ITC- Sunehra Kal

Impact Assessment Report

Sustainable Agriculture Project

Timtala, Runmochan Clusters of Amravati District

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Executive Summary

The sustainable agriculture project under ITC 'Mission Sunehra Kal' initiative is focusing on restoration and replenishment of natural resources associated with agriculture such as soil, water, vegetation, and biodiversity. Through sustainable agriculture programme, it is targeted to reduce the risk associated with farming activities. The strategy is to make multilevel interventions at each phase of agricultural activity with the incorporation of modern technology and stakeholder participation. To make the agriculture practices more sustainable, the approach taken through the project is to ensure capacity building, technological knowledge dissemination and providing institutional support. The project aims to innovative and inclusive growth while forging a strong connection with the rural agrarian communities in the rain-fed area.

Two talukas named Nandgao Khandeshwar and Bhatkuli in Amravati district of Maharashtra are presently under the 'Sustainable agriculture Programme of Mission Sunehra Kal' initiative. Both these talukas fall under drought-prone areas. Ten villages from these talukas were selected for the project and were given assistance for both in farm practices and off-farm practices. Five villages belong to Timtala cluster, Nandgaon Khandeshwar and the rest to Runmochan cluster of Bhatkuli.

This report is an impact assessment of the project implemented in these two clusters of Amaravati district. The objective of the assessment is to identify the tangible and intangible benefits to the individual as well as a community along with with the environmental benefits obtained in sustainable agriculture project through forward and backward integration while ensuring Natural resource management with women-centric inclusive community development.

In the management of Natural resources related to agriculture, the priority is given to interventions for draught proofing. Activities that can improve the moisture content in soil has been planned and implemented in the project. Better moisture retention in the soil directly benefits in agriculture crop production. Water harvesting measures are taken through activities such as check dams, Farm ponds are created.

To promote sustainable agriculture in the region, a strategy is developed to intervene in the identified focal points. These interventions are categorized into 5 different components. They are, Seed smart, Water smart, Nutrient smart, climate-smart, Knowledge smart.

In seed smart, it focuses on to develop access to modern improved verities of quality seeds. The climate resilient crop verities with better productivity are introduced through this. In water smart, Promotion of micro irrigation systems such as sprinkler and drip irrigation are promoted. To reduce the wastage of water in flood irrigation practice, BBF planting method is introduced. Through nutrient smart, it focuses on is to identify the optimum level of the nutrient to be maintained for the crop in the region. To ensure this, Soil testing and soil health cards are issued to the farmers for better understanding of fertigation and dosage. Promotion of intercropping the legumes plants with other major crops carried out. Through climate smart, it indicates the use of agricultural systems that utilize ecosystem services to support productivity, adaptation, and mitigation. The major actions taken for climate risk reduction are better information provision through ICT based capacity building of farmers are carried out.

The role and involvement of the community is key to accomplishing the aim of projects based on participatory sustainable natural resource management and agriculture. The Farmer Field Schools (FFS) serve as a medium to disseminate technology, technical knowledge and scientific inputs for increasing farm productivity, improving crop varieties to make agriculture more sustainable and climate resilient. To strengthen the participation of women in agriculture, skill development is done through capacity building activities.

The impact assessment of the sustainable agriculture initiative in the project has shown positive results. But there have seen the variation in the adoption and benefits of the projects in the two clusters. The Timtala cluster has shown better participation of community-based institutions and good results in indicators that assessed in the household survey.

Introduction

Creating business strategies that bring several livelihood opportunities and a positive environmental footprint through sustainable and innovative development models have always been a difficult task for governments and private companies worldwide. An innovative initiative by ITC Limited named, "Sunehra Kal" aims to innovative and inclusive growth achieve exactly that. Through this initiative, ITC Limited has forged a strong connection with the rural communities that practice rain-fed agriculture. Severe water stress in summer, crop failures due to lack of expertise in modern agricultural practices, gender inequality, migration of the youth for jobs, underdeveloped dairy farming, etc have had a huge impact on the economy of these rural communities. ITC Limited aims to alleviate these issues from the selected rural areas thus bring in sustainable and inclusive growth.

