among various categories of project beneficiaries with allocation of assets among 'C' category of beneficiaries is the highest with 42 percent of assets provided to this category, followed by category 'B' (37 percent) and category 'A' 19 percent. (Refer to Table 40 on Distribution of Individual Assets across categories). The WWMC is responsible for managing the Vulnerable Group Fund (VGF) supporting livelihood enhancement of vulnerable groups to ensure equity amongst vulnerable households. IGA proposals are developed by the FNGO in consultation with concerned individuals/groups and funds are disbursed to the vulnerable individuals/groups, through the GPs after signing of an agreement with GP.

Individual Activities
7700 beneficiaries put together have earned an overall average net profit of Rs. 3,753.93 L (excluding wage and working capital). The average annual net income of the beneficiary for the year 2020-21 was Rs. 16,878. Activities providing maximum net average income had been trading (grocery shops, vegetable shops, etc.) and production (food stalls, handicrafts, etc.) both giving an average annual net profit of upwards of Rs. 23,000 (Refer to the Table 125)

Group Activities
4748 beneficiaries in 854 groups have earned an overall average net profit of Rs. 1007.59 L (excluding wage and working capital). The average annual net income per beneficiary for the year 2020-21 was Rs. 13874 (5 members per group). Activities providing maximum net average income were production (bakery, food stalls, handicrafts, etc.) and livestock (goatery, dairy, poultry) both giving an average annual net profit of upwards of Rs. 20,000 for each group member (Refer to Table 125).

Table 124: Average annual net income (profit) of vulnerable group activities

Type: Group	Activity type	Average Annual Net income
Group	Farm based	12144.9
	Livestock	51433.7

	Production	45992.8
	Service	21531.3
	Trading	22922.1
Group Activities average Income (annual)		**28418.8**
Individual	Farm based	9333.5
	Livestock	8432.9
	Production	17363.3
	Service	14451.2
	Trading	16739.6
Individual activities average income (Annual)		**11055.6**
Overall average income (Annual)		**12833.8**

15.9 Impacts & Conclusion

The ESMF and corresponding ESG focus upon ensuring that interventions are planned and undertaken in an environmentally and socially sustainable manner. There is a clear focus on adopting practices that are locally relevant and contribute towards overall socio-economic development. The project adopts a highly participatory approach, involving communities in planning and designing plans that conform to the ESG. Importantly, women form a core stakeholder group and can ensure that their voices are heard through institutions such as the Women Aam Sabha. Women-centric plans are developed and incorporated in the GPWDP thus ensuring that specific steps are taken to address their requirements. The project also emphasizes the need to improve the condition of transhumant and ensure that they can access basic facilities such as healthcare and education to the extent possible during their period of residence in project areas.

While the project has ensured that the ESMF is adhered to and ESG are followed in undertaking various interventions, there is a need to maintain this focus going forward as well. The community are well aware of the environmental & social safeguard measures and are doing their utmost to carry this forward in their planning process and incorporate the same in the development plan in their GPs.

It has been in the best interest of the project and community as each member of the village community has taken up full and effective participation in the project. The community has displayed its strong sense of ownership by agreeing to share project costs by contributing time and money for project activities. All individuals, RVC, User Groups, livelihood activity groups and the Water and Watershed Management Committee (WWMC) of the GP have implemented decisions taken by the Gram-Sabha. Further, the GP and RVC have kept everyone well informed on all developments and decisions and consulted the community regularly on all issues. The project has ensured transparency through the accessibility of proceedings and records to all community members. Care has been taken that the disadvantaged groups have profited equally from this project. The GPWDP has incorporated provisions to benefit women, the poor, landless labourers, marginal farmers, members of the Scheduled Castes and Tribes, and transhumant populations. Social equity has been the cornerstone of this project.

Findings suggest that recommended practices related to usage and handling of pesticides are being followed by the farming community to a considerable extent as compared to the inception of the Project. Similarly, the adoption of biopesticides and other environment-friendly applications has been well accepted due to the focussed approach and assistance by the project. This also addresses the SDGs as biopesticide-driven sustainable agriculture can reduce poverty (SDG1: No Poverty) and address hunger (SDG2: Zero Hunger). Stewardship of the natural resources is required for the continuous exploitation of the environment for agricultural productivity (SDG6: Clean Water and Sanitation, SDG12: Sustainable Consumption and Production, SDG14: Life Under Water and SDG15: Life on Land). With the adoption of practices, the community is poised to carry forward sound environmentally friendly approaches from the planning to its execution stage.

For the VGA interventions, as observed from income generated for the year 2020-21, the impact of the Covid-19 pandemic has been negligible. Though the year 2019-20 saw a slight decline in business for the VG enterprises, however, once lockdown restrictions were lifted the businesses were able to revive themselves. This was due to the fact that the activities selected under VGA were based on the day to day

necessity of people in the area and were planned in such a way that it could sustain itself as it had no competition and people were able to get the required services in time and thus the business was not impacted.

16. Financial Management System

The financial management system for the project has been developed keeping in mind the need to adhere to basic principles such as effectiveness, transparency, accountability and ease of implementation. The project has two systems for drawing and disbursement of money which are as follows:

- Treasury System: Funds are released by the financial wing of WMD to DDOs to pay the salary of employees and meet expenditures required to be incurred for the smooth running of offices
- Cash Credit Limit (CCL) System: Funds are released to DDOs in the following two heads:
    - 20-Grants-in-Aid: Utilized to meet expenditures incurred by GPs for implementing project activities:
        - Implementation Fund
        - Vulnerable Group Fund
        - Incentive fund
    - Other Expenditure: Utilized to meet expenditures incurred by Project Directors, field DPDs and other DDOs in the implementation of demonstration and training activities other than project activities

The funds provided under 20-Grants-in-Aid are summarized as follows:

- *Implementation Fund*: This fund is available to GPs in a separate bank account, named as 'Watershed Development Project Account' and operated jointly by the Gram Pradhan and a Woman Ward Member, for implementation of activities proposed in GPWDP and inter GP space MWS plan. An additional amount to the extent of Rs. 80,000, per annum, is provided to each GP in the above account to pay an honorarium to the Account Assistants and meet their expenditures. Nearly 20 percent of the watershed treatment fund is set aside with the concerned DPD for treatment of inter-GP spaces which lie within the MWS but are out of the jurisdiction of GPs. The objective of this additional fund is primarily to ensure that holistic treatment of the complete MWS takes place in a manner that complements the efforts of the GPWDP. For utilization of this additional fund, the PNGO/MDT in consultation with the concerned forest division, GPs and Van Panchayats develops a plan which is submitted to the Divisional Forest Officer of the concerned forest division for approval. The implementation of the project activities in this plan of inter-GP areas is carried out by the respective Van Panchayats.
- *Vulnerable Group Fund*: This fund is provided as a grant in the account of GP 'Watershed Development Project Account' to finance approved Income Generating Activities for individuals/groups amongst vulnerable households.
- *Incentive Fund*: This has been provided for GPs, CBOs and individuals to motivate them to work in an efficient, transparent and participatory manner.

17. Financial allotment

Initial on-account payment to the extent of 10 percent of each year's Annual Work Plan is given at the beginning of the financial year by the project to the GP and is adjusted at the end of the year. The first right of implementation of every work under the project rests with village-level entities such as individual farmers, RVC, User Group or the Van Panchayat. If these options are not available then the GP can decide to execute the works. If none of these options is feasible then works are awarded to independent contractors with a written statement from the WWMC regarding their inability to undertake the said activities. The WWMC outsources such work to contractors which village-level stakeholders are not competent to undertake. Appointment of contractors can be done only after the concerned beneficiaries have deposited their contribution for the activity.

2 Preparation of Estimates and Technical Sanction

Estimates for each activity included in the annual work plan are prepared by the WWMC with support from the MDT/PNGO after receipt of the on-account payment. Technical representatives from the MDT along with a WWMC member visit the site of work before preparing the estimates. Technical sanction is taken keeping in mind the sanctioning limits at various levels under the project.

3 Sub Project Agreement

A Sub Project Agreement is entered into between the GP and implemented through the WWMC in case of activities that the GP does not undertake directly. The design and cost estimates of the structure are a part of this agreement.

4 Implementation and Monitoring of Work

The Technical Representative from the MDT guides implementers and monitors activities so that they are completed as per schedule. The representative records observations in a Measurement Book (MB) after verification. The Accounts Assistant in each GP keeps the MB in his/her custody.

5 Registers at the GP Level and Payment Authorization

The registers maintained at the GP level are a Perforated Project Cash Book, a Sanction Register, an Integrated Activity Register and a Beneficiary Contribution, Register.

The bills submitted by the implementer based on actual progress are cross-checked with the Integrated Activity Register by the Accounts Assistant. All payments are then authorized by the WWMC in the course of meetings which are held on a weekly basis for this purpose.

6 Payment by Crossed Cheque and Reimbursements

Payments are preferably made to implementers by crossed cheque. For amounts not exceeding Rs. 2000, cash payment is allowed. In exceptional cases, this limit can be raised to Rs. 5000; but in such cases, a public witness is required before making the payment.

Reimbursement of expenditures incurred on works as per the approved work plan of GPWDP is claimed by GPs after submitting requisite financial statements. All expenditures incurred in a particular month are reimbursed by the DPD at the end of the month.

7 Funds for Various Sub-Components

Fund for implementation of demonstration activities is provided by WMD through the DPD. Division level officers inspect and unit-level teams verify demonstration works before making payments.

Funds for the implementation of activities under the enhancing livelihood opportunities sub-component are provided by the WMD. The field DPD offices and the PNGO through their MDTs are responsible for the implementation of various individual/group activities under this subcomponent. The expenditure and

statement of accounts of expenditure under this sub-component are made by the concerned project offices. The GP through the WWMC maintains records of beneficiaries and benefits accrued to them from this subcomponent.

Funds for income-generating activities for vulnerable groups are used to finance small income-generating activities for vulnerable individuals/groups. IGA proposals are developed by the FNGO in consultation with the concerned individual/group. Funds are disbursed to vulnerable individuals/groups, through the GPs after the signing of an agreement with GP. Endorsement of each proposal by the MDT to ensure that it is in accordance with the ESMF is mandatory.

8 Disbursement Arrangements

A Designated Account (DA) for the project is maintained in the Reserve Bank of India (RBI) and is operated by the Controller Aid, Accounts and Audit (CAA&A) in accordance with the Banks operational policies. There is a one-time fixed advance of US$ 6 million which is maintained throughout the project and adjusted towards the end of the project implementation. Disbursements are made based on quarterly IUFRs.

The project submits withdrawal applications supported by IUFRs to CAA&A in DEA for onward submission to the Bank for DA replenishment. The Bank replenishes the DA in an amount equivalent to the eligible expenditures claimed by the project and as reported in the IUFRs. All expenditures reported in the IUFRs are subject to confirmation/ certification by the annual audit reports. Any difference between the expenditure reported in the IUFRs and those reported in the annual audit reports are analysed and those expenditures which are confirmed by the Bank to be ineligible for funding (i.e., refundable to IDA), are adjusted in the subsequent disbursements.

9 FMIS

The Directorate of Treasuries, Pension & Entitlements has developed software for Financial Management Information System (FMIS) and has been rolled out following an operation field testing. The financial progress reports are generated regularly using FMIS. The main features include

- Browser Compatible Application
- Single Login for multiple roles- Aadhaar no./Mob No/Emp No. Three Tier System (Operator/Supervisor/DDO)
- E-sign facility to Sign documents digitally through Aadhaar
- OTP/Biometric based Authentication Through Aadhaar
- Scanning of documents at each stage
- No Need to Submit Physical Paper to Treasury
- DashBoard to Users
- Time-Bound Disposal and Reconciliation
- Finance Data Centre UK
- Mobile App – IOS/Android
- Auto Generation of Reports in official mail id.
- Facility to receive reports through WhatsApp also
- Online Application for Leave, Loan, Advances
- Tax Returns Generation – 16/16A/24Q/26Q/GSTR7/GSTR7A
- Inter Treasury Transfer of Funds
- Online / Offline Challan
- Inter Treasury Refund within Department

18. Procurement

One of the key requirements for the project to be implemented in a transparent, accountable and equitable manner is the design and adoption of stringent norms and procedures for key project management activities such as procurement. Procurement for the project is being carried out in accordance with the World Bank's "Guidelines: Procurement under IBRD Loans and IDA Credits" dated January 2011, and "Guidelines: Selection and Employment of Consultants by World Bank Borrowers" dated January 2011, and the provisions stipulated in the Project Agreement and Financing Agreement and detailed in the Project Operational Manual and the Procurement Plan. At the same instance keeping in mind the Government of Uttarakhand Audit Checklist relating to procurement, there have been guidelines that have been incorporated into this Project but had been commonly pointed out in the earlier projects.

Procurement activities are undertaken by the project at two levels, namely at the WMD level and at the GP level. At the WMD level procurement of works, goods, consultancies and trainings are undertaken. For works procurement typically NCB is followed. The NCB Standard Bidding Documents of the Bank and as agreed with the Government of India are used. Good procurement includes IT equipment, office equipment, furniture and also some more sophisticated research equipment and software. In the case of goods and software ICB, NCB, Shopping or Directorate General of Supply and Disposal rate contracts within the shopping threshold are followed.

The project has appointed various consultancies for specific activities such as hydrological monitoring and M&E etc. For services estimated to cost less than US$ 800,000 or equivalent, shortlists composed entirely of national consultants can be prepared. The Bank's Standard Request for Proposal Document is used as the base for the procurement of consultancies under the project.

Procurement at the GP level is for obtaining goods, works and services required for GPWDP implementation. A Community Procurement Manual has been developed for guiding all community-level procurement activity. The Manual provides step-by-step instructions to the GPs on how they should go about procuring various goods, works and services required for the implementation of the project. It includes the forms and formats to be used for procurement procedures applicable in the project. It aims to promote a consistent approach for planning, execution, reporting and monitoring of project-related procurements through the application of rules and procedures thereby enhancing the capacity of the GPs to undertake procurements to meet the project needs.

Principles Governing Administration of Public Procurement

Accountability: Governments, public and various other agencies acting on their behalf must be accountable for correct and complete execution of their tasks and duties and accept responsibility for decisions and actions being made as a Procurement Officer

Competition: Procurement should be carried out through competition unless there are convincing reasons to the contrary

Consistency: Suppliers should, all things being equal, be able to expect the same general procurement policy across the public sector

Effectiveness: Public bodies should meet commercial, regulatory and socio-economic goals of government in a balanced manner appropriate to procurement requirement

Efficiency: Procurement processes should be carried out as cost effectively as possible

Fair-dealing: Suppliers should be treated fairly and without unfair discrimination, including protection of commercial confidentiality where required. Public bodies should not impose unnecessary burdens or constraints on supplies or potential suppliers

Integrity: There should be no corruption or collusion with suppliers or others; integrity means that the procurement processes are honest and in compliance with the respective laws, that the best available, most suitable technical expertise is employed in a non-discriminatory manner

Informed decision-making: Public bodies need to base decisions on accurate information and to monitor requirements to ensure that they are being met

Responsiveness: Public bodies should endeavour to make such procurements which serve the aspirations, expectations and need of the community

Transparency: Laws, regulations, institutions, processes, plans and decisions are made accessible to the public at large or at least to public "representatives" so that processes and decisions can be monitored, reviewed, commented upon and influenced by the stakeholders, and decision makers can be held accountable

The project has effectively ensured timely procurement of major consultancies including PNGO Rudraprayag and Uttarkashi, M&E Consultant and Hydrology Consultant, Internal Auditor and seven Agri-Business Support Organizations.

The Project has a robust audit system in place with the objective to audit the internal control mechanism working within the project through internal audit of the offices and divisions as well as audit the

implementing agencies in the field covering the entire transaction cycle. Audit reports are submitted by auditors periodically.

The audit Manager at the state level is responsible for overall coordination, & planning, reporting and liaison with the Client and reviewing the audit reports, findings and issues and taking corrective action on the same. Any long pending issues are brought to the notice of the Project Director for necessary resolution through the Audit Manager. He/she is responsible for all statutory compliances the same time there are Regional Auditors, working on the directions of the Project Directors of respective Divisions who undertake regular checks at the Division and GP level for all the financial transactions and matters of importance including compliance to any audit observations.

19. Impacts

Watershed programmes have always stressed upon improvement of wasteland, runoff reduction, water conservation and protective irrigation mechanism in all areas including rainfed and irrigated areas. Benefits accrued from successful watershed development projects include improved agricultural yields and increased access to drinking water.

> *The overall attributes of the watershed development approach, by and large, are three fold, viz. promoting economic development of the rural area, employment generation, and restoring ecological balance (DoLR, 2006).*

This section is a gross but precise analysis to examine effectiveness and assess impact of the Gramya-II covering a wide range of intended and un-intended impacts by the project.

19.1 Impact on Ground Water Level

One of the key impact of the project is the Increase in ground water table in watershed areas which is one of the important measurable indicators of successful watershed programme. The project has promoted various water harvesting structures that has played a key role by storing water and allow sufficient time for water to percolate into the ground. The project has created water holding capacity of 1.15 million cubic meters. Land development activities such as contour bunding, land levelling and cultivation practices also have contributed towards accumulation of ground water. The increased water levels have rendered some respite in the drinking water situation in the project villages as evidences indicate less time consumption in water collection and period of water scarcity reducing.

Water availability interventions have been undertaken throughout the project area and number of traditional as well as new water sources have been made available and their water discharge increased significantly. Beneficiaries, mainly women, have corroborated the fact as 55 percent said that they do not spend any time in bringing drinking water to their household as water is available at or near their house. In contrast, only 6 percent of the respondents in control areas said they have to spend no time in bringing drinking water and over 90 percent spend up to 1 hour in bringing drinking water to their dwellings.

19.2 Impact on Soil Erosion Reduction

Uttarakhand comes under a high soil erosion zone with an estimated average annual soil loss rate of 27.45 tons per ha per yr. with the values ranging from 0 to 250 tons per ha per yr. This estimated annual soil erosion rate amounts to a total soil loss of 119 MT per year from the area. Project has made several efforts to restrict the eroding soil. The project has been able to cover over 50 percent of the area under natural resource conservation measures which has helped increase the soil moisture retention and also reduce the soil run-off and erosion.

19.3 Impact on Income

Income gains in Agriculture

The state for the past two years has faced the repercussions of the Covid-19 pandemic and the lives and livelihoods were greatly impacted due to the same. However, the state showed faster recovery in agriculture sector followed by education sector[15]. The project progress had also slowed down during the phase but they have continued to support the beneficiary during the project execution. The per capita annual income of Uttarakhand state has been on a steady rise over the last decade. The per capita annual income of Uttarakhand estimated at Rs. 115,632 for the year 2014-15 is higher than the national average of Rs. 86,879. However, the baseline income for the project areas in the same year was Rs. 1,40,616.

[15]Economic Survey, Uttarakhand 2020-2021

The final impact evaluation, estimates the impact on income in real terms as a result of the project interventions. The results are based on the responses of the household survey and indicate the overall average annual income of households in the target areas is Rs. 1,93,565. The same comparison in control areas indicated the income has risen from Rs. 1, 41,132 in the baseline assessment to Rs. 1,53,813 at the time of final impact evaluation.

Evaluation indicates many direct and indirect benefits accrued by the project beneficiaries through various intervention. The section describes accrued benefits from systematic income gains. The project has created a diverse source of income for the project household through agriculture, animal husbandry and farmer interest groups which is visible from the various interventions through which they have been able to accumulate income. The annual household income of the target beneficiaries has increased from an average of 1,40,616 to Rs. 1,93,565 post project in the project area during Final impact assessment. The project area showed an increase of 38.3 percent as compared to 8.9 percent in control area. The difference in difference indicates that the beneficiaries in project area are earning an incremental income of Rs. 40,268 exclusively due to project benefits.

Table 125: Average Annual Income of Households

Overall	Baseline		Endline		DiD
	Project	Control	Project	Control	
Household Income	1, 40,616	1, 41, 132	1,93,565	1,53,813	40,268

The distribution indicates that there are 3 percent higher number of household as compared to the control households in the higher income slab of 0.5 millions or more. Even in the lower income group of less than Rs. 50,000 annual average income the share of control households is nearly half of the sample and the share of project households is 12 percent lesser in the category. It appears that all the intervention had an accumulated impact on the overall income levels of the household. The average income from agriculture for farmers across the project has increased from Rs. 12,655 at the time of baseline evaluation to Rs. 19,888 at the final impact evaluation. A 57 increase in the income in real time.

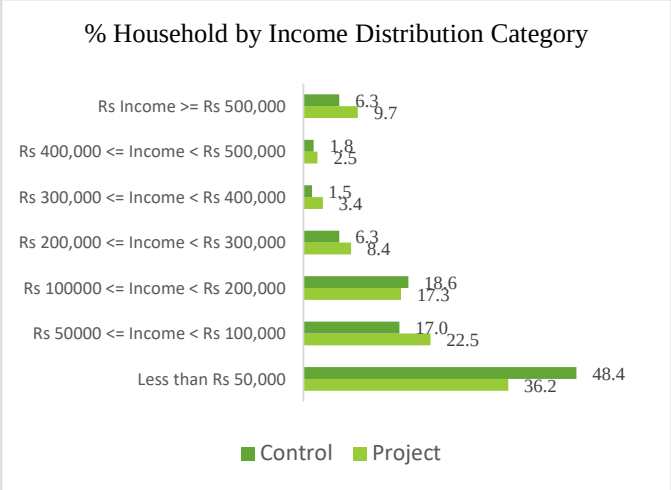


Figure 20: Household income distribution by category

The agriculture income as a share of total household income is about 10.3 percent for the project sample followed by income from livestock (6.2 percent). Given the primacy of agriculture in generating household incomes, the interventions pertaining to livelihood enhancements proposed under Gramya II project including formation and strengthening of FIGs and FFs, development of agri-business plans and marketing strategies, is well-targeted and is poised to significantly contribute to household income enhancement.

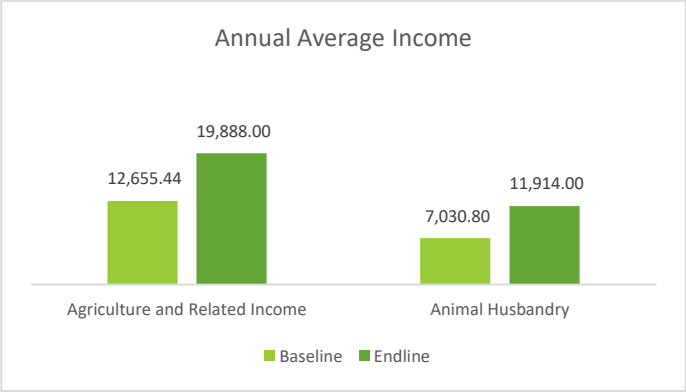


Figure 21: Share of income from different sector

For farmers directly benefitted by the agriculture interventions of the project, the income increase has been more significant than the overall sample. A total of 17488 farmers have been aggregated into 1488 FIGs and these FIGs have collectively made a turnover of Rs. 245.17 million in the year 2021-22. This amounts to an average annual income of Rs. 14,109 for each farmer associated with the project FIG only from the agriculture. The income of farmers associated with FIGs was Rs. 4,956 in 2015-16 therefore registering a 183 increase due to project interventions.

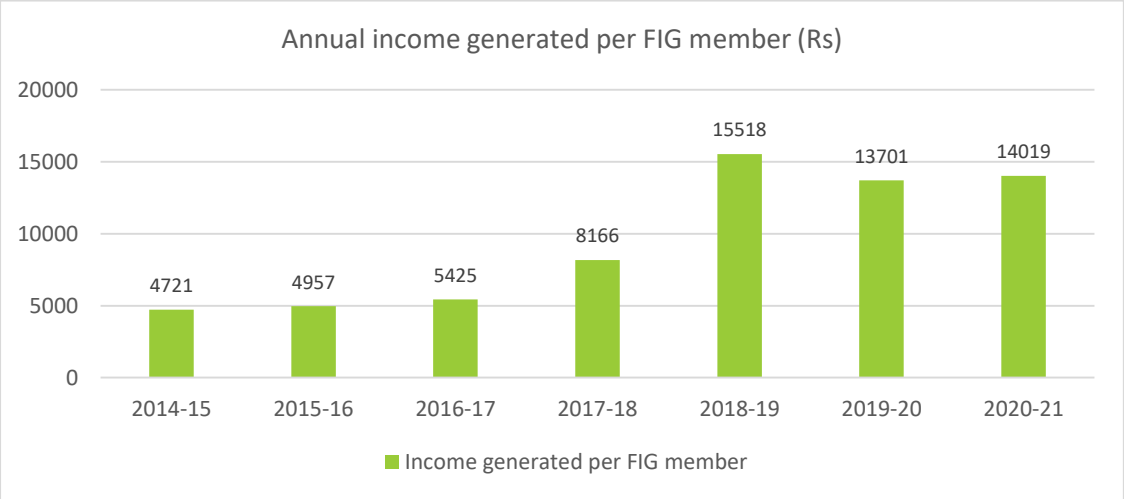


Figure 22: Annual income of FIG members

The above graph also shows that the per member annual income for the year 2018-19 was the highest during the project period, and declined in the year 2019-20. This was an impact due to the COVID-19 lockdown when many farmers were unable to sell their produce in the mandi's due to limitations of transport, labour and market availability. The incomes have partly recovered in the year 2020-21 and are expected to be at par with 2018-19 levels in the year 2021-22.

Income gains from labour days generated through project

Gramya II had opened up a gate way of opportunities to rural employment, this is made possible partly with the increase in area under cultivation, irrigated area, high yielding varieties, adoption of advanced technologies in crop and animal husbandry sectors and through innovations in marketing and post-harvest value addition. For instance, the local and rural human resources who were involved in the implementation process of various project interventions had provided gainful employment of 89,82,164 person-days

With the hilly terrain offering limited scope of mechanization in farm operations, it had ensured additional direct employment generation of 89,82,164 person-days for the households in the project area. In addition, several project interventions had ensured to reduce the drudgery of farm work and shift working hours that were hitherto spent on forage, fuel wood collection, fetching water for households and livestock to other productive activities wherein the household income enhancement had been achieved. By the end of financial year 2021-22, the project had generated an income of Rs. 2198.9 million at current prices.

Income gains through Individual and Group IGA Activities

The vulnerable group activities under the Vulnerable Group Fund have been found to be very impactful for community by not only providing gainful employment but also giving a boost to local economy due to expansion of local enterprises developed by the Vulnerable groups. The project covered 14,148 Vulnerable individuals through individual and group grants on a plethora of livelihood activities. Total 1040 groups have been developed. Majority of the enterprising activities are Production, Trading and Service related followed by Farm and Livestock based activities.

Laxmi Masala Processing Group, Based at Hanumangarhi, Run by Mr. Pushkar Singh Rawat (VGA Group Member)

The group has well equipped unit having all the essential equipment like polymyrizer, impact hammer, drier, band celler, hand ceiling etc. Chanchal Singh Mehra, heading the Group is well experienced as he worked with MDH Company for a long period. Because of this activity he left MDH and decided to stay in village. The per day production of spices in this unit is 80 kg. Total 22 spices are manufactured here. Several groups are associated with this group. The raw material is collected from around 72 villages. Only 80 percent Jeera is imported from outside. The other members of Laxmi SHG contribute their time in the form of labour for cleaning, drying, grinding and packaging of spices and are paid in cash by. Marketing is done in local market only and the unit rates to purchase raw spices from farmers are same for all. In the past the farmers associated with Laxmi Ichchuk Samooh used to sell raw spices in nearest market where there was no surety of fixed prices and sale. The women associated with the unit are now earning Rs. 3000 to 4000 per month with an assured non-fluctuating profit.

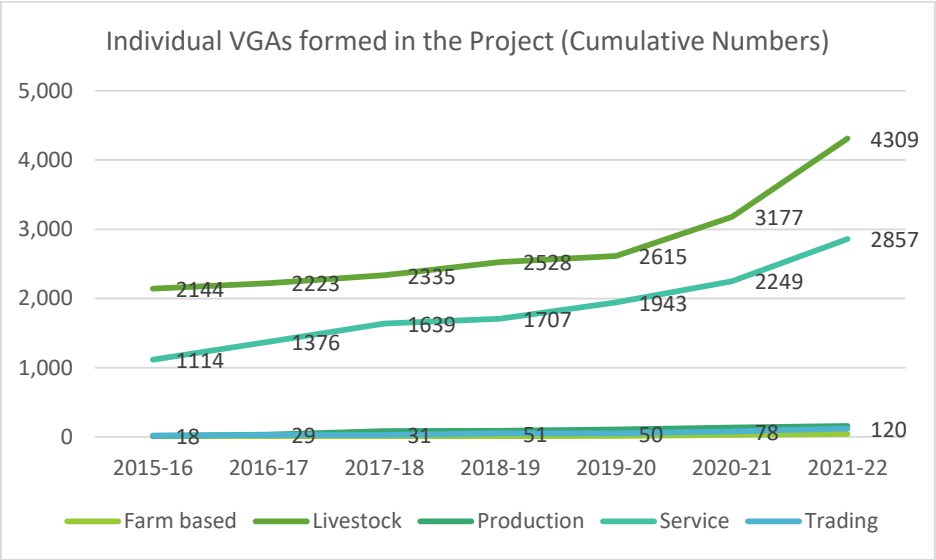


Figure 23: Individual VGAs formed in the Project

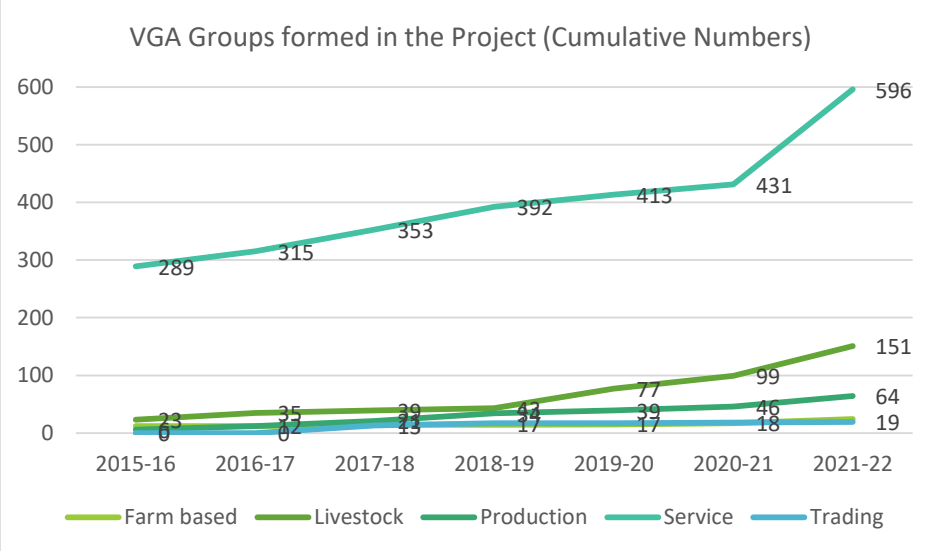


Figure 24: VGA Groups formed in the Project

Against the overall grant of 3690.96 Lakhs for IGA activities at both individual and group level put together over a seven year period have earned an overall net benefit of Rs. 445 Million. Activities providing maximum net average income were production (bakery, food stalls, handicrafts, etc.) and livestock (Goatery, dairy, poultry) both giving an average annual net profit of upwards of Rs. 20,000 for each group member.

The average annual net income for group activities is Rs. 28,418, with highest returns from livestock based activities. Under individual activities, the average annual income is Rs. 17,363 with highest income for beneficiaries under the production category. The overall net annual income from VGA activities is Rs. 12833.8 which is almost similar to the income earned by farmers associated with FIGs through direct project interventions.

Table 126: Average annual net income (profit) of vulnerable group activities

Type: Group	Activity type	Average Annual Net income
Group	Farm based	12144.9
	Livestock	51433.7
	Production	45992.8
	Service	21531.3
	Trading	22922.1
Group Activities average Income (annual)		**28418.8**
Individual	Farm based	9333.5
	Livestock	8432.9
	Production	17363.3
	Service	14451.2
	Trading	16739.6
Individual activities average income (Annual)		**11055.6**
Overall average income (Annual)		**12833.8**

The VGA activities have been instrumental in bringing additional source of income for the vulnerable households and create multiple avenues locally for other unemployed youth. There were some sectors where an immediate return could be seen with an average gestation period of 24 months such as farm, production, service and trading.

Unit Ghatigad, RVC Patet, VG:- Vimla Devi

I received a Grant of Rs 30,000/- allotted to Vimla Devi for General store at the road side. I have also started a tea stall from the profits earned by my own efforts along with general store. I often sell the vegetables produced at village level by FIGs. It has helped me with a monthly income of 3000 to 4000 throughout the year.

Unit Ghatigad, RVC Patet, VG: - Vimla Devi

We received a grant of Rs. 1,00,000/- and we together decided to start a small dairy. We were also provided with Cowsheds with 10 % contribution by us in the form of labor. We started saving Rs. 100/- per month saving in joint account. We have been able to earn an income of 11,000 annually.

VG-Tailor, Sh. Manoj Singh

We are given a one-time grant of Rs. 30000/-. We purchased 03 machines including sewing, pico etc. All other essential tools like iron, ceaser etc. The beneficiary is heart patient and had a tailor shop 05 years before at Aikeshwar, Pauri. His wife and daughter are also supporting him. Monthly income from tailoring is around Rs. 7000/- to Rs. 8000/- We are also maintaining Logbook is maintained showing the per day income.

19.4 Impact on Asset Holding

Interventions in livestock and animal husbandry such as improved livestock breeds for Natural breeding as well as Artificial Insemination and health camps for livestock has contributed to better birth rates in livestock and their progeny. The average livestock ownership has changed in project samples and in many cases it has doubled. Change in income of a household and increased number of productive assets such as livestock is both a cause and effect of income change which is clearly evident in the treatment sample.

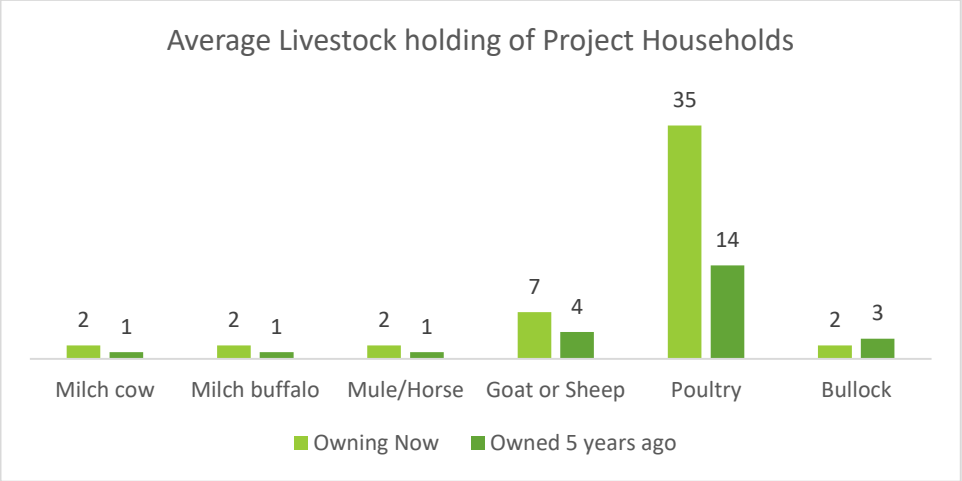


Figure 25: Average livestock holding of project households

19.5 Reduction in Drudgery among Women

Farm mechanization and distribution of farm tools have also helped in reducing the drudgery of women in farm labour and allowed ease of work. Distribution of animal husbandry input has considerably helped reduce the work especially for women who are the primary carrier of livestock in rural homes. Fodder cultivation has ensured availability of feed for livestock around the year. The problems associated with fodder collection such as availability, carrying distance and time and effort are no more an issue Among the 15 percent beneficiary in project area who received mangers, 65 percent of them have reported that due to construction of manger they have been able to save fodder and avoid wastage thus reduction in the drudgery of women. Energy conservation interventions like providing solar cookers/pressure cookers and bio gas has provided the rural women with a smokeless cooking tool that utilizes renewable energy. The time and effort spent in gathering fuel wood from the forest for cooking, and the respiratory ailments associated with cooking on an open Chulha have significantly reduced.

Time saved due to lower frequency of fodder collection*:* Prior to the project an average 2.5 hours was spent in collection of fodder daily and often involved 2 or 3 members of the household. Presently after project interventions of fodder plantation, the time has reduced to 1 hour and also number of members involved in fodder collection are 1 or 2. This has amounted to a savings of almost 7 wage days per month.

Time saved due to Stall feeding of animals*:* The stall-feeding initiative has been received very well and 87 percent of the women farmers have said that they find it convenient now to provide fodder and take care of animals as there is less effort and time involved. Over 74 percent of the beneficiaries have said that the stall-feeding program has had a positive impact and made it easier for them to feed the animals.

Impact on the Dietary Improvements in Family

Changes in health and nutrition are seen as a long term impact and any direct attribution because of project may be very difficult to make. But even in such a scenario it is understood that the increase in income vis-à-vis increase in consumption affects the nutrition intake through a number of different mechanisms. The diet quality pathway therefore is directly affected through the rise in income. Control of resources also has an implication on nutrition of the family. Like when women have greater control over household decisions there is likelihood that she has greater influence on diet quality pathway. Qualitative insights indicate the IGA

activities have brought greater independence among women to be able to spend for household consumption. Hence a stronger influence in deciding diet for the family or even for themselves. However, having said that there is a direct correlation between change in income, women's role in influencing decision, improved child's diet and family health. This impact trajectory was further explored in end term through carbohydrate and protein intake in family compared to that of baseline.

The data from Final impact assessment has shown that carbohydrate and Protein intake of farmer families in project area is 12.4 percent (for twice a day) and 8.8 percent (Twice a day) respectively more than control areas.

Table 127: Nutrient intake of beneficiaries			
Nutrient	**Project (%)**	**Control (%)**	**Difference**
Carbohydrate (Twice a Day)	55.1	42.7	12.4
Protein (Twice a Day)	60.1	51.3	8.8

There is an increasing trend of consumption of protein among households who own cattle.