Through this initiative, ITC is committed to deepening their engagement in identified rural areas to promote their holistic developmental models and improve the lives of the main stakeholders, which are the rural farming communities. Through sustainable agriculture programme, it is targeted to reduce the risk associated with farming activities. This is achieved by focusing on areas such as capacity building and knowledge sharing, natural resource management, and support to the farmer groups through various institutions established. ITC's agribusiness partnerships with the farming communities have generated a sustained wealth for decades for rural households. Promoting the developmental strategies among the underdeveloped rural communities in the long term will significantly improve their Human Development Indices (HDI) as well.

One main area of interest of this initiative is gender equality and the empowerment of women and girls. Gender equality can only be achieved when there is equal access to resources and opportunities regardless of gender. In most of the rural areas, it's not the reality. Through “Mission Sunehra Kal ", ITC envisions a tomorrow where there are no restrictions on the empowerment of women and girls. This initiative has specific programs designed solely for farming women in the areas of agriculture-related skill development and entrepreneurship, so the development of the identified rural area is inclusive in every way.

This report is an impact assessment of the work of ITC Limited in the two talukas of Amaravati district of Maharashtra, one of the many geographical locations that were under " Mission Sunehra Kal" initiative. The main sector in these talukas is agriculture and it is usually rainfed. These are one of the many drought-affected areas of Amaravati district and in need of better farming and water conservation practices. Since the people there depend entirely on agriculture for a livelihood, ITC has been assisting them in that sector for several years. Without sustainable farming practices, crops are bound to fail. By using water recourses thoughtfully and modern agricultural practices smartly, the overall wellbeing of the rural communities can be made a reality.

About Project Area

Two talukas named Nandgao Khandeshwar and Bhatkuli are presently under the "Sustainable agriculture Programme of Mission Sunehra Kal " initiative. Both these talukas fall under drought-prone areas. Ten villages from these talukas were selected for the project and were given assistance for both in farm practices and off-farm practices. Five villages belonged to Januna cluster, Nandgaon Khandeshwar and the rest to Jasapur cluster Bhatkuli. The total geographical area of the project is 4215.96 ha and out of this the treatment area is 3909.46ha. In total 96.54% of the project area is under agriculture use.

(i) Januna Cluster

Januna cluster is located in Nandgaon Khandeshwar Taluka, Amravati District of Maharastra state. The Cluster has five villages namely Timtala, Januna,Khirsana, Nirvana and Adagaon villages covering two Gram Panchayats of Januna and Khirsana respectively of which Januna is a separate panchayat while all other three village falls under Timtala panchayat. The total Cluster area of the is about 2419.61 Ha.

The nearest town is Badnera which is about 8 to 10 Km from various villages in Januna cluster and is well connected by *pucca* road. Patil, Koli, Bodha, Matang, and Nahavi communities are the primary inhabitants of the villages. There are some Minority communities too in these villages. The livelihood of these people is primarily based on rainfed agriculture, animal husbandry, wage labor, and goat rearing. Majority of farmers about 50 percent are small farmers with less than two ha of land while 25 percent has more than 2 ha of land. The productivity potential of

the land is average due to non-availability and quality of water. The Cluster area is a predominantly drought-prone area.

2.2 Jasapur Cluster

Jasapur cluster is located in Bhatkuli Taluka, Amravati District of Maharastra state. The Cluster has four villages namely Sarmaspur, Jasapur, Nanded Khurd and Runmochan villages covering two Gram Panchayats of Jasapur and NandedKh respectively, the total Cluster area is about 935 Ha. The nearest town is Bhatkhul which is about 10 Km from Jasapur cluster and is well connected by *pucca* road. The livelihood of these people is primarily based on rainfed agriculture, animal husbandry, wage labour, and goat rearing. Majority of farmers about 50 percent are small farmers with less than two ha of land while 25 percent has more than 2 ha of land. The productivity potential of the land is average due to non-availability and quality of water. The Cluster area is a predominantly drought-prone area.

Agro-climatic conditions of the project areas

Both Januna and Jasapur clusters fall under Moderate Rainfall/Central Vidarbha Agro Climatic Zone. The soil is mainly black soil derived from basalt rock. The texture of the soil is medium to heavy and alkaline. Groundwater cannot be used for irrigation due to its saline nature. The areas are drought-prone due to lack of substantial rain every year. Water shortage is seen especially during summer in the areas where the water supply scheme by the state government is not covered.