Table 128: Frequency of protein intake among HH owning livestock			
Overall	**Once in a day**	**Twice in a day**	**Thrice in a day**
percent households (owning livestock)	11.2	60.1	28.7
Percentage households (not owning livestock)	35.6	51.3	13.1

Household preferences for nutrient rich food, shift in allocation of food chart in favour of children and frequency of intake of such diet has been influenced due to availability of options on food crops grown by each household under the project. Almost all farmers involved in high yielding agricultural crops (cereals, pulses, and millets etc.) in study villages have decided to dedicate certain portion of their land holding under organic farming practices to produce the crops that are being used for self-consumption. These farmers plan to increase the area under organic farming after realizing the cost-benefit of organic farm produce based on conventional market price. The whole farming system and not just bio composting, package of practice include seed treatment, IPM/INM combined with exposure and awareness has thus facilitated the spread of health-consciousness among the farming community. Organic farming is also contributing to a nutrient rich diet for the farmers thus allowing a healthier lifestyle. The project has made the FIG members more health conscious, as they perceive that bio-composting techniques, organic farming practices, vegetable cultivation and hygienic milk production would help in improvement of family health. Homestead plantations Homestead plantations under the project have been taken up by marginal farmers due to their feasibility in small land areas. Beneficiaries have appreciated the provision of tools and implements and this has allowed farmer families to include diverse nutrients in their diet with availability of various fruits.

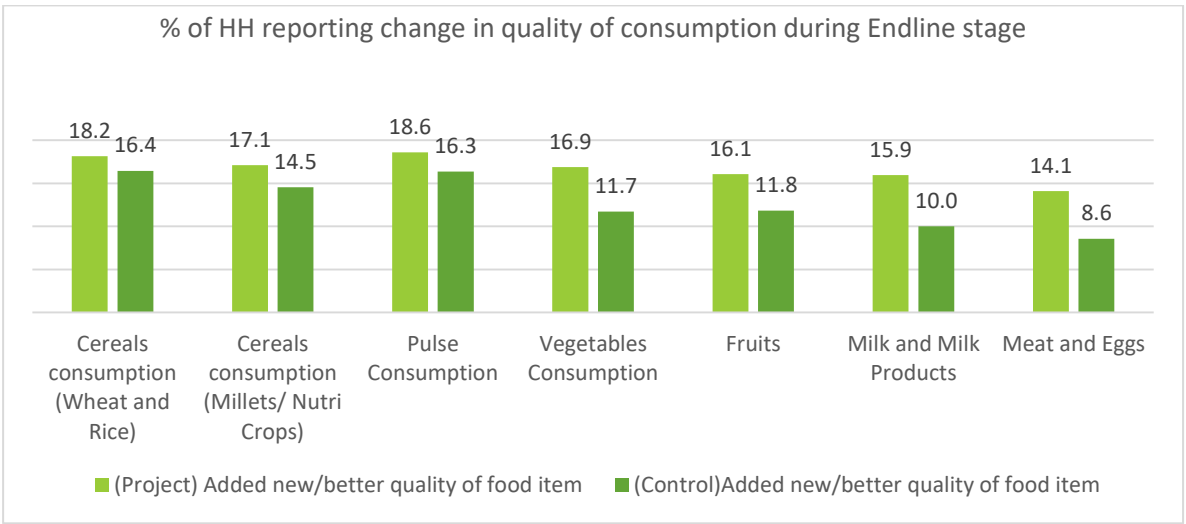


Figure 26: Change in quality of consumption during Endline stage

The endline evaluation indicates that there has been not only changes in quantity of consumption but also quality of consumption. While the food patterns will remain same based on location and geography there is value addition in the food plate in terms of additional intake of fruits, vegetables and nutri crops. The graph above indicates that compared to the control location proteins (Meat and Eggs, Milk) and Vitamin (Vegetable) and Fruits. Households in the project site have not only added new and better quality food but have also added new items to regular meal.

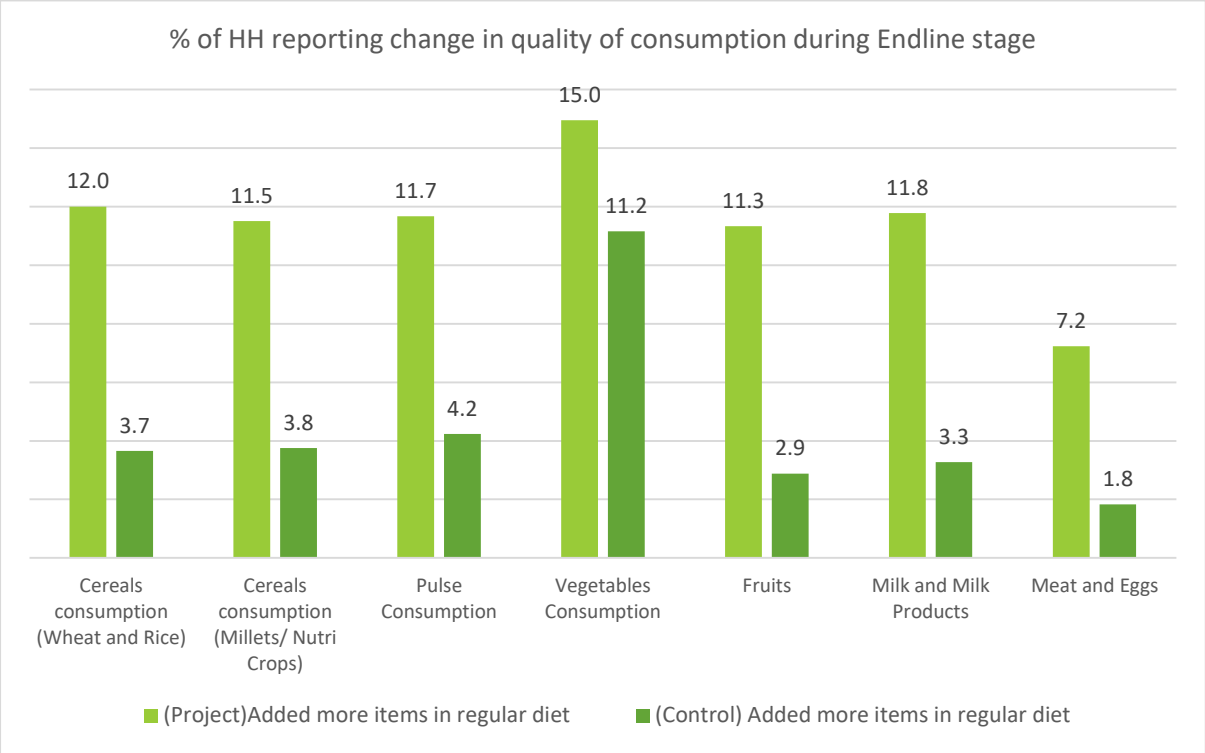


Figure 27: Change in quality of consumption during Endline stage

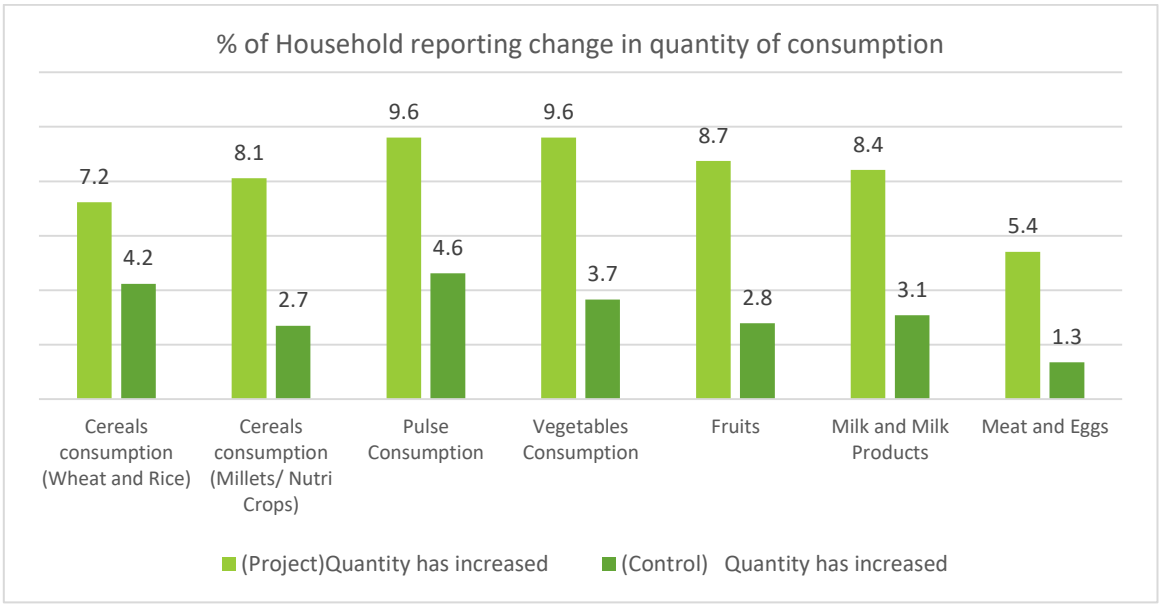


Figure 28: Households reporting Change in quantity of consumption during Endline stage

20. Economic and Financial Analysis

GRAMYA II was conceived following the success of GRAMYA I. The main objective was to conserve and improve the productive natural resource base in hill agriculture. The project introduced various interventions such as terrace repair/vegetative boundaries, crop demonstrations, provided quality seeds and seedlings, introduced the cultivation of off-season vegetables and high-value crops, orchard development and rejuvenation, adopted a cluster approach for orchard development/vegetable farming, took up homestead plantations with fruit, fodder and fuelwood trees. The project also promoted the protected cultivation of high value, off-season vegetable crops through the polyhouse/poly tunnel demonstrations. The project also helped in forming farmer interest groups (FIGs), and farmers' federations and strived to develop agribusiness growth centres with post-harvest value addition activities. All these interventions coupled with decentralized decision making by the project beneficiaries has facilitated/contributed to achieving the enhanced potential of natural resources and augmenting the incomes of the beneficiaries.

Prior to Gramya II, large tracts of cultivable lands within the watersheds were either left fallow or yielded uneconomic returns. A holistic and integrated watershed treatment of both the arable and non-arable lands with a ridge-to-valley approach, to conserve and develop the productive potential of natural resources in the project area has resulted in enhanced efficiency of natural resource use as well as increased availability of water.

Changes to rainfed and irrigated cropped area

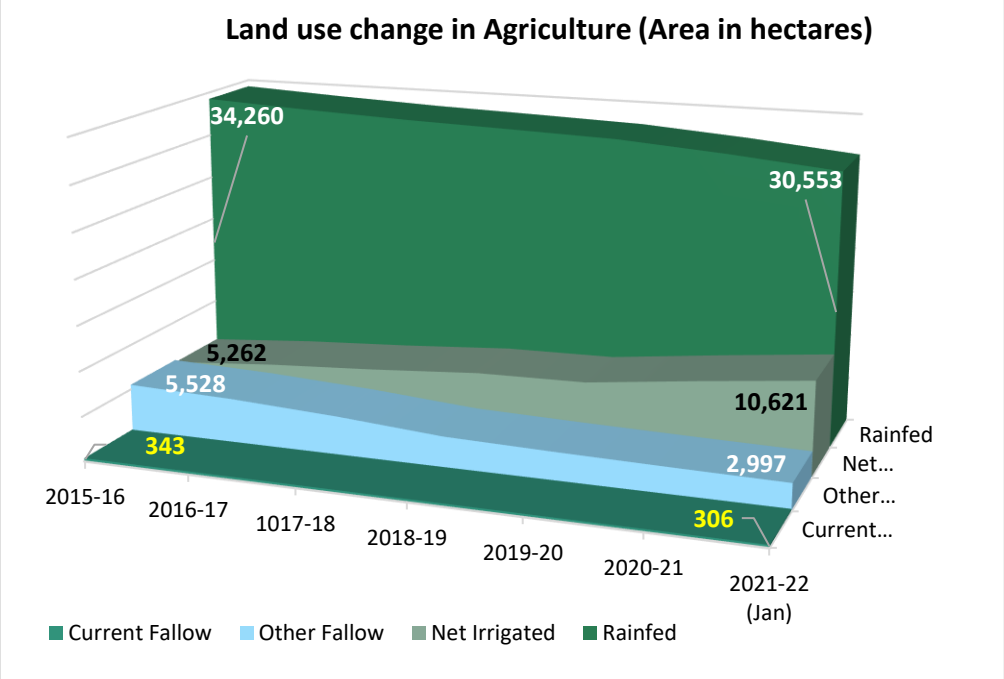


Figure 29: Changes in the rainfed and irrigated area – Gramya II

During the inception of the project, the total arable land was 45,050 hectares of which, 5,562 hectares were irrigated and the remaining 34,260[16] hectares was under rainfed farming (Figure 29). Moreover, 5,528 hectares were classified as '*Other fallow land*' (culturable land, that is not cultivated for more than three years is grouped under the category of other fallow lands). On average about one percent of the rainfed area is not cultivated for any given year and are called *Current fallows*. (The land parcel, which is left without cultivation for one or less than one agricultural year is classified as current fallows. In certain areas, it is a cultural practice adopted for land to recoup the lost fertility through natural processes or it could be a result of the delayed onset of monsoon or a farmer's willful choice due to some other constraints).

[16] PAD has adopted a figure of 34,695 hectares under rainfed farming.

The net irrigated area increased from 5,262 ha in 2015-16 to 10,621 by 2021-22 (Figure 30) due to various project interventions as against a project target of 7,893 ha (as per PAD). This increase of 5,359 ha was largely attributed to a '*push and pull*' dynamic transition of the rainfed area getting converted to irrigated area (backed by assured sources of irrigation) and area under other fallows brought under cultivation (raising rain-fed crops).

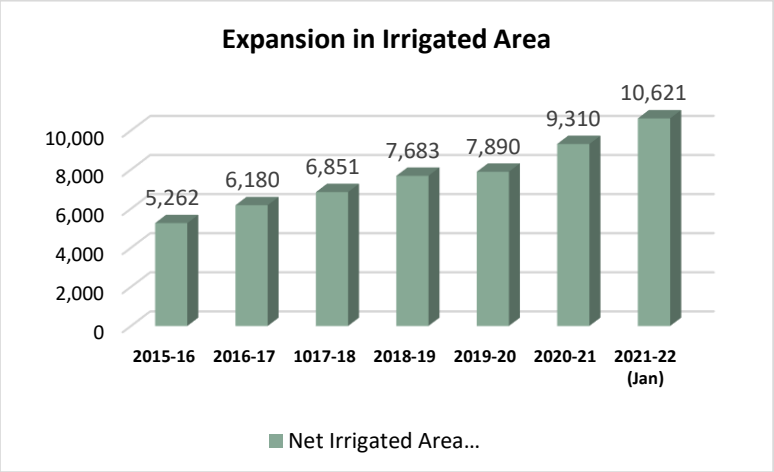


Figure 30: Area expansion under irrigation

With an increase in the net irrigated area and subsequent reduction in rainfed area, the area under current fallows also fell proportionately, bringing most of the land under cultivation and improving the land-use efficiency. Project interventions led to the expansion of area under orchards and an additional area of 3,233 ha has been added to orchards during the 7 years (both from individual and cluster approaches). It should be noted that these orchards form a part of the irrigated area.

Improved utilization of natural resources has been demonstrated through the increased area brought under cultivation (reducing the fallow area) as well as expanding the irrigated area through rejuvenation and development of water resources. Almost all the major (both irrigated as well as rain-fed) crops registered a significant increase in productivity.

Impact of Interventions and Valuation of Benefits

Agriculture and Horticulture

The benefits from agriculture are reflected in the increased area under crops coupled with the increased productivity of the crops. The changes in productivity, both for rainfed as well as irrigated crops, has been presented below. Economic analysis is carried out for impact assessment of the project using values for the area and productivity of major crops during the base year and at the terminal year of the project.

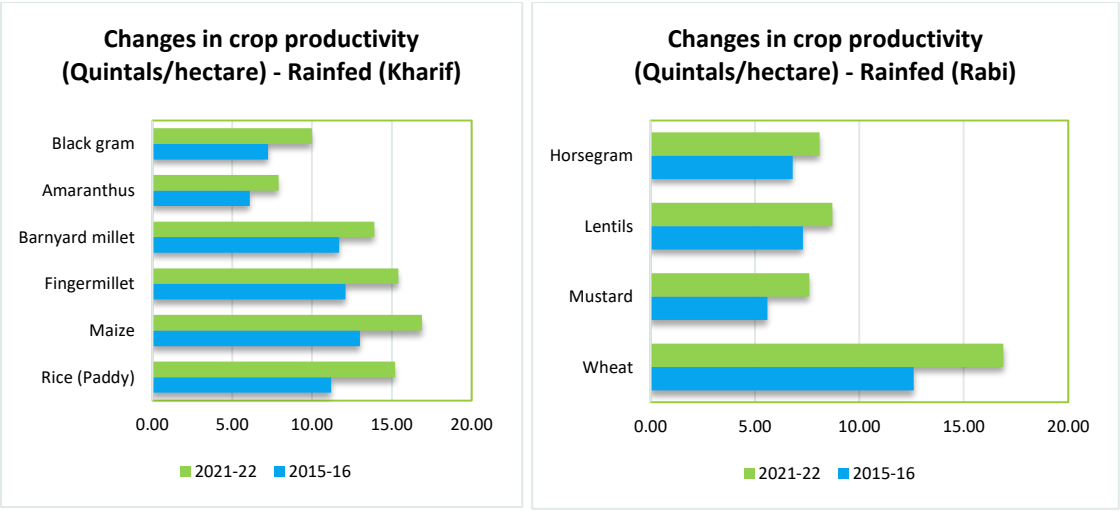


Figure 31: Productivity change in Rainfed Crops in Gramya II

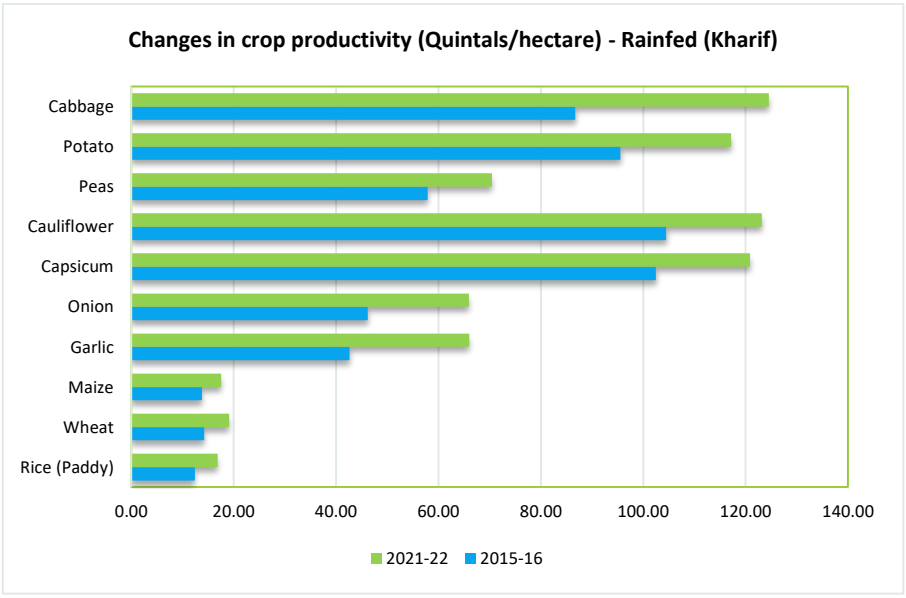


Figure 32: Productivity change in Irrigated Crops in Gramya II

The incremental values have been multiplied by the crop price to obtain an estimate of the benefit. Farmgate prices based on field data has been used. However, Minimum Support Prices (as specified on the Ministry of Agriculture website) for respective years are considered wherever farm gate prices were not available. Similarly, input costs for major crops were collected from the project area and are supplemented from the Ministry of Agriculture website and a few cost details for vegetable crops are borrowed from 'An Economic Analysis of Cost and Return of Off-Season Vegetables with Focus on Poly House Effect in Uttarakhand, AERC, New Delhi Report. Input costs have been deducted from the gross returns to obtain the net benefit. The analysis is carried out by grouping crops into irrigated and rain-fed crops. The increase in agricultural benefits could be attributed to the adoption of improved varieties, the use of improved package of practices, protected cultivation of off-season high-value crops (vegetables) as well as the adoption of soil and water conservation measures.

Fruit orchards are planted under the horticulture component. Key fruit trees planted under the project include pomegranate, citrus, pear, etc. The benefits from orchards were calculated using the increased area under orchard and consequent increase in fruit production. Costs of inputs are based on the field survey. An approach similar to agriculture is used in the case of horticulture to determine the net benefits. However, in this case, the benefits accrue after a time lag (time taken for the trees to bear fruits). Hence, net benefits considered here covers the time period from bearing fruits and onwards. The interventions for rejuvenation

and development of orchard on individual and with cluster approach are grouped together for analysis. The fruit trees have a gestation period ranged from 3 to 5 years to start bearing of fruits. Moreover, the yield in the initial period is low and reaches its peak after few years. We have taken care of this while estimating the yield of fruit crops/orchards. As stated earlier, homestead plantations includes fruit trees, fuel wood as well as fodder yielding trees. Hence, the benefits from homestead plantation are evaluated considering the output under all the three heads.

Forage Production: Project interventions included distribution of mini-kits (0.04 ha each), Napier border plantations along the ridges of the terrace and through fodder row plantations. It is assumed and expected that the beneficiaries would continue to raise and nurture these to meet the green fodder requirements for their livestock. In addition, fodder trees grown in homestead plantations also provide green fodder (by chopping of tender branches) at regular intervals and are accounted for forage production. Dry fodder / byproduct from crop residues is not considered in this analysis. The area, productivity and the average market price of respective green fodder is considered for estimating the benefits.

Protected Cultivation: Benefits derived from protected cultivation (polyhouses) are estimated as the difference between the value of output and cost of inputs used.

Bio-compost and vermi-compost: Project conducted demonstrations for making bio-compost and vermi-compost using cow dung, crop byproducts and refuse. The quantity of Biocompost and Vermicompost produced by the beneficiaries and the average market price for these products was estimated from the survey data collected for the report.

Carbon sequestration and Watershed services: As a part of watershed treatment and source sustainability, about 3,897 ha of area is covered under afforestation and planted with local plant species. For estimating the carbon sequestration and watershed services benefits that these forest trees provide, quantification details provided by the Chopra Committee Report[17] and as adopted by PAD has been used for the present analysis. It was assumed that the newly planted trees would take about 20 years to reach the growth levels to provide one hundred percent of the annual benefit as quantified in the Chopra committee report.

Renewable Energy: Project interventions focused on renewable / alternate energy for fuel, lighting, grinding and lifting/pumping water. Demonstrations were conducted and beneficiaries trained for operating of Biogas plants and for making Pine briquettes. While the biogas substitutes LPG cylinders, pine briquettes substitute an inefficient use of fuelwood cut from adjoining forests and other plantations. In the present analysis, the output from biogas plants as well as pine briquettes are valued using expenditure saved on LPG and fuel wood.

Solar energy: Values of power generated by solar panels used for various interventions like solar lanterns, solar Panels used for community street lights, solar powered water lifting pumps, etc. The power consumption, hours of use in a day and the number of days of operation in a year for devices that operate on conventional electricity are used as a proxy for the savings in costs resulting from solar energy. The power saved is then converted into monetary values using appropriate tariffs.

VGA/IGA Activities: The landless and vulnerable households were assisted to take up either their traditional income generating activities or engage in new activity to improve and secure their livelihood by augmenting the income. The project provided financial support to 7,485 individuals as well as for 854 groups to start new venture / services. The net income generated from these activities has been estimated and used for economic analysis.

Animal Husbandry/Livestock interventions: The project demonstrated and encouraged construction of cattle sheds, mangers and animal charis (water storage tanks for cattle) and also promoted stall feeding of cattle instead of open grazing. The benefits in terms of reduction in the wastage of fodder, saving in veterinary expenses due to improved hygiene and cleanliness, improved milk yield, saving of time for fodder collection are accounted based on survey data and by interacting with the beneficiaries during field visits.

[17] Report of the Expert Committee on Net Present Value, Constituted by IEG, Delhi as mandated by the Supreme Court of India, 2005.

Employment: Total employment generated due to project activities / interventions as well as the additional employment created due to increased cropping intensity has been considered as project benefits and valued using appropriate wage rates.

Agribusiness Growth Centers (ABGC): ABGCs were developed to bring synergy between backward and forward linkages in agriculture. These were aimed at providing one stop service to farmers to provide inputs, technical support, aggregation, grading and marking support as well as platform for value addition. The ten ABGC has been established in the recent past, are in nascent stage and these would accelerate their activities in the near future. The benefits are evaluated based on the available data.

Seed Federation: This unique activity was taken up in Almora division of the project to produce certified seed of major cereal and pulse crops grown the region. The net benefits are derived by deducting total costs from the gross returns received from sale of certified seeds.

Agriculture/ Horticulture and Orchard Development: Various interventions facilitated expansion of area under various rain-fed as well as irrigated crops coupled with increased productivity leading to increased production and net income. The Introduction of improved seed varieties and demonstration of protected cultivation of off-season crops helped to earn higher returns from relatively small areas.

Irrigated Agriculture: During the commencement of the project, 13% of the arable lands (5,262 ha) was under irrigated agriculture. Gramya II supported investments in location-specific interventions to include runoff harvesting and recycling structures to capture, store and use the rainwater for increasing irrigation coverage. At full development, Gramya II, brought 6,238 ha of hitherto rainfed area under irrigation. The trickledown effect of these interventions had resulted in increased cropping of 227% ex-post Gramya II as against 171% ex-ante. The increase in area under irrigation and its intensity had infused confidence amongst beneficiaries in risk taking and switching over to high value crops requiring higher investment as well.

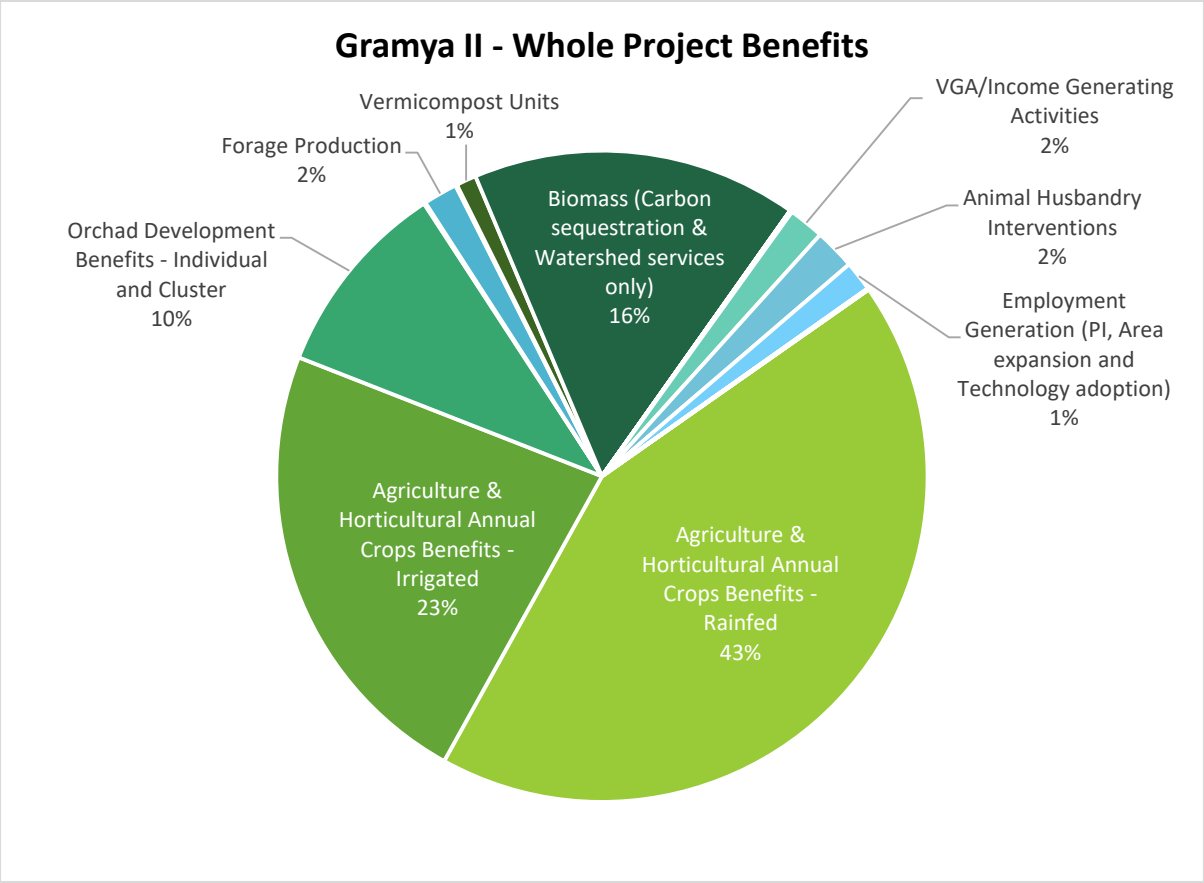


Figure 33: Distribution of Project Benefits by Interventions

Distribution of Project Benefits by Interventions: The impact of the project interventions is captured through the economic benefits realized in broad sectors, of which Rainfed and irrigated agriculture and horticulture contributed 66 percent to total income (Figure 33). Quantification of biomass benefits from afforestation, natural regenerations of Oak trees, homestead plantations and Napier border plantations has contributed 16 percent of the project benefits. The next major stream of benefit originated from Orchards (10 percent) that has been developed following individual farmers and cluster approach involving a group of farmers.

Animal husbandry sector is addressed in more than one intervention; for instance, livelihood activities through VGA/IGA includes dairy, goatry, poultry etc. (The livelihood activities alone contribute about 2 percent of the project benefits). Forage crop cultivation contributes as an input for the Animal husbandry intervention (2 percent) as well as mitigating runoff and sedimentation from terraces. A similar benefit of 2 percent is generated through VGA/IGA. The other major benefit is from Vermicomposting that contributes close to one percent of the project benefits.

Employment Generation: Gramya II, had opened up a gate way of opportunities to rural employment, this is made possible partly with the increase in area under cultivation, increase in irrigated area, high yielding varieties, adoption of advanced technologies in crop and animal husbandry sectors and through innovations in marketing and post-harvest value addition.

Economic and Financial Analyses

Table 129 : Economic Analysis

Project Interventions	BCR	NPV	ERR	BCR	NPV	FRR
Project as a whole	2.43	10817	23.78%	2.70	12834	27.78%
WS Treatment & Rainfed area development	2.43	10450	23.58%	2.70	12434	27.59%
Enhancing Livelihood opportunities	2.48	367	31.27%	2.61	400	34.57%

Cost-benefit analysis has been conducted for a project period of 30 years. Costs and benefits are estimated at 2013 prices over 30 years with 12% opportunity cost of capital. Present value of discounted project financial benefits over the project life, due to the project interventions, are estimated at Rs 10,817 million, contributed by watershed services, forest plantations, agriculture, animal husbandry, agribusiness and IGA. The economic rate of return (ERR) for the project as a whole is 23.78%.

Financial analysis is done at market prices. The financial rate of return (FRR) for the project as a whole is 27.78%. Net Present Value at 12% opportunity cost of capital for 30-year project life is Rs 12,834 million.

21. The Road Ahead

The Gramya project has implemented a plethora of interventions and accomplished its objectives as envisaged and beyond. The project has not only impacted the arable lands within the project area through the watershed development and agriculture interventions but has also made significant changes in the non-arable lands with convergence based, comprehensive catchment area treatment plans in the inter GP areas and reserved forest areas. The project has accrued benefits that are both tangible and intangible through the synergetic effort of various institutional arrangements. Sustainability has been a cornerstone of the project's implantation and all the interventions have been implemented keeping in mind long term survival of the impacts and accrual of benefits by the community.

During the project conceptualization and design, the sustainability of various interventions was duly addressed. The project implementation at the field level was done through the Panchayati Raj Institutions to ensure the sustainability of the community and private assets created through the project. A comprehensive approach to drainage line treatment was advocated to ensure the long-term sustainability of the watershed development activities in 82 MWS from the project.

Institutions at the Local level: The responsibility of the approval of the GPWDP plans was placed with the Gram Sabhas. The implementation responsibility lay with GPs and the project provided them with the financial resources to sub-committees (WWMC). Furthermore, the project ensured capacity building support to GPs. This further encouraged them to continue operating and maintaining the investments financed by the project.

Interventions at the Community level: The interventions at the community level were decided through an intensive participatory process including the application of the ESMF safeguards. The GPWDP was approved by a general meeting of the Gram Sabha. Once approved, the investments were physically constructed by user groups or RVC and the finances and procurements were managed by the GP.

Women Aam Sabhas: Mobilizing women for ensuring their participation in project activities has been one of the major objectives of the project. The project helped empower women by enabling them to draw maximum benefits from the project and help reduce their drudgery. Women Aam Sabha has helped in greater participation of women in governance forums and for voicing out their concerns about the need for work in the village. WAS has enabled women are getting a platform to discuss and formulate need-based proposals and getting them incorporated into GPWDP for implementation.

Establishment of User Groups: For the sustainability and operation & maintenance of the community assets created in the project the User Groups were established. They manage the assets by maintaining and managing a revolving fund. By the end of the project, 1381 User Groups were formed for various water conservation structures having a corpus of Rs. 5.81 millions collected from user fee.

Farmer Interest Groups: In order to ensure the sustainability of Agri-business interventions, issues of future demand and supply scenarios and the identification of a long term business models were critically addressed which involved value chain analysis to identify the best possible options for the farmers. Efforts were made to develop a supply chain management system on case to case basis for Farmer's Interest Groups (FIGs).

Farmer Federation: Following on the success of the cluster approach and creating farmer federations in Gramya I, Gramya II initiatives have focused on forming the Farmer Federation by organizing the FIGs and making them self-sustainable through institutional and capacity building support. The Federations have been also instrumental in helping farmers decide the crops to cultivate as per market demand, bridge the gap between farmers and corporations by eliminating intermediaries and get a fair price for their produce as per market situations

Agribusiness Growth Centres: These Agri-business Growth Centres were established with the institutional support of the Gramya II in form of capital investment in form of a grant. The Growth Centres provided input and output support facilities to the farmers in the nearby village cluster as well as Input, advisory and extension support and Value addition, Marketing and Logistic Support.

The road ahead envisioned for the interventions and impacts of the project is enlisted below.

Expanding irrigation potential: Over the project period, many drainage line treatments, soil conservation, water harvesting and source sustainability measures have been successfully implemented. The progress has been more than that envisaged in the GPWDP Plans. Changes in water discharge due to source treatment, improvement in soil moisture content, improvement in water availability are some of the impacts observed. The project interventions have contributed to bringing over 5,000 ha of land under irrigation through the establishment of various irrigation structures. The ownership of these irrigation structures lies with the respective gram panchayats and water user groups have been formed for the operation and maintenance of these structures. The groups collect a user fee from the beneficiary farmers and the collective fund will be utilized for the future management of the structures. Furthermore, the MGNREGS has provisions for allotting funds for labour work in construction and/or repairs/ renovation/ restoration and desilting of water bodies/tanks etc. which can be tapped into for the purpose. There is also potential for convergence with Irrigation and other line departments, to increase the functionality and ensure proper maintenance of these structures. It has also been observed that the said structures as well as the impacts of the watershed treatment have not been utilized at their full potential. There is a scope to bring more land under irrigation by adding more structures to harvest and distribute water. The user groups also can add more members to the user groups and/or utilize the water for more seasons, for other purposes such as animal husbandry or ever domestic uses.

Harnessing renewable energy for irrigation: The project has promoted and popularized solar-powered water lifting pumps in combination with geo-membrane lined water tanks. 24 solar-powered water lifting pumps have been installed under Gramya irrigating 242 ha and ushering a change in cropping pattern in the hitherto rainfed lands. These systems have long term low costs and are also more reliable in the hill context compared with its alternative viz., diesel operated or electric powered pump sets. With the rise in both the electricity tariff and fossil fuel prices, the adoption of alternate energy resources seems to be a sensible and profitable approach. On the other hand, under the Ministry of New and Renewable Energy Guidelines for Implementation of Pradhan Mantri Kisan Urja Suraksha evem Utthan Mahabhiyan (PM KUSUM) Scheme, it has been envisaged that individual farmers will be supported to install standalone solar agriculture pumps of capacity up to 7.5 HP in off-grid areas. The project interventions have helped to establish the success of these systems and as a result, the Agriculture department has surveyed the area for replication of the solar water lifting systems through this scheme. The established water user groups have been sensitized and their capacity is built to initiate proposals under the scheme for replication and scaling up of the irrigation system. Additionally, in order to achieve an earlier breakeven, the water user groups can also explore the possibility of net-metering and grid interconnection, wherein power can be generated on days when the sunshine is not available for power generation.

Scope for high value protected farming: Protected cultivation through poly houses and polytunnels is yet another innovation attempted in Gramya II. While the benefits of poly houses seldom require elucidation, scale economies are crucial for early break-even of capital cost. Gramya was successful in installing 2,858 poly houses in the project area and demonstrated that there was significant cost reduction with the increase in the size of polyhouse Rs. 1,652 per sq. m. to 1,409 per sq. m. as the size increased from 27 sq. m. to 100 sq. m. However, the topography of the hill slopes and terraces limit the scope of achieving such economies of scale from large size poly houses.

Protected cultivation of agricultural and horticultural crops thus needs to focus on crops with very high value in order to give sufficient returns on the investment costs incurred by the farmer. The farmers engaged in protected cultivation can engage in growing exotic vegetables such as bok choi, brussels sprouts, asparagus, celery, etc. which have a good demand in high-end restaurants and also give high returns. On the floriculture front, priority can be given to flowers such as lilium and orchids which are of high value. And have good commercial demand. It has been already established that the cultivation of vegetables and flowers under protected cultivation is a highly profitable enterprise. However, an economic analysis[18] of the same has

[18] Kumar, P.; Kar, A.; Singh, D.R.; Perumal, A.; Shivamurthy, S.G.C.; Reddy, K.V.; Badal, P.S.; Lala Kamble, A.; Kamalvanshi, V.; Jha, G.K.; et al. Protected Cultivation of Horticultural Crops in Uttarakhand: An Economic Analysis. Agronomy 2021, 11, 692. https://doi.org/10.3390/agronomy11040692

indicated that the subsidy scheme needs to be continued to encourage maximum farmers to adopt protected cultivation and farmers need to be encouraged to form farmers producers' organizations (FPOs), which would help them in seeking a better quality of inputs and enhancing negotiating power in the market to realize maximum returns for their farm produce. Hence, linkages for a subsidy with national agencies such as National Horticultural Board (NHB), National Horticulture Mission (NHM), Mission for Integrated Development of Horticulture (MIDH), Horticulture Mission for North East & Himalayan States (HMNEH) and Rashtriya Krishi Vikas Yojana (RKVY) need to be continued and made accessible to the farmers to encourage a large number of farmers to adopt protected cultivation, which has tremendous potential in the region.