The Total area of the Jasapur cluster is 1489.85 ha of which 97 percent is Land under agriculture. Almost 100 percent of it in all the villages is rainfed expect Runmochan village where there are some open wells used for support irrigation. Januna cluster is a little larger which is about 2419.61 ha of which 96 percent is Land under agriculture. Almost 90 percent of it in all the villages are rain-fed. There is no water source for irrigation like canal or River. The small percentage of irrigated land available in the village is irrigated with the help of open dug well.

The objective of the Study

Any project that is targeted to achieve sustainability in agriculture development, through forward and backward integration while ensuring Natural resource management with women-centric inclusive community development, needs to be assessed to identify the tangible and intangible benefits to the individual as well as a community along with the environmental benefits.

The following two major aspects of the project were evaluated broadly.

(i) The effectiveness of interventions and the impact of these activities in natural resource management , sustainable agriculture and environment.

(ii) The community participation and involvement in implementing these interventions along with the benefits and outcomes generated out of these activities for individuals as well as the community as a whole.

The study consists of activities implemented over the period of 3 years (Fy. 2016-17 to Fy. 2018-19)

Methodology

Framework was prepared initially to define the scope and area of the study. The list of major criteria and indicators for evaluating the impact is identified. The ranges and scores are decided based on the ranking of these criteria. A matrix consisting of these criteria indicator and scores based on this is prepared in test checked villages of the project.

Sample Methodology

The sample methodology adopted for the selection of villages as well as the households carried out by two different methods. For the household, survey samples are collected from all 10 villages. 15 percentages of households were surveyed from each village. The selection of households and interventions covered for the survey is selected based on the stratified random sampling method. This method ensures equal representation of stakeholders from each stratum. Later all these results of the survey were test checked against an identified control

village. So, effectiveness of the interventions and their uniformity among project villages can be verified. The sample size taken from each village is given below.

Table:1 Details of selected sample size for the household survey

Sr. No	Village	No of beneficiary HHs		
		Total Households	Survey sample	Percentage of HH covered
1	Timtala	246	37	15
2	Nirsana	109	18	17
3	Januna	257	40	15
4	Khirsana	74	12	16
5	Adgaon	124	19	15
6	Jasapur	48	8	17
7	Sarmaspur	123	19	15
8	Nanded	52	8	15
9	Runmochan	52	8	15
10	Amala	166	25	15
	Total	**1251**	**194**	**16**

The team composition was of professionals who have expertise in the area of Agriculture and social work and watershed works. The data collection tools such as Household survey, Focus Group discussion Interview of the beneficiary has been used. For the household survey, the questionnaire is prepared on the basis of major Impact indicators, Socioeconomic indicators, and institutional indicators. The secondary data is used to identify the benchmarks and improvement in the situation over a time period. These secondary data are utilized to compare and carry out analysis with the household survey results. The rainfall data, water storage details in water harvesting and recharge structures, crop production and productivity, etc.

Table: 2 Composition of different interventions covered in the survey

Sr. No	Village	Water Harvesting Structure	Recharge Pits	Farmbund	Farm pond	Gabion	Vermicompost	FFS	ABC
1	Timtala	8	16	15	0	0	4	6	2
2	Nirsana	0	7	7	0	1	1	4	
3	Januna	4	18	13	0	0	5	7	1
4	Khirsana	0	11	5	0	0	1	5	0
5	Adgaon	1	2	12	0	1	5	3	2
6	Jasapur	0	0	2	2	0	4	0	0
7	Sarmaspur	6	0	6	0	0	4	2	0

8	Nanded	3	0	2	3	0	3	3	0
9	Runmochan	3	0	0	2	0	3	4	0
10	Amala	0	0	20	0	0	0	5	0
	Total	**25**	**54**	**82**	**7**	**2**	**30**	**39**	**5**

Project Interventions

The project is designed and implemented into 2 major components as explained below,

(a)Natural resource management for draught proofing and development of sustainable agriculture

(b) Community-based institution development for skill development and establishing micro enterprises that ensure livelihood and income generation.

Natural Resource Management

The large part of the land in the project area is classified as agriculture land. Hence, in terms of natural management in the area, the management plan is based on the interventions and activities planned for the land under agriculture. The agriculture activity is depending on the resources such as soil, water, and vegetation. Hence, the activities are planned for natural resource management is targeted for improvement of land and water resources. The activities are categorized into major 3 components.

Soil Moisture Conservation

The quality of agriculture land is developed by better management of soil and organic and inorganic matter in it. The quality of soil is decided by the water holding capacity and organic carbon available in it. The retention of moisture content in the soil is very important for improving crop productivity. Activities such as farm bundling, Loose boulder structure, and gabion structure are planned under the project.

Table: Details of activities for soil moisture conservation

Sr No	Village	Recharge Pit		Farm Bund		CCT		LBS		Gabion	
		Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial
1	Timtala	48	10.18	12988	3.41	1481	0.62	0	0.00	1	0.19
2	Januna	90	20.76	35426	9.60	1920	0.81	20	1.19	6	0.74
3	Nirsana	36	8.72	29132	8.37	4192	1.30	3	0.17	4	0.48
4	Khirsana	38	9.22	7794	2.34	1396	0.59	9	0.56	3	0.60
5	Adgaon	44	10.20	32205	9.66	4371	1.84	31	1.83	10	1.77
7	Runmochan	-	-	9332	0.00	0	0.00	-	-	-	-
8	Nanded	-	-	19261	0.00	0	0.00	-	-	-	-
9	Jasapur	-	-	24272	0.94	287	0.12	-	-	-	-
10	Sarmaspur	-	-	7532	0.26	0	0.00	-	-	-	-
11	Amla			22168	6.66	0	0	-	-	-	-

Total	**256**	**59.07**	**200110**	**41.25**	**13647**	**5.27**	**63**	**3.74**	**24**	**3.78**

The impact assessment exercise has observed that, after the interventions for soil moisture conservation, there is an improvement in the retention of moisture in the area. Crops such as wheat and chickpea are cultivated in Rabi season.

The details on the impact of Farmbunding and Recharge pits are discussed in the case study section of this report.

Water Harvesting Structures

In regions where agriculture is based on rain-fed, the scope of doing the second crop under Rabi season depends on the moisture content in the soil and facility available for support irrigation. Hence, to secure the crop from failure, sources for support irrigation have to be developed. Though developing the surface water harvesting structures the storage of excess rainwater which may have lost through runoff can be done. Surface water harvesting structures are a sustainable source of irrigation. For this, taking into consideration local knowledge and the need of the farmers' earthen structures like Doha, Farm ponds, Recharge pits and Check dams are implemented in the project.

Sr.No	Village	CNB (Check Dam)	Amount	Doha		
		No.S	Rs.in Lakhs	No.S	Cum	Amount Rs.in Lakhs
1	Timtala	2	5.51	3	9530	6.29
2	Januna	1	3.22		-	-
3	Nirsana	0	0.00	1	1750	0.89
4	Khirsana	1	3.85		-	-
5	Adgaon	1	2.93		-	-
6	Runmochan	0	0.00	2	13140	
7	Nanded	0	0.00	1		
8	Jasapur	0	0.00	1		
9	Sarmaspur	0	0.00	1		

10	Amla	0	0.00	-	-	-
Total		**5**	**15.51**	**9**	**24420**	**7.18**

Sustainable Agriculture

The sustainable agriculture is "the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such development, conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable."(FAO). At the same time, sustainable agriculture has to ensure economic viability as well as profitability. It is the efficient use of nonrenewable resources and integrates it with natural biological cycle to ensure the environmental quality and natural resource base. To make the agriculture practices more sustainable, conventional agriculture practices need to be tuned in to making it more environmentally, socio-economically viable.

The sustainable agriculture project under Mission Sunehra Kal initiative is focusing on restoration and replenishment of natural resources associated with agriculture such as soil, water, vegetation, and biodiversity. To make the agriculture practices more sustainable, the approach taken through the project is to ensure capacity building, technological knowledge dissemination and providing institutional support. The major agriculture practices are adjusted to make it more environmentally and socially economically viable through 5 major intervention in agriculture. They are described below,

Seed smart

The agriculture productivity and quality of the products are influenced by the seeds. Access to modern improved verities of quality seeds is an important component of sustainable agriculture. The climate resilient crop verities are introduced through the project. This ensured optimum utilization of resources such as water and fertilizers, that in turn helped in the reduction of input cost as well as the environment impacts.