Market linkages for commercial crop production: The focus of agricultural activities under Gramya has been on vegetables, agriculture crops and spices. The increase in production of these crops has been the largest impact on the project. Farmers have moved from sustenance farming to farming for high-value crops and commercial farming. This made agribusiness emerge as the most crucial component to help farmers in translating the project investment into income. Agribusiness activities under Gramya focused on the marketing of surplus production, value addition through improved post-harvest management and processing, and making marketing infrastructure and trade support available to the farmers. These activities supplemented with other efforts such as infrastructure development in form of all-weather roads, bridges, and creating logistics support have enabled farmers to dispose of the surplus production in local as well as outstation markets. The growth of marketing volume over the years through FIGs and FFs demonstrate that farmers in the project area have been exposed to commercial cultivation and marketing of vegetables and other commercial crops. Commercial cultivation of various in-demand crops is being undertaken to move away from the traditional case of subsistence farming. As production levels increase, it will be crucial for FFs and ABGCs to ensure the diversity in production is maintained so that the market is not saturated with a single or few kinds of produce which may cause to drive down the prices. Access to market information, risk management and mitigation measures need to be looked at through these institutions to provide important farm and market advisories to farmers. At the same time, the profitability of agriculture is at risk due to natural climatic conditions in the State. For this, insurance through the insurance agencies, as well as linkages through PMFBY (Prime Minster Fasal Bheema Yojana- an insurance service for farmers for their yields), should be encouraged to ensure the risks of agriculture are covered.

Off-Season vegetables & Organic certification: Off-season vegetable production has proved to be very remunerative for the farmers in the project area. However, the perishable nature of vegetables renders high variation in the fluctuation of prices leading to poor return sometimes. Storage of vegetables and other high-value horticulture crops for a longer duration is a limitation in the hills and therefore, requires support from govt. for the development of cold storage of suitable size for better post-harvest management of these crops.

As most of the farmers in the project area were observed following the resilient resource-conserving agricultural practices and technologies suitable for organic production, efforts are needed to go for certified National Programme for Organic Production (NPOP) or Participatory Guarantee Systems (PGS) organic production in convergence with Uttarakhand Organic Commodity Board. The certified organic produce would fetch the farmer premium price and hence, more benefits per unit area.

Sustaining farm incomes& market linkages: With its abundant natural resources and numerous agro-geo climatic zones, Uttarakhand has tremendous potential to turn into a hub for the production and sale of several agro-horticulture produce. Gramya has contributed to increasing the gross cropped area, gross irrigated area and productivity of various crops, resulting in increased production levels. However, to sustain and increase farm incomes, it is essential that a significant channel of the post-production value chain is established. This involves, strengthening the farmer institutions facilitated and nurtured in the project. Few success stories are well documented from this project, however, to ensure that the institutions become empowered and self-reliant, handholding support may be required beyond the project period.

The growth centres established as part of the project, seek to empower entrepreneurs and farmers by supporting the production of high-value products and diversification of existing outputs through the development of fixed assets and supporting infrastructure. The State Government supports these initiatives by plugging the gaps through infrastructural and institutional development. In near future, the growth centres

will help build capacities of people, provide skills, and strengthen backward linkages by dovetailing several existing schemes through various state departments.

As a way to address this challenge and lead the marketing activities under the project, ABGC Khyarsi has come forward as a lead institution (or progressive growth centre) that will consolidate the activities of all the ABGCs and the marketing of the Gramyashree products. This would entail the establishment of a management committee consisting of representation from all the federations. The ABGC Khyarsi would oversee the accounting, procurement and input marketing, provision of technical support, and overall management of the marketing activities for the Gramyashree brand and stores. With convergence initiatives, the institutions may seek support for the production of high-value crops, diversification of existing outputs through the development of fixed assets and supporting infrastructure. In near future, capacities should be built of members, strengthening backward and forward linkages, dovetailing from several existing schemes through various state departments and value addition and marketing support through a convergence approach.

Animal husbandry: While the project has been instrumental in changing the animal housing and feeding pattern through the provision of animal sheds, mangers and charis, fodder cultivation, management of animal health is a crucial parameter where the department will step in. The paravets trained through the project have made animal health care services available to the farmers at their doorstep. Linkages of these paravets to the Animal Husbandry department will ensure further improvement in healthcare in terms of timely vaccination of all animals against at least, HS and FMD if not all other diseases like SP, BQ and Anthrax and treatment of cases at the doorstep of animal owners.

Animal Husbandry has also been undertaken in groups under FIGs and continued support from federations for animal husbandry producers to increase the revenues by providing efficient marketing outlets for animal products at remunerative prices is the need. Besides helping with a better price of milk, meat and eggs, the institutional support from federation will also help to collectivize measures to increase the productivity of animals (AI, NBC) and minimization of cost of production with technical inputs like cattle feed and fodder seeds, etc. in a more efficient manner. Diversion of more fallow land for fodder production and arrangement for supply of seed of high yielding varieties of fodder would go a long way to shorten the gap between the availability and requirement of good quality nutritious fodder to produce increased quantity of milk at a reduced cost.

Withdrawal Strategy: The Gramya project has ensured independent institutionalizing of activities and measures ingrained in the project design for the long term sustainability of assets created as part of the project interventions. The GPWDP include a withdrawal strategy for implementation in the last year of the plan. The withdrawal strategy that clearly defines the roles and responsibilities of local institutions in the maintenance and sustainability of the various assets. A withdrawal document in consensus with the GPs is being prepared by the WMD and will be signed with the respective GPs. The document outlines the infrastructure that has been set-up as part of Gramya II and how its operation and maintenance will take place in the future.

The withdrawal strategy consists of:

- Post project O&M arrangements for the project so that the assets created under UDWDP-II are maintained and continued to give benefits.
- Sustainability and scaling up of IGAs undertaken by vulnerable groups
- Ensure that each implementer (including the GP, RVC, VP, WWMC, User groups, vulnerable groups/ individual beneficiaries, FIGs and FFs) is aware of the operations and maintenance (O&M) responsibilities and a long-term plan is prepared for the O&M
- Preparation of agreements that outline the responsibility in terms of time and money of each member of the community towards O&M activities, particularly for common properties and assets.

The project will create two type of assets which can be categorized as individual assets and community assets. All the assets created by the project will be entered in a separate Register at the Gram Panchayat level and listed in the agreement signed between the project and the respective GP.

Table 130: List of activities/ Assets created in the project and future management		
Activity/ Assets	**ResponsibleDepartment /Institutions / Organization**	**Role**
Agriculture / Horticulture Activities-	Agriculture/ Horticulture Department	District/ Block level functionaries to provide extension and input support
Federation and ABGC	GP and Federation	District/ Block level functionaries to provide extension and input support, FFs will manage the assets
Animal Husbandry assets	Individual beneficiary/GP for community assets created in GP land	District/ Block level functionaries to provide extension and input support
Forestry and DLT structures created in inter GP spaces	Concerned Forest Division, Van Panchayat and Gram Panchayat	Concerned Forest Division will be responsible for Inter GPs space in Reserves Forest Areas. Concern Van Panchayat and Gram Panchayat will be responsible for maintain assets in Van Panchayat Areas
Plantations on Community lands	Van panchayat	The Van Panchayat would provide for watch and ward and maintenance of these areas in consultation with the community
Pasture lands	Concerned GP,VP and user group as per ownership of land	Responsible for maintenance of these community asset
Water Storage Tanks, Irrigation guls, village ponds and other water conservation structures	Concerned User group	Responsible for O&M of assets Responsible for utilization O&M fund
Multi Utility Centre, culverts, small bridges,	Concerned Gram Panchayat	Gram Panchayat will be responsible for maintenance of these community assets
Individual Assets – (Bio- gas, poly house, poly tunnel, mangers, tools, equipment etc.	Individual beneficiary	Individual beneficiary will be responsible
IGA for Vulnerable households	Concerned Livelihood Group/ Individual beneficiary	Concerned Livelihood Group/Individual beneficiary District, Block level functionaries for further extension and input support
Alternate energy equipment, machines and tools.	Concerned individual/ User Groups/ VGs	Individual beneficiary/ User Groups/ VGs will be responsible

22. Annexures

1. **Time series analysis of source discharge data**

Average Post monsoon Discharge of water sources in lpm											
District	**No of sources**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Variations**	**% variations**
Dehradun	261	1.1	1.05	1.39	1.4	1.41	1.41	1.42	1.43	0.33	30.0
Pithoragarh	279	5.1	5.19	5.5	5.9	5.92	6	5.8	6	0.9	17.7
Bageshwar	96	17.5	19.4	19.45	19.5	20.5	20.12	20.2	20.4	2.9	16.6
Pauri	196	2.9	2.98	2.9	2.9	3.3	3.3	3.2	3.3	0.4	13.8
Tehri	381	10.2	11.01	11.24	11.67	11.9	12	12.2	12.75	2.55	25.0
Uttarkashi	144	10.7	10.77	12.59	13.50	14.10	14.15	14.30	14.31	3.61	33.7
Almora	550	0.6	0.65	0.65	0.70	0.72	0.72	0.71	0.72	0.12	20.0
Rudrapraya g	147	7.67	8.2	8.35	8.54	9.165	9.16	9.2	9.21	1.54	20.1
Total	**2054**	**6.97**	**7.41**	**7.76**	**8.01**	**8.38**	**8.36**	**8.38**	**8.52**		

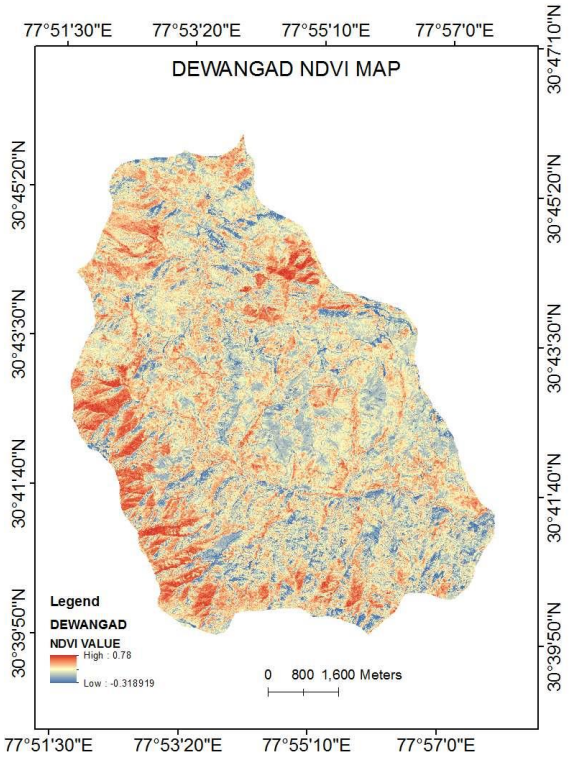
Average Pre monsoon Discharge of water sources in lpm										
District	**No of sources**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Variation**	**% variation**
Dehradun + PMU	261	0.48	0.5	0.505	0.515	0.55	0.56	0.56	0.075	15.6
Pithoragarh	279	2.65	2.8	3.05	3.1	3.2	3.2	3.21	0.56	21.1
Bageshwar	96	10.1	11.32	11.35	11.38	11.9	12	12.1	2	19.8
Pauri	196	1.06	1.09	1.15	1.23	1.27	1.30	1.26	0.2	18.9
Tehri	381	3.97	3.98	4.13	4.36	4.54	4.50	4.59	0.62	15.6
Uttarkashi	144	6.9	7.32	7.32	7.40	7.80	7.80	7.82	0.92	13.3
Almora	550	0.36	0.37	0.36	0.40	0.44	0.44	0.45	0.09	25.0
Rudraprayag	147	4.1	4.18	4.28	4.55	4.86	4.90	4.92	0.82	20.0
Total	2054	3.70	3.95	4.02	4.12	4.32	4.34	4.36		

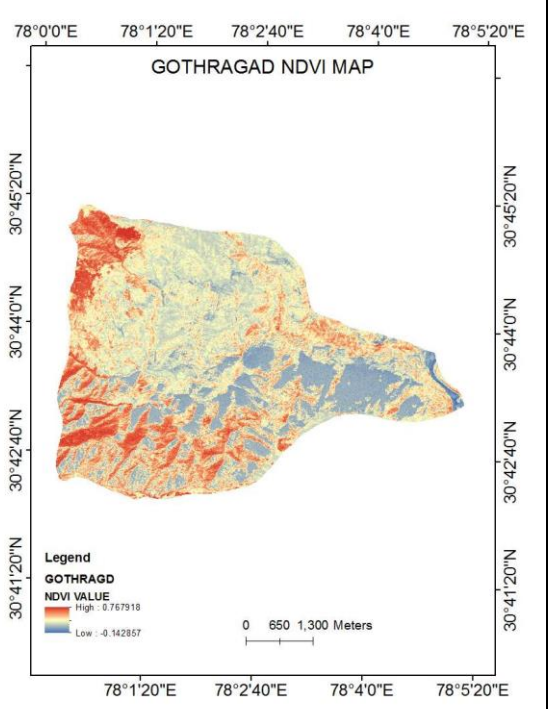
2. **Division wise details of direct beneficiaries**

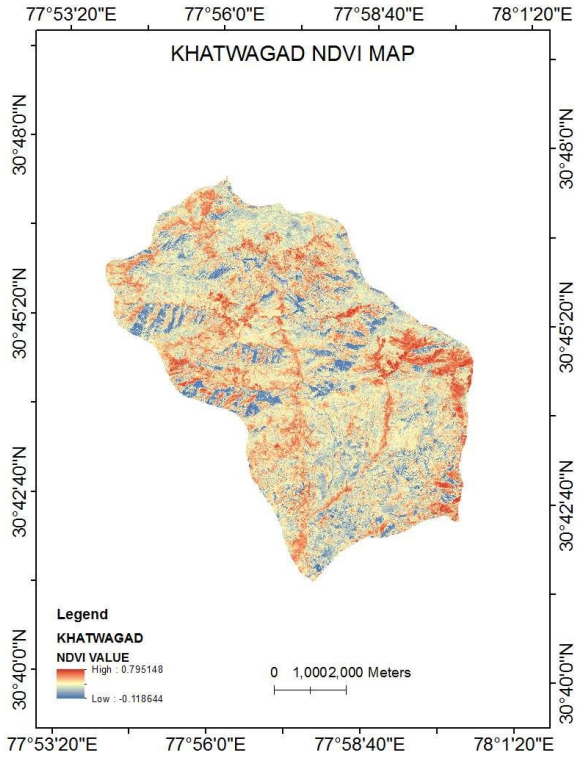
Division	Total Households	Beneficiary households	Female beneficiaries	Male Beneficiaries
Rudraprayag	11622	10037	2120	7904
Uttarkashi	10153	4250	366	3887
PMU	696	683	56	629
Dehradun	5477	4944	325	4608
Thatyur	7007	6403	636	5761
Pauri	5192	4654	1592	3056
Almora	11197	9220	1766	7490
Bageshwar	7470	6046	1013	5028
Pithoragarh	6439	4629	943	3686
Total	**65253**	**50866**	**8817**	**42049**

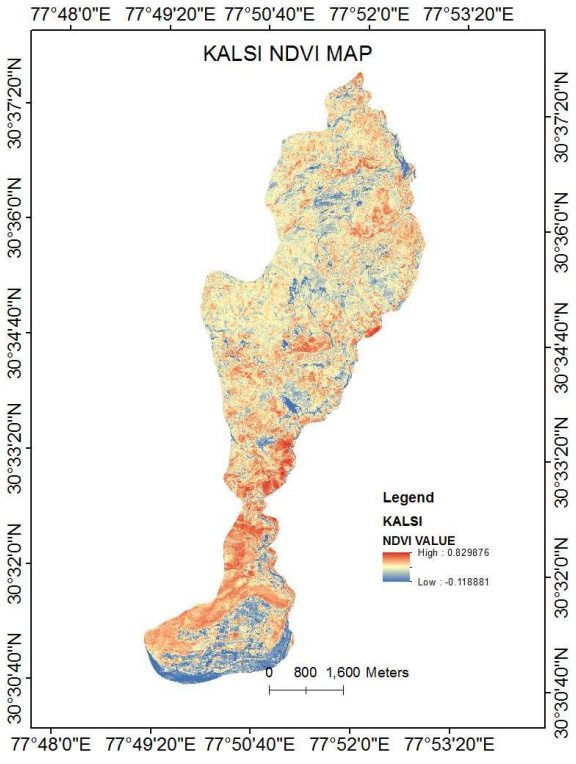
3. NDVI images

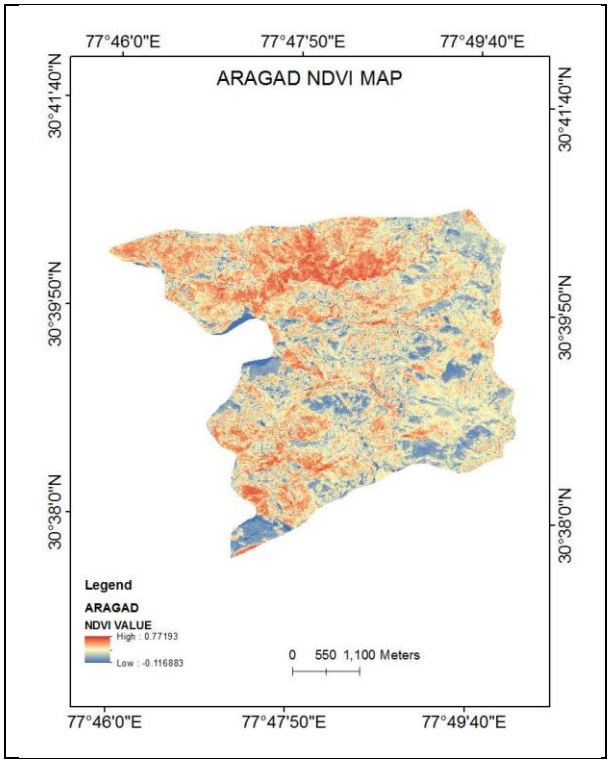
1. NDVI images Dehradun division











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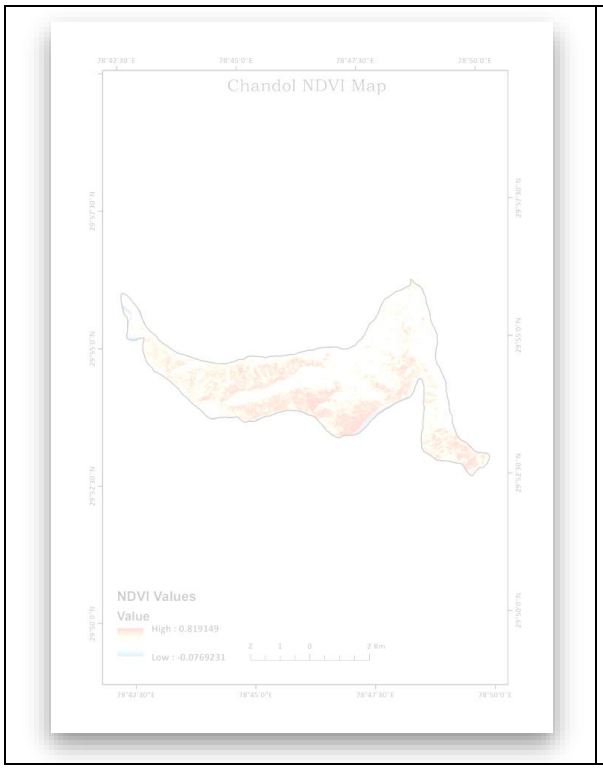
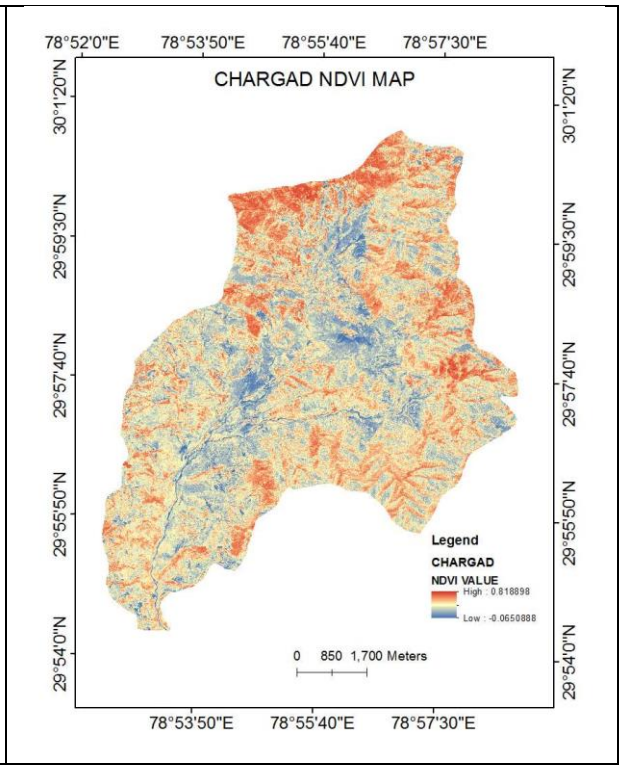
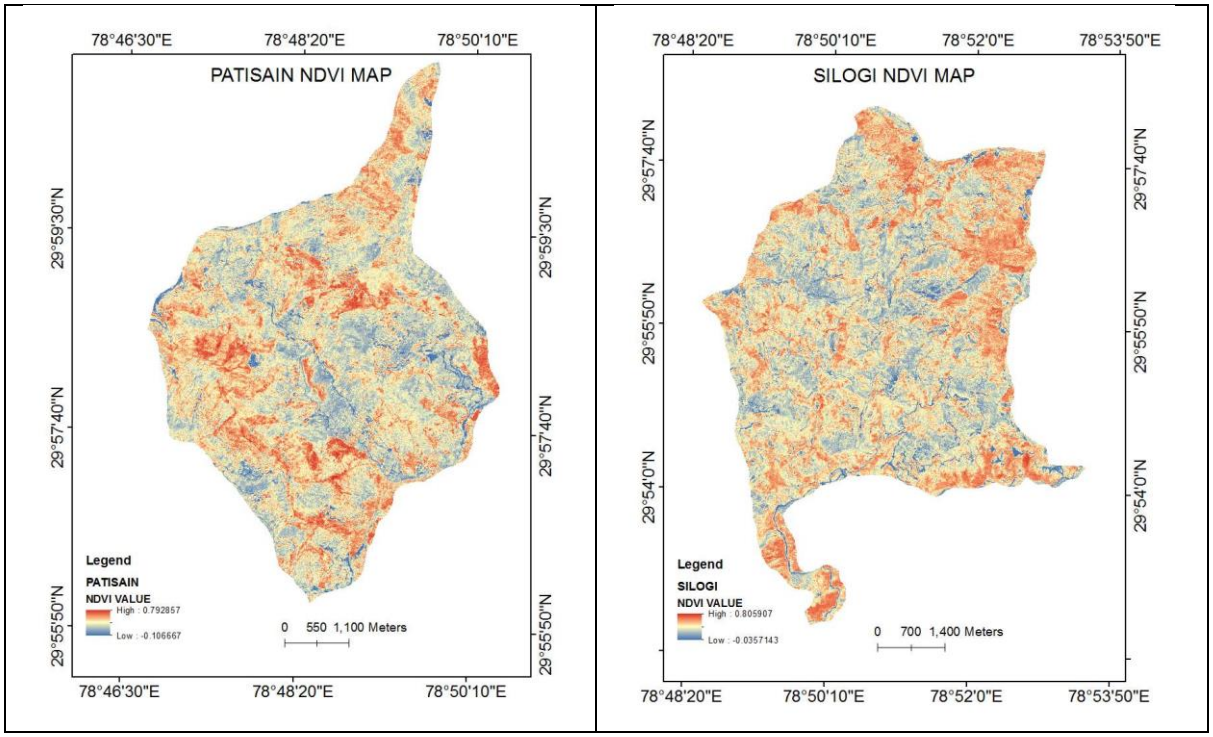
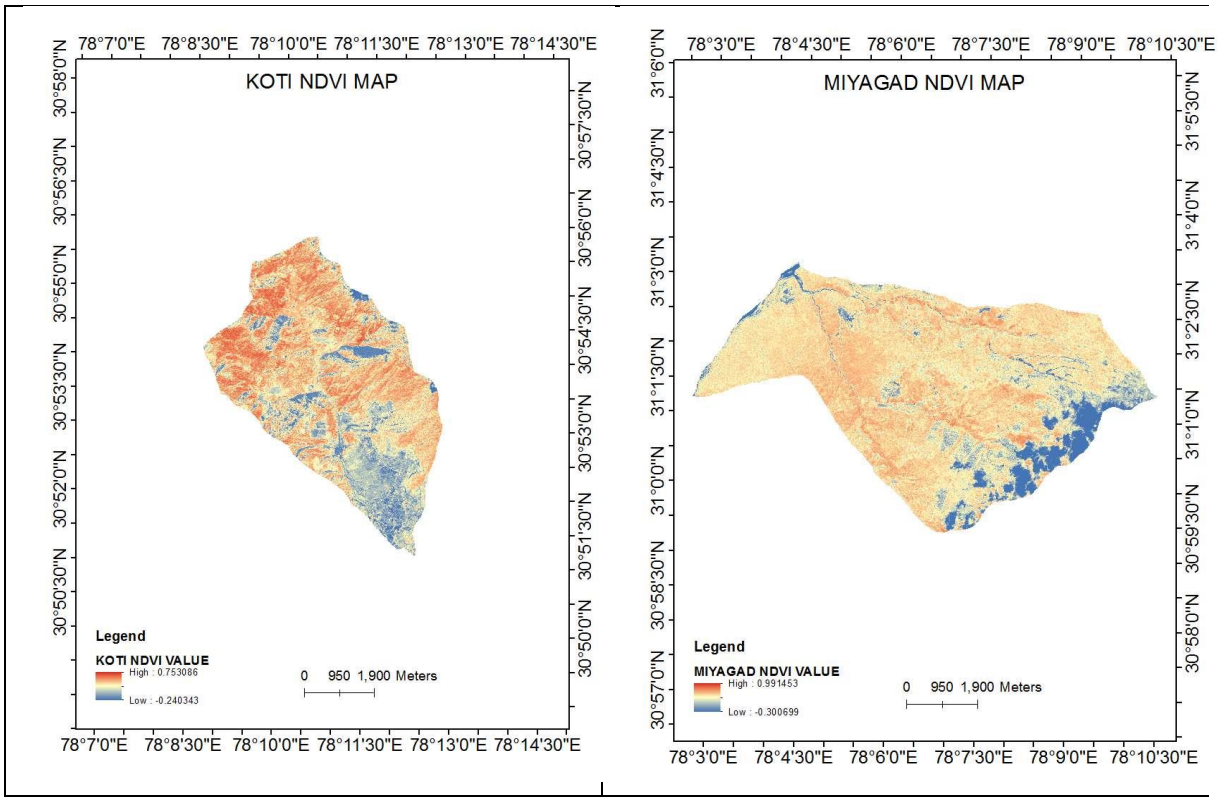
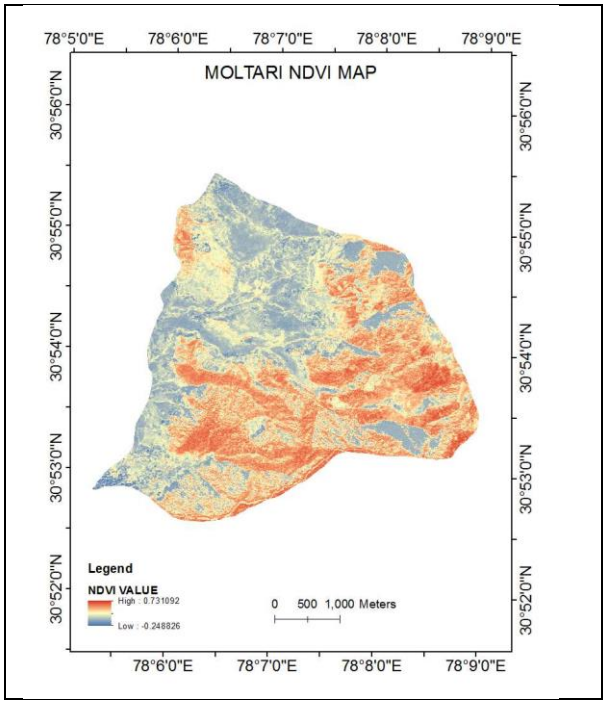