The interventions on seed are made in 2 major crops of the region, Soybean, and wheat. In Soybean JS 9305 variety is introduced. Two new varieties of wheat named MACS6222 with the

help of Regional Research Center (RRC), Amaravati, and MACS6478 by KVK, Durgapur was given to three farmers belonging to Januna and Timtala villages for demonstration.

Required training is imparted on the seed treatment, germination and sowing techniques, application of fertilizers, etc. Demonstration plots are created and the learning process is carried out in Farmer Field school (FFS) through regular field visits, discussions, and analysis.

These seeds have shown better germination rate and improved productivity while reducing the input cost. The impact and benefits of this intervention are discussed in the case study 'Climate-Smart Agriculture'.

Nutrient smart

The nutrient management is important to maintain the sustainability of the soil by taking in consideration of factors such as crop verity, irrigation, weather, traditional agriculture practices, etc. The nutrient plan is prepared based on the optimal nutrient use efficiency which in turn provides better crop yield and quality with better economic returns. The major part of nutrient management is to identify the optimum level of the nutrient to be maintained for the crop in the region. This is important to avoid the over application of nutrients in the soil. Such a measure will help reduce the input cost in agriculture along with protecting the water and soil quality and minimize the environmental impact.

To ensure this, Soil testing and soil health cards are issued to the farmers for better understanding of fertigation and dosage. Other than this, the organic nutrient management is also important to ensure soil health. This ensures the utilization of manure, other biofertilizers along with inorganic fertilizer application to minimize the harm to the soil and environment. The natural means to improve the nutrients in the soil is promoted. The promotion of intercropping the legumes plants with other major crops is a method adopted to enhance the nutrient in the soil.

Water-smart

The demand and utilization of water for agriculture purpose has been increased due to various reasons such as climatic changes, change in crop pattern, increase in cropping area, etc. These factors may cause severe stress on the resources available. The gap in demand and supply can be met by the creation of new sources and management of resources. Hence, to promote sustainable water utilization the following measures are taken under the project.

In the rain-fed area, water availability is good during monsoon. Hence, better management of resource available and conserve it for future use of water harvesting structures such as farm ponds, recharge pits are created. The creation of new sources with the help of natural resources available helped the farmers in agriculture.

Irrigation management is important for the judicious use of resources. The micro irrigation systems such as sprinkler and drip irrigation are promoted through the project. For the crops where the traditional practice of flood irrigation is practiced, the Broad bed and furrow (BBF) planting method is introduced. This ensures the retention of moisture content in the soil through water conservation and proper drainage technology in deep black soils and ensures proper aeration in the seedbed and root zone reduces the excessive demand in irrigation.

The introduction of BBF has given better results in soya crop. The major impacts of this system are assessed during the study. The farmers are confirmed that after the introduction of BBF there has been an increase in water use efficiency. The better distribution of water for crop and improved moisture content level in the agriculture field has ensured less moisture stress during nonrainy days. The time and energy saving in the irrigation is reduced by (20-25%)and water requirement is reduced by 25-30% in the crop. Weed management became easy and better. Overall an increase of 15-20% in crop productivity is observed.

Knowledge smart

The economic viability and crop productivity is influenced and associated with many factors. The better knowledge and skill at the farmer level is important for the better management of

the agriculture system and its viability. Through this project, various steps are taken for capacity building of farmers. Training is organized for the farmers at the village on pre-sowing, Planting techniques, crop and pest management practices. The support of KVK is ensured in the capacity building programs. The group based learning process through Farmer Field School (FFS) is adopted. Sharing practices and technologies have done through increased cooperation, and information sharing among stakeholders; and the development of outreach, extension and technical assistance.Local knowledge, as well as the capacity to link research and local activities, plays a key role in scaling up the Climate Smart Agriculture approach to reinforce the resilience of farmers' livelihoods.

Crop demonstration plots are developed and the benefits of a crop variety are assessed by the farmer groups during the field day and yield analysis exercises. The training made an impact on the promotion of a new variety of seeds and technology in the project area.