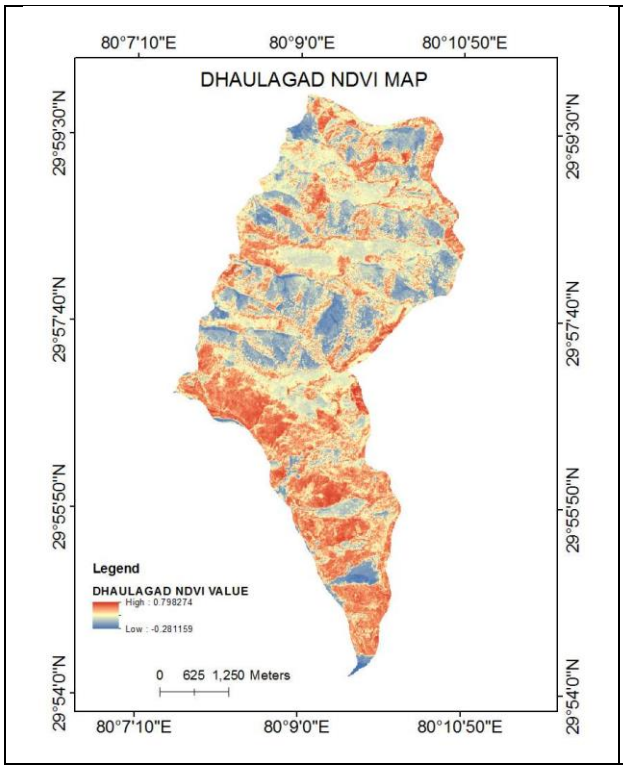


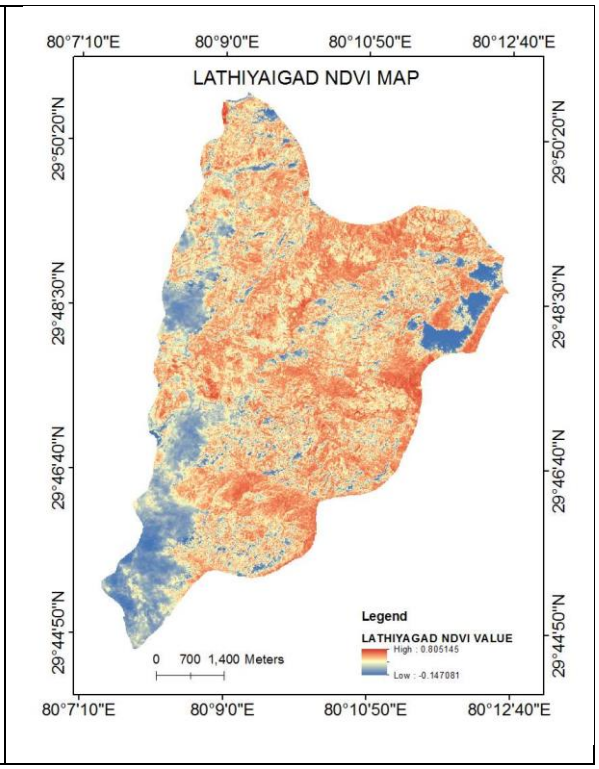
3. NDVI images Uttarkashi division

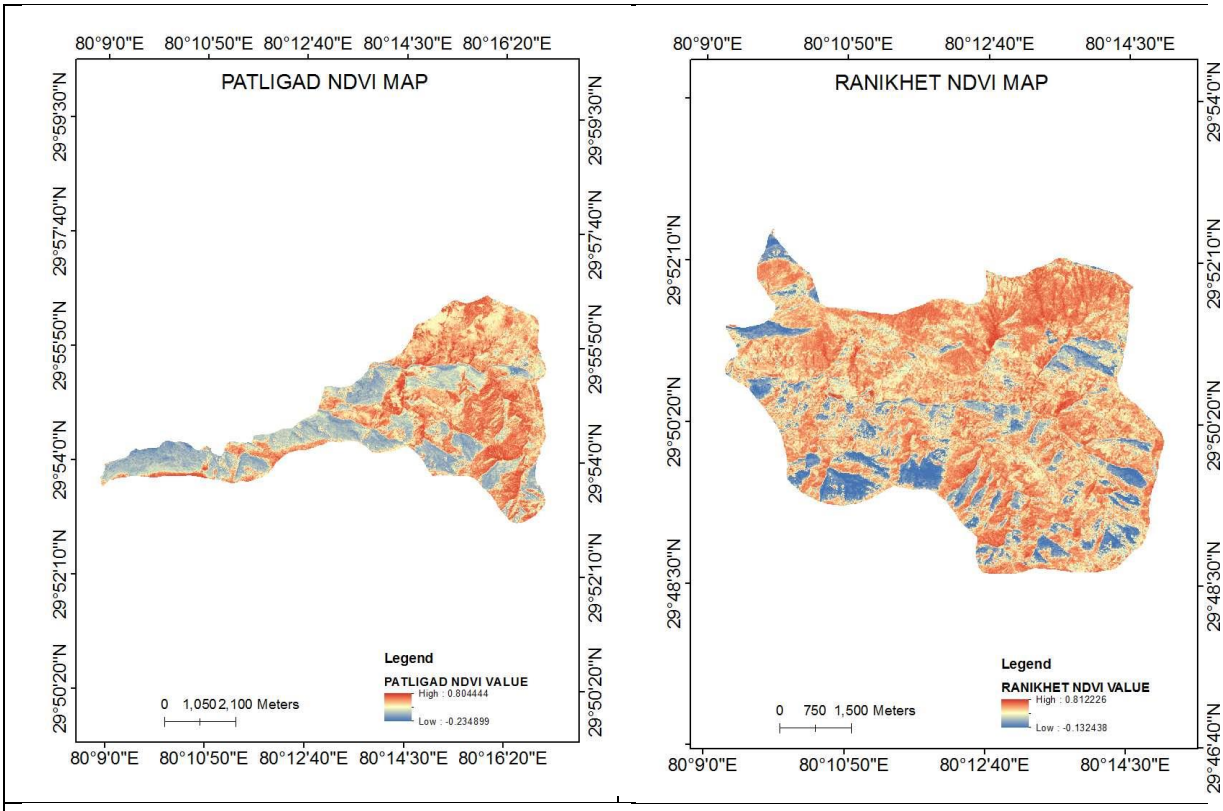




4. NDVI images Pithoragarh division






PATLIGAD NDVI MAP
80°9'0"E
80°10'50"E
80°12'40"E
80°14'30"E
80°16'20"E
29°59'30"N
29°57'40"N
29°55'50"N
29°54'0"N
29°52'10"N
29°50'20"N
Legend
PATLIGAD NDVI VALUE
High : 0.804444
Low : -0.234899
0 1,050 2,100 Meters
RANIKHET NDVI MAP
80°9'0"E
80°10'50"E
80°12'40"E
80°14'30"E
29°54'0"N
29°52'10"N
29°50'20"N
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RANIKHET NDVI VALUE
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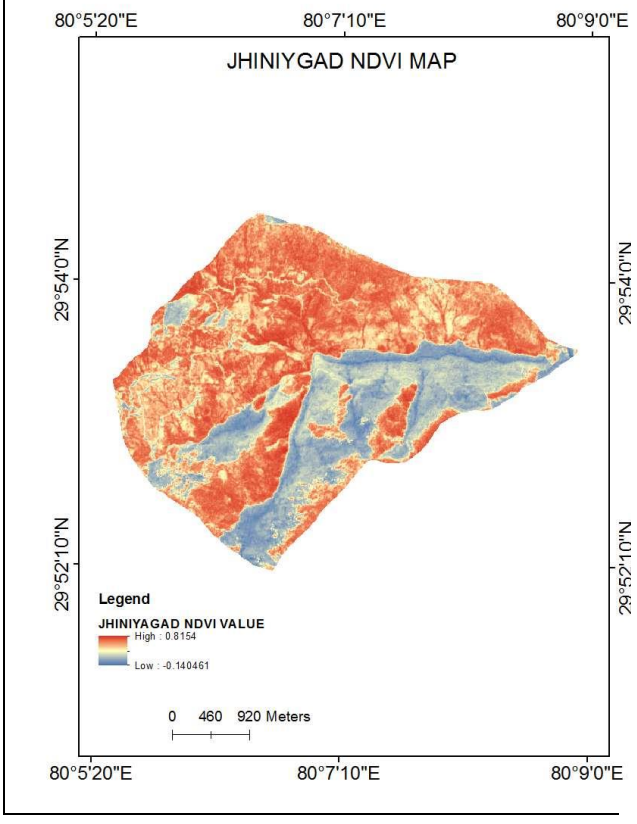
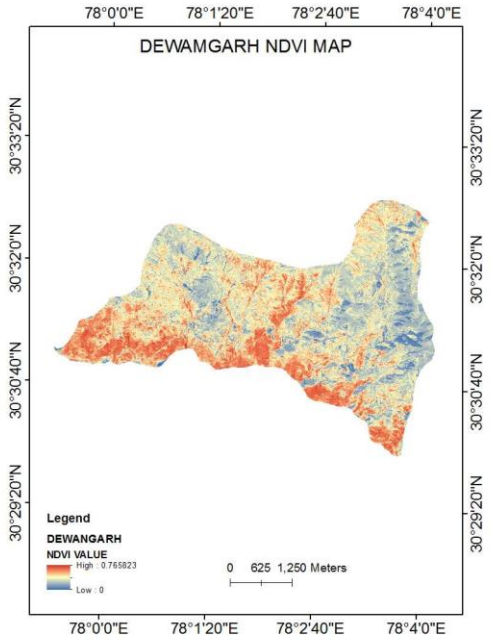
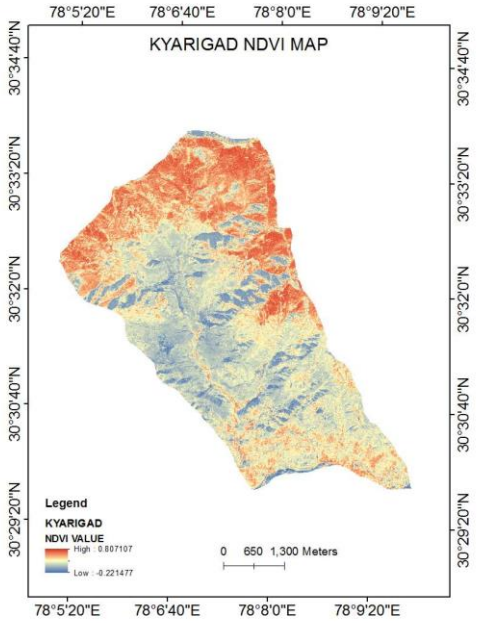
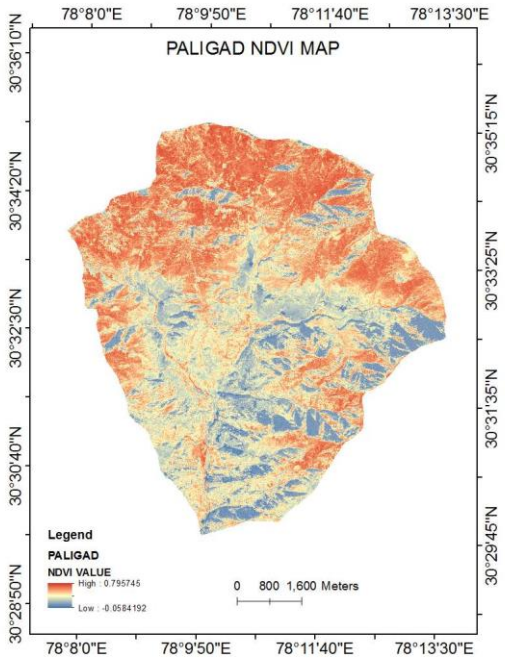
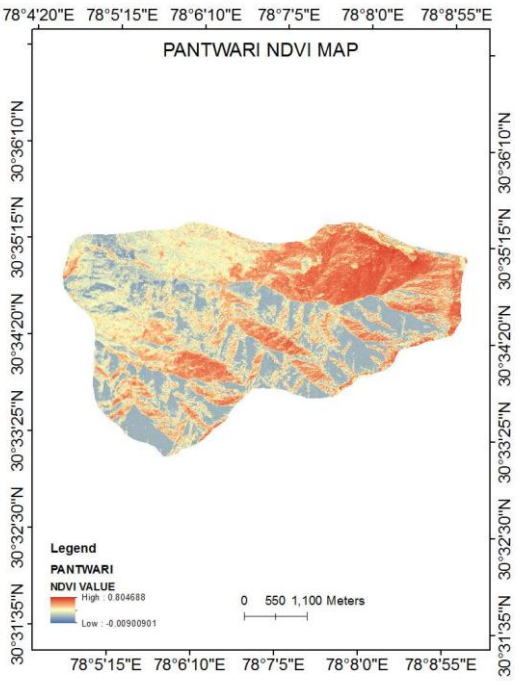

JHINIYGAD NDVI MAP
80°5'20"E
80°7'10"E
80°9'0"E
29°54'0"N
29°52'10"N
Legend
JHINIYAGAD NDVI VALUE
High : 0.8154
Low : -0.140461
0 460 920 Meters

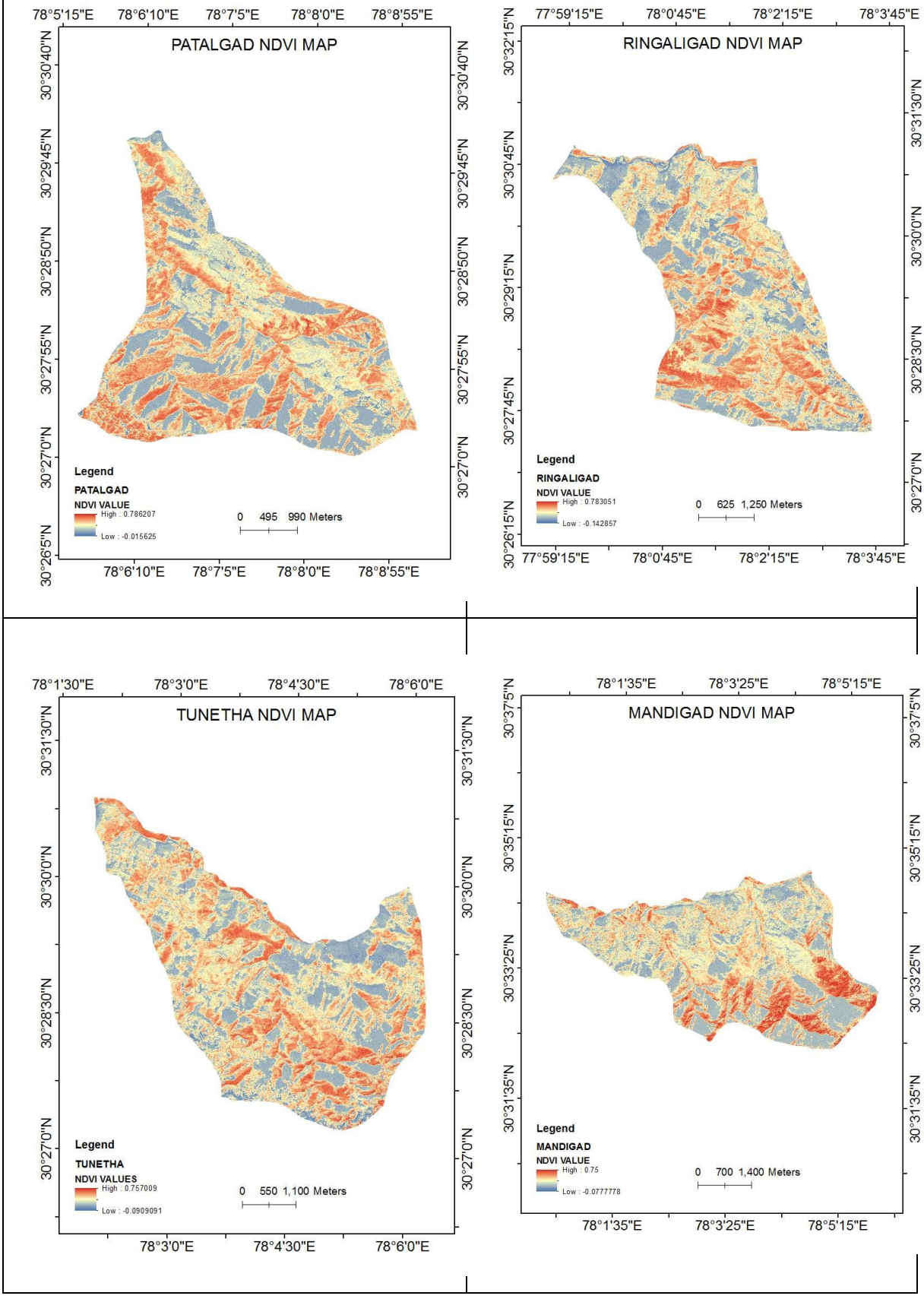
5. NDVI images Thatyur division



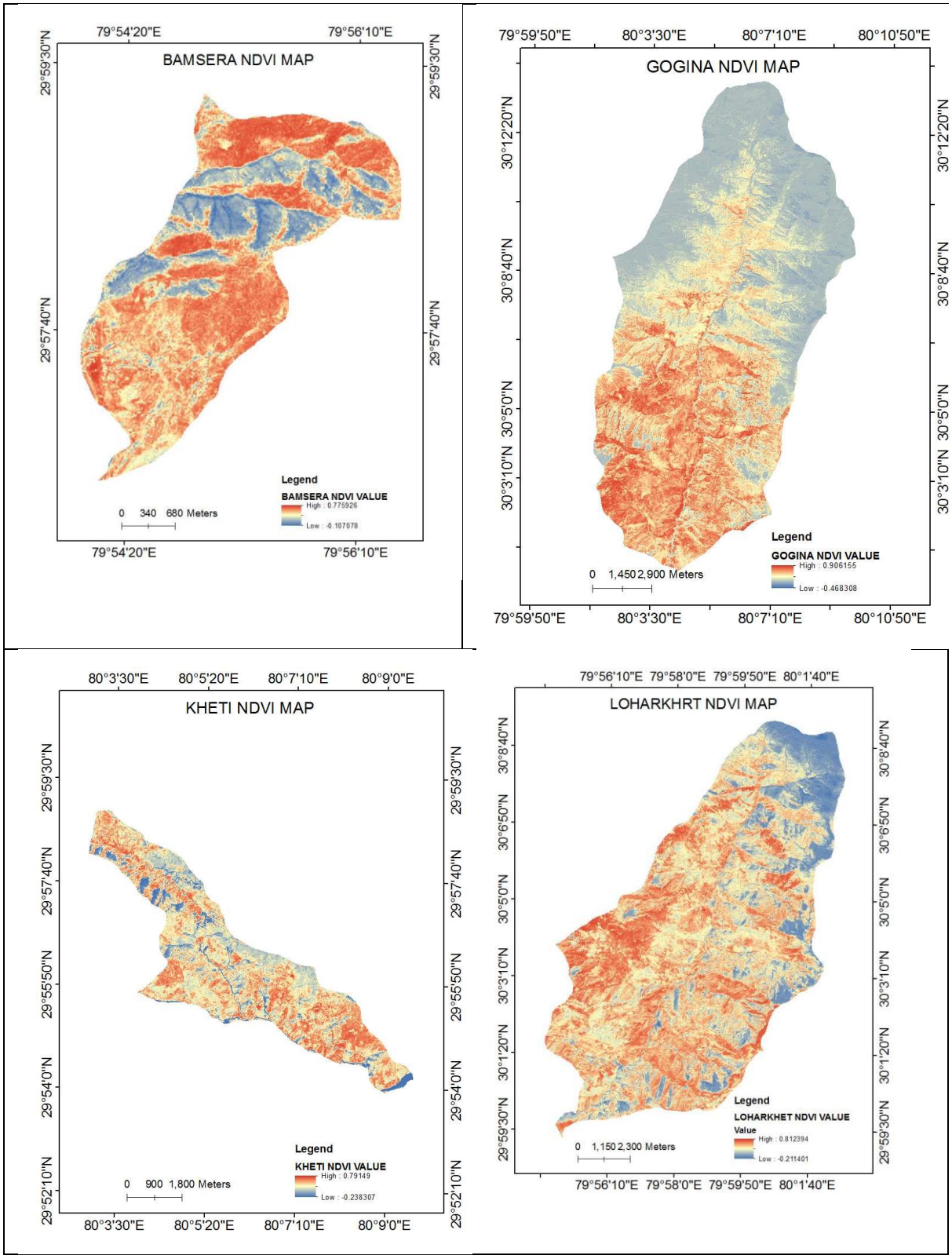


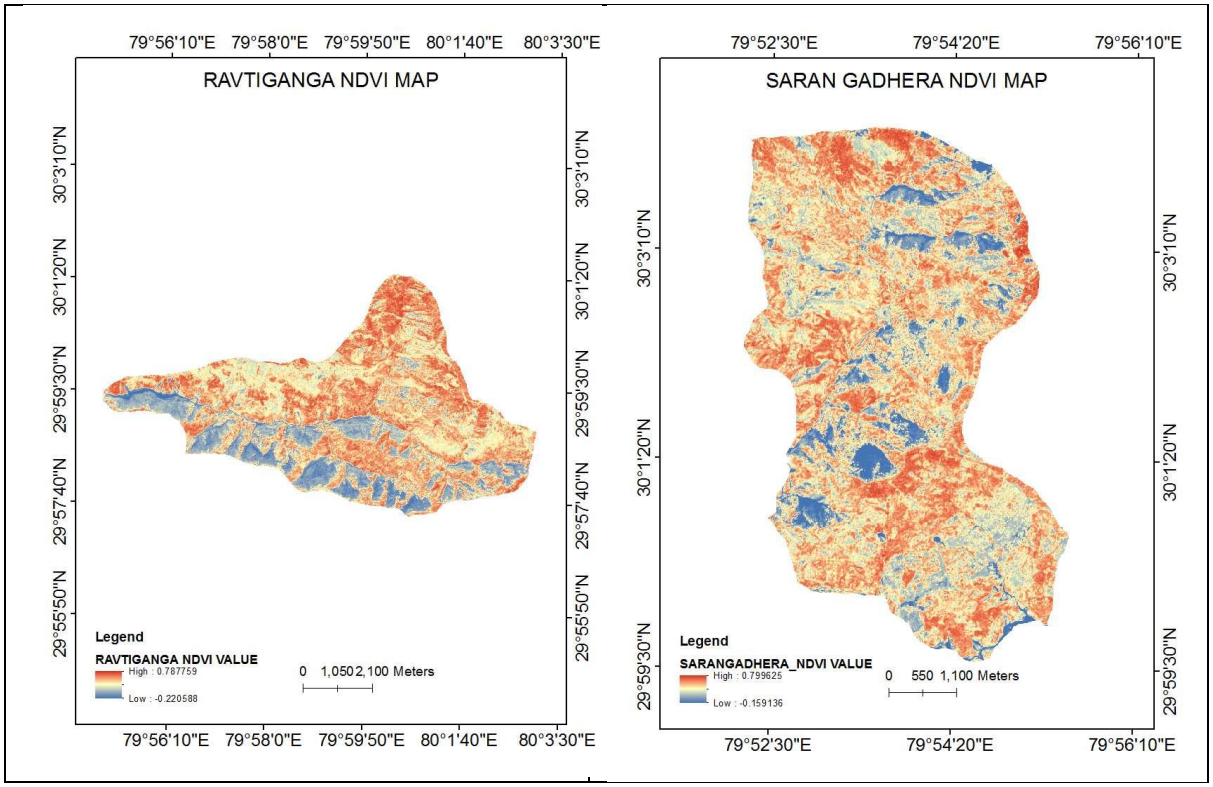




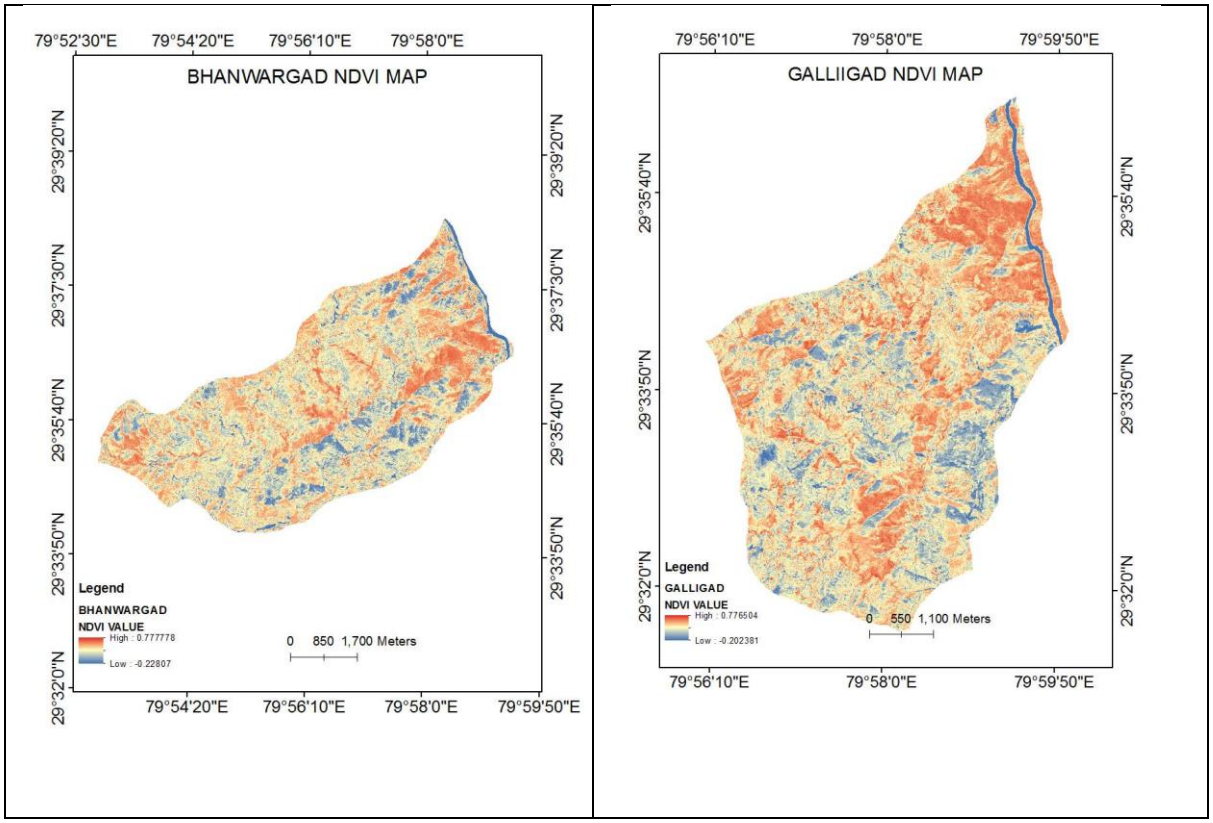

PATALGAD NDVI MAP
78°5'15"E
78°6'10"E
78°7'5"E
78°8'0"E
78°8'55"E
30°30'40"N
30°29'45"N
30°28'50"N
30°27'55"N
30°27'0"N
30°26'5"N
Legend
PATALGAD
NDVI VALUE
High : 0.786207
Low : -0.015625
0 495 990 Meters
RINGALIGAD NDVI MAP
77°59'15"E
78°0'45"E
78°2'15"E
78°3'45"E
30°32'15"N
30°31'30"N
30°30'45"N
30°30'0"N
30°29'15"N
30°28'30"N
30°27'45"N
30°27'0"N
30°26'15"N
Legend
RINGALIGAD
NDVI VALUE
High : 0.783051
Low : -0.142857
0 625 1,250 Meters
TUNETHA NDVI MAP
78°1'30"E
78°3'0"E
78°4'30"E
78°6'0"E
30°31'30"N
30°30'0"N
30°28'30"N
30°27'0"N
Legend
TUNETHA
NDVI VALUES
High : 0.757009
Low : -0.0909091
0 550 1,100 Meters
MANDIGAD NDVI MAP
78°1'35"E
78°3'25"E
78°5'15"E
30°37'5"N
30°35'15"N
30°33'25"N
30°31'35"N
Legend
MANDIGAD
NDVI VALUE
High : 0.75
Low : -0.0777778
0 700 1,400 Meters