Climate-smart

The extensive changes in rainfall and temperature patterns threaten agricultural production and increase the vulnerability of people dependent on agriculture for their livelihoods, which includes most of the world's poor. Climate change disrupts food markets, posing population-wide risks to the food supply. Threats can be reduced by increasing the adaptive capacity of farmers as well as increasing resilience and resource use efficiency in agricultural production systems. Through climate smart, it indicates the use of agricultural systems that utilize ecosystem services to support productivity, adaptation, and mitigation. This approach also aims to strengthen livelihoods and food security, especially of smallholders, by improving the management and use of natural resources and adopting appropriate methods and technologies for the production, processing and marketing of agricultural goods. To maximize the benefits and minimize the tradeoffs, CSA takes into consideration the social, economic, and environmental. Repercussions on energy and local resources are also assessed. A key component is the integrated landscape approach that follows the principles of ecosystem management and sustainable land and water use. That involves incremental or transformative actions. Incremental changes include better information provision; timely access to production inputs; shifts in production techniques to enhance ecosystem services and maintain

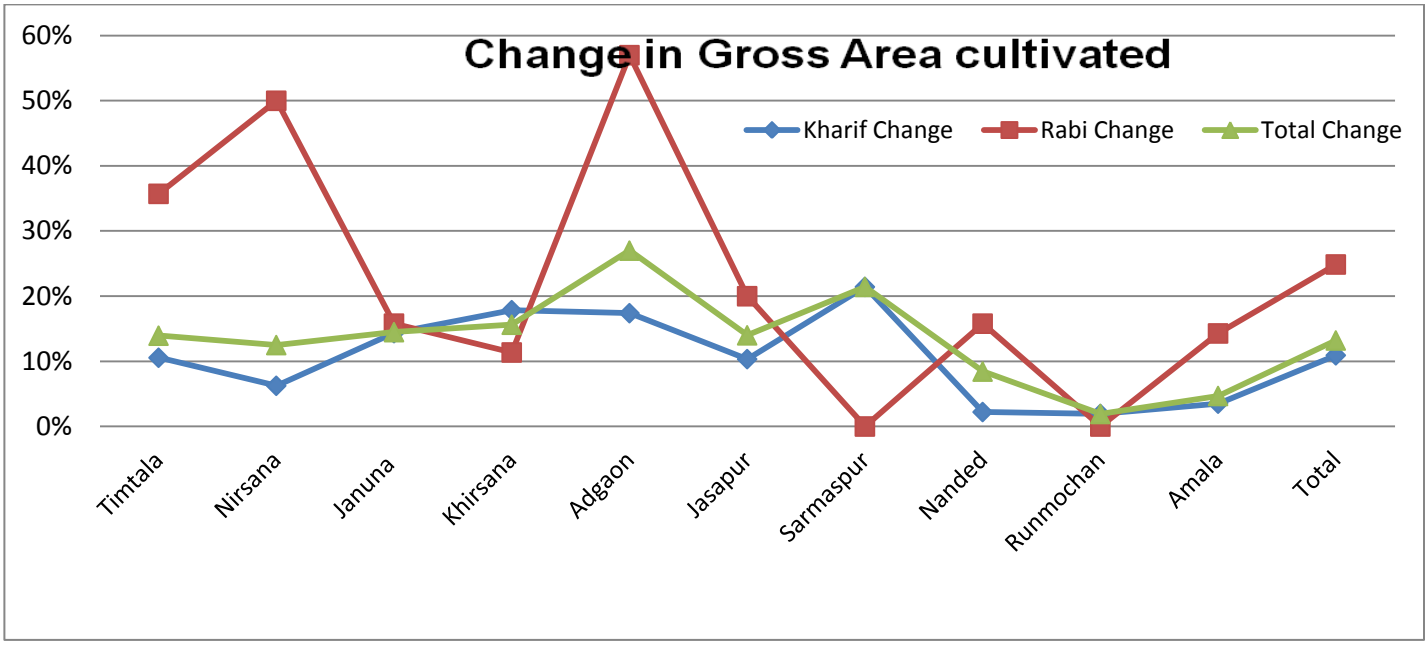
productivity under climate shocks; improved market governance to reduce price volatility, and expanded insurance and safety net programmes. The major actions taken for climate risk reduction are better information provision through ICT based capacity building of farmers are carried out.