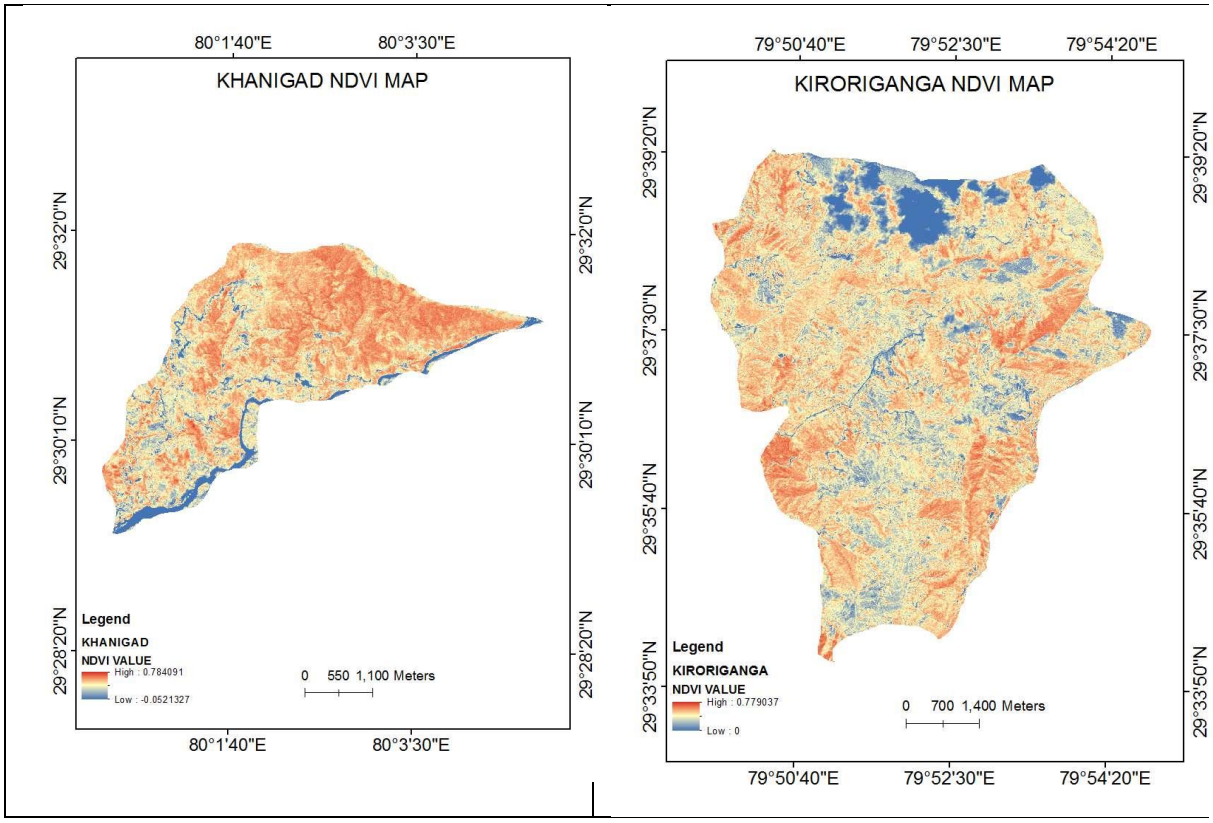
6. NDVI images Bageshwar division





7. NDVI images Almora division





4. Micro watershed wise change in Biomass

Development Block	MWS	Avg. Biomass (t h-1) 2014-15	Avg. Biomass (t h-1) 2021-2022	% Change	Total Biomass (t) 2021-2022
Dehradun Division					
Chakrata	Gothragad	28.51	28.58	0.25	77932.29
Kalsi	Kalsi	23.45	23.65	0.85	70513.26
	Khatwagad	23.13	23.01	-0.50	142596.40
	Aragad	22.25	22.70	2.00	48460.77
	Dewangad	23.83	24.75	3.88	172379.85
	Total Biomass Dehradun				511882.567
Thatyur Division					
Jaunpur	Patalgad	13.01	13.47	3.50	21399.67035
	Kyarigad	27.31	27.72	1.50	78126.39885
	Paligad	33.20	34.86	5	206705.058
	Ringaligad	21.59	22.56	4.50	49742.7524
	Tunethagad	19.93	20.33	2.00	45893.3904
	Mandigad	26.02	26.92	3.45	61073.63167
	Dewangad	27.99	28.34	1.25	52922.34225
	Pantwarigad	32.19	32.99	2.50	62654.05775
	Total Biomass Thatyur				578517.3017
Pauri Division					
Pokhra	Chargad	40.489	43.93	8.50	122552.96
Ekeshwar	Silogi	29.87	32.89	10.15	140914.24
	Patisen	34.41	38.19	11.00	258944.86
	Chandol	28.88	29.74	3.00	80042.01
	Total Biomass				602454.08
Uttarkashi Division					
Mori	Miyagad	25.5	26.38	3.45	119839.11

Development Block	MWS	Avg. Biomass (t h-1) 2014-15	Avg. Biomass (t h-1) 2021-2022	% Change	Total Biomass (t) 2021-2022
Purola	Moltadi	25.07	26.26	4.75	48162.83
Naugaon	Koti	32.28	32.93	2.0	96268.93
	Total Biomass Uttarkashi				264270.88
Rudraprayag Division					
Ukhimath	Rawanganga	34.54	38.34	11.0	158027.56
Agastmuni	Dangi	36.55	40.21	10.0	119114.62
	Uttarsu	33.92	36.97	9.0	134116.93
	Total Biomass Rudraprayag				411259.13
Pithoragarh Division					
Berinag	Jhiniyagad	30.49	33.67	10.5	42367.81
Munsyari	Patligad	26.28	29.17	11.0	95255.63
	Dhaulagad	27.926	30.44	9.0	77892.08
Didihat	Lathiyagad	30.114	34.33	14.0	73318.15
	Ranikhet	32.267	33.88	5.0	138760.33
	Total Biomass Pithoragarh				427594.01
Bageshwar Division					
Kapkot	Saran gadhera	31.786	36.76	15.7	453466.71
	Loharkhet	29.97	32.92	9.9	449623.81
	Gogina	20.096	23.20	15.5	442074.46
	Revatiganga	27.63	31.11	12.6	142511.36
	Kheti	29.763	32.14	8.0	84443.06
	Bamsera	27.155	28.11	3.5	25033.69
	Total Biomass Bageshwar				1572119.41
Almora Division					
Dhauladevi	Bhanwargad	26.26	27.97	6.5	109595.40
	Khannigad	32.38	33.61	3.8	46212.13
	Galligad	25.77	27.70	7.5	86033.67
	Kiroriganga	28.44	30.74	8.1	149993.39
	Total Biomass Almora				391834.59

5. Stratum Wise Biomass Distribution in MWS

Development Block	MWS	Avg. Biomass (t h-1) 2021-22	Tree Biomass (t h-1)	Herb + Shrub biomass	Total Biomass (t) 2021-2022
1. Dehradun Division					
Chakrata	Gothragad	28.58	28.15	0.43	77932.29
Kalsi	Kalsi	23.65	23.29	0.35	70513.26
	Khatwagad	23.01	22.67	0.35	142596.40
	Aragad	22.70	22.35	0.34	48460.77
	Dewangad	24.75	24.38	0.37	172379.85
	Total Biomass Dehradun				511882.56
2. Thatyur Division					
Jaunpur	Patalgad	13.46	13.26	0.20	21399.67
	Kyarigad	27.72	27.31	0.42	78126.40
	Paligad	34.86	34.34	0.52	194027.15
	Ringaligad	22.56	22.22	0.34	49742.75
	Tunethagad	20.32	20.02	0.30	45893.39
	Mandigad	26.91	26.51	0.40	61073.63
	Dewangad	28.33	27.91	0.43	52922.34
	Pantwarigad	32.99	32.50	0.49	62654.05

		Total Biomass Thatyur			578517.30
		3. Pauri Division			
Pokhra	Chargad	43.93	43.27	0.66	122552.96
Ekeshwar	Silogi	32.89	32.41	0.49	140914.24
	Patisen	38.19	37.62	0.57	258944.86
	Chandol	29.74	29.30	0.45	80042.01
		Total Biomass			602454.08
		4. Uttarkashi Division			
Mori	Miyagad	26.38	25.98	0.40	119839.11
Purola	Moltadi	26.26	25.87	0.39	48162.83
Naugaon	Koti	32.93	32.43	0.49	96288.93
		Total Biomass Uttarkashi			264270.88
		5. Rudraprayag Division			
Ukhimath	Rawanganga	38.34	37.76	0.58	158027.56
Augustmuni	Dangi	40.21	39.60	0.60	119114.62
	Uttarsu	36.97	36.42	0.55	134116.93
		Total Biomass Rudraprayag			411259.13
		6. Pithoragarh Division			
Berinag	Jhiniyagad	33.67	33.17	0.51	42367.81
Munsyari	Patligad	29.17	28.74	0.44	95255.63
	Dhaulagad	30.44	29.98	0.46	77892.08
Didihat	Lathiyagad	34.33	33.82	0.51	73318.15
	Ranikhet	33.88	33.37	0.51	138760.33
		Total Biomass Pithoragarh			427594.01
		7. Bageshwar Division			
Kapkot	Saran Gadhera	36.76	36.21	0.55	453466.71
	Loharkhet	32.92	32.42	0.49	449623.81
	Gogina	23.20	22.85	0.35	442074.46
	Revatiganga	31.11	30.65	0.47	142511.36
	Kheti	32.14	31.66	0.48	84443.06
	Bamsera	28.11	27.68	0.42	25033.69
		Total Biomass Bageshwar			1572119.41
		8. Almora Division			
Dhauladevi	Bhanwargad	27.97	27.55	0.42	109595.40
	Khannigad	33.61	33.11	0.50	46212.13
	Galligad	27.70	27.29	0.42	86033.67
	Kiroriganga	30.74	30.28	0.46	149993.39
		Total Biomass Almora			391834.59

6. Annexure List of Banned Pesticides

Aldrin
Benzene Hexa Chloride (BHC)
Calcium Cyanide
Chlordane
Copper acetoarbenite
Dibromocworopropane (DBCP)
Endrin
Ethyl Mercury Chloride
Ethyl parathion
Heptachlor
Manzona
Methomyl 24% Formulation
Nicotine Sulphate
Nitrofen
Paraquate dimethyl sulphate
Penta Choloro nitrobenzene
Penta cholorophenol (PCP)
Phenyl Mercury Acetate
(PMA) Sodium Methane Arsonate (MSMA)
Tetradifon
Toxaphene
Phosohamidon 85% SL

Methomyl 12.5% L	Aldicarb
Chlorbenzilate	Deildrin
Ethyl dibromide (EDB)	Maleic Hydrazide
Trichloro Acetic Acid (TCA)	Aluminium phosphamide
Carbofuran 505 WP	Captafal 80%
Malathian 25 DP & 50% EC	Methoxy ethyl mertcury chloride (MECE)

Extremely hazardous (Class Ia) technical grade active ingredients of pesticides (common name) not permissible in the project

Aldicarb	Difethialone	Parathion-methyl
Brodifacoum	Diphacinone	Phenylmercury acetate
Bromadiolone	Disulfoton	Phorate
Bromethalin	Ethoprophos	Phosphamidon
Calcium cyanide	Flocoumafen	Sodium fluroacetate
Captafol	Fonofos	Sulfotep
Chlorethoxyfos	Hexzchlorobenzene	Tebupirimfos
Chlormephos	Mercuric chloride	Terbufos
Chlorophacinone	Mevinphos	

Highly hazardous (Class Ib) technical grade active ingredients of pesticides (common name) not permissible in the project

Acrolein	*Ethiofencarb*	Omethoate
Allyl alcohol	Famphur	Oxamyl
Azinphos-ethyl	*Fenamiphos*	Oxydemeton-methyl
Azinphos-methyl	Flucuthrinate	Paris green (C)
Blasticidin-S	Fluoroacetamide	Pentachlorophenol
Butocarboxim	Formetanate	*Pindone*
Butoxycarboxim	Furathiocarb	Pirimiphos-ethyl
Cadusafos	Heptenophos	Propaphos
Calcium arsenate	Isazofos	Propetamphos
Carbofuran	Isofenphos	Sodium arsenite
Chlorfenvinphos	Isoxathion	Sodium cyanide
3-Chloro-1, 2-prppanediol	Lead arsenate	Strychnine
Coumaphos	Mecarbam	Tefluthrin
Coumatetralyl	Mercuric oxide	Thallium sulphate
Zeta-cypermethrin	Methamidophos	Thiofanox
Demeton-S-methyl	Methidathion	Thiometon
Dichlorvos	*Methiocarb*	Triazophos
Dicrotophos	Methomyl	Vamidothion
Dinoterb	Monocrotophos	Warfarin
Edifenphos	Nicotine	Zinc phosphide

Moderately hazardous (Class II) technical grade active ingredients of pesticides (common name) not permissible in the project

Alanycarb	Endosulfan	Paraquat
Anilofos	Endothal-sodium	Pebulate
Azaconazole	Esfenvalerate	Permethrin

Azocyclotin	Ethion	Phenthoate
Bendiocarb	Etrimfos	Phosalone
Benfuracarb	Fenazaquin	Phosmet
Bensulide	Fenitrithion	phoxim
Bifenthrin	Fenobucarb	Piperophos
Bilanafos	Fenpropidin	Pirimicarb
Bioallethrin	Fepropathrin	Prallethrin
Bromoxynil	Fenthion	Profenofos
Bromuconazole	Fenthin acetate	Propiconazole
Bronopol	Fentin hydroxide	Propoxur
Butamifos	Fenvalerate	Prosulfocarb
Butylamine	Fipronil	Prothiofos
Carbaryl	Fluxofenim	Pyraclofos
Carbosulfan	Formothion	Pyrazophos
Cartap	*Fuberidazole*	Pyrethrins
Chloralose	Gamma-HCH	Pyroquilon
Chlordane	Guazatine	Quinalphos
Chlorfenapyr	Haloxyfop	Quizalofop-p-tefuryl
Chlorphonium chloride	Heptachlor	Rotenone
Chlorpyrifos	Imazalil	Sodium fluoride
Clomazone	Imidacloprid	Sodium hexafluorosilicate
Copper sulphate	Iminoctadine	Spiroxamine
Cuprous oxide	Ioxynil	Sulprofos
Cyanazine	Ioxynil octanoate	Terbumeton
Cyanophos	Isoprocarb	Tetraconazole
Cyflutrin	Lambda-cyhalothrin	Thiacloprid
Beta-cyfluthrin	Mercurous chloride	Thiobencarb
Cyhalothrin	Metaldehyde	Thiocyclam
Cypermethrin	Metam-sodium	Thiodicarb
Alpha-cypermethrin	Methacrifos	Trizamate
Cyphenothrin	Methasulfocarb	Trichlorfon
Deltamethrin	Methyl isothiocyanate	Tricyclazole
Diazinon	Metolcarb	Tridemorph
Difenzoquat	*Metribuzin*	Vernolate
Dimethoate	Molinate	Xylylcarb
Dinobuton	Nabam	
Diquat	Naled	

7. List of Knowledge Management Documents at Directorate and Division Level

Directorate	Summit on Climate Resilient Mountain Agriculture: Book of Abstract
	Addressing Climate Change in the Mountains: Outcomes of Summit on Climate Resilient Mountain Agriculture
	Centripetal Convergence: Compilation of Departmental Development Schemes
	Project Brochure
	Brochure on Nursery Techniques
	Brochure on MTR Findings (GRAMYAVITHIKA)
	Catalogue on Growth Center Products
	Quarterly Newsletters (GRAMYA DARPAN)
Bageshwar	Study on Solar Water Lifting Pump for Irrigation
	Goatry - A successful Intervention under VG Activitiy
	Kiwi Cultivation and ABGC Shama
	Study on Strawberry Cultivation
	Incense Stick- Micro Enterprise

	Polyhouse: Impact Study at Shama
Pithoragarh	Manual on Fruit Cultivation In Hill Region
	Nursery Establishment Manual
	Information on Goat Rearing
	Manual on Poultry
	Package of Practices for Cauliflower and Tomato
	Information on Protected Cultivation in Polyhouse
	Package of Practice for Rainfed Agriculture
	Techniques of Medicinal Plant Cultivation
	Integrated Aquaculture Manual
	Practices adopted for Water Conservation
	Conservation of Water Sources in Project Area
	Training manual of Mushroom Cultivation
	Techniques of Animal Feed
	Manual on Value Addition of Flowers
	Manual on Value Addition of Fruits and Vegetables
	Precautions while using Pesticides
Pauri	Importance and Benefits of Cluster Based Agriculture
	Micro Irrigation System applicable for Mountain Regions
	Package of Practices for cultivation of Capsicum
	Manual for Poultry Management
	Manual on Cultivation of Dhingri Mushroom
	Fodder Conservation
	Package of Practices for Cultivating Zuccini, Cucumber, Tomato, Cauliflower
	Manual on Soil Health and Nutrient Management
	Benefits of Protected Cultivation in Polyhouse
Rudraprayag	Technical information and management techniques of capsicum, French bean, Potato, Tomato and Ginger cultivation
	Animal Husbandry and Nutrition Management in Hilly area
	Poultry Management Techniques
	Goatary Management Techniques
	Scientific Techniques of Fodder Production for milch animals
PMU	Package of Practices for Moringa Cultivation
	Package of Practices for Ginger and Turmeric Cultivation
	Benefits of Vegetable Cultivation in Poly House
	Vegetable Production Techniques
	Product Catalogue – Dharkot Collection Centre
	Product Catalogue – Growth Centre Thano
	Crop Production and Techniques Calendar 2021
	Crop Production and Techniques Calendar 2022
Uttarkashi	Package of Practices for Floriculture
	organic Techniques of IntegratedPlant Nutrient Mangement (IPNM)
	Common pests, diseases and weeds on Kharif Crops and preventive measures to be adopted
	Integrated Pest Managemnt for Tomato Crop
	Information on Breed Improvement and Goat Rearing
	Guide for Women Motivators
	Protected Vegetable Cultivation in Polyhouses
Vikas Nagar	Technical Information on Floriculture
	Organic Techniques of IntegratedPlant Nutrient Mangement (IPNM)
	Technical Information on Cultivation of Dhingri Mushroom
	Manual for Protected Vegetable Cultivation in Polyhouses
	Booklet with Information on Animal Husbandry
	Technical Information on Goat Rearing in Jaunsar Region
	Technical Information on Poultry Management in Hilly Regions

	Technical Information on Animal Husbandry and Nutrient Management in Hilly Regions
	Fodder Management for Milch Animals
Tehri	Protected Vegetable Cultivation in Polyhouses
	Techniques for Protected Cultivation
	Package of Practices of Fruit Crops
	Handbook for Organic Farming
	Integrated Pest Management in Vegetable Cultivation
	Handbook for Cultivating Oyester Mushroom
	Information on Poultry Farming
	White Grub Pest Management in Hilly Region
	Milk Production and Prevention from Tonsillar Disease
	Introduction of Line Department Schemes for Agriculture Development
	Booklet on Dairy Farming
	Guide for Production Group for Vegetable Cultivation
	Handbook on Mulching


उत्तराखण्ड विकेन्द्रीकृत जलागम विकास परियोजना-2
कृषि व्यवसाय ग्रोथ सेन्टर, न्याय पंचायत - रंगेऊ
अठगाँव फल एवं सब्जी स्वायत्त सहकारिता, गेहरीधार-पुनाह पोखरी
द्वारा संचालित समन्वित कृषक सुविधा, प्रसंस्करण एवं विपणन केन्द्र
रजि. नं. टी.सी. 16
स्फ. एस. एस. आई. नं. 22621025000010