Results

Sustainability assessment has the potential to considerably increase the sustainability performance of planning outcomes and decision-making. The results of the outcome based on the household survey are discussed below. Various indicators are observed to identify the economic, environmental and social benefits in the project area.

Data collection and inferential statistics

Area under Crop

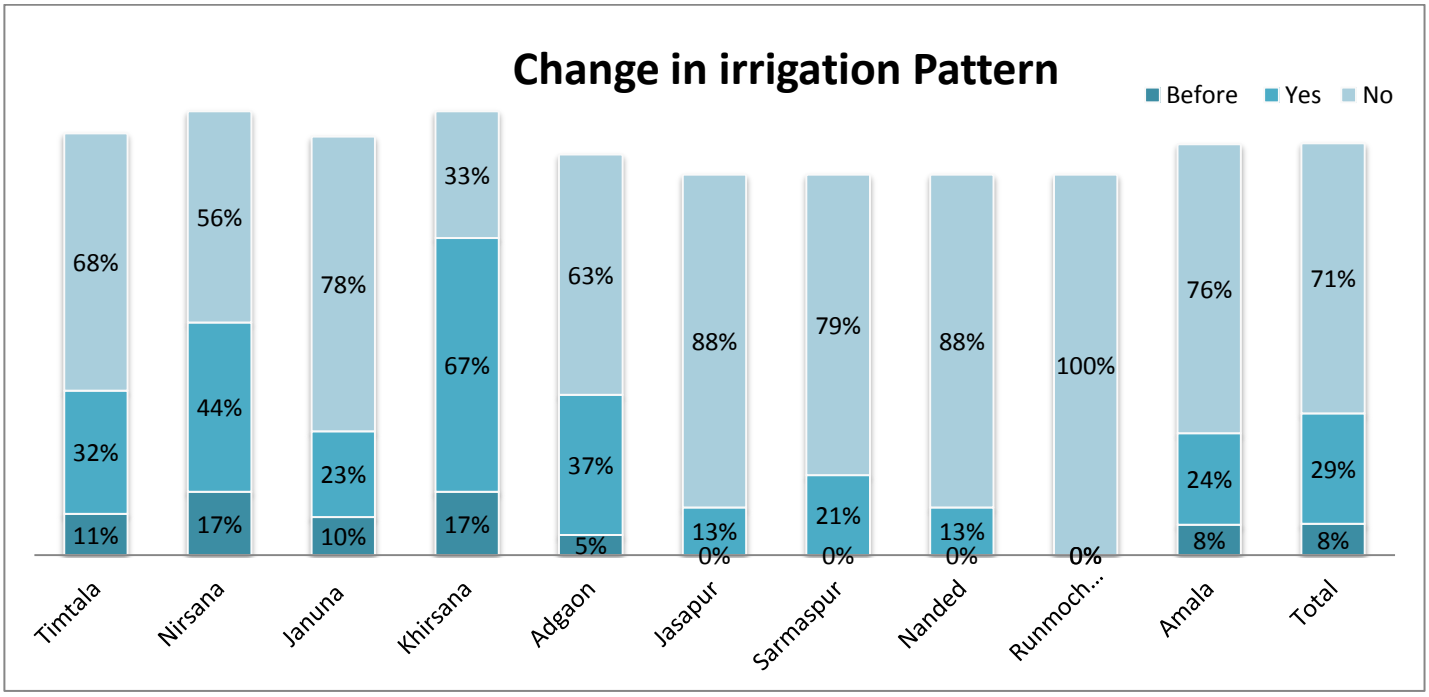


Among the surveyed households, it is shown that there is an increase in area under cultivation in the Kharif season. Compared with the situation before the project, there has been an increase of 11% in the area brought under cultivation the season. The farmers used to keep their land fallow because of non availability of backward linkages and agriculture services in the region. The increase in area in Kharif season is a result of various interventions made in the form of mechanization and increased availability in the region.

The Rabi season has shown good development in terms of the area brought under cultivation compared to the period before the project. In the cluster, there is an increase of 25% area brought under cultivation compared to the area in which crops are cultivated during Rabi before.

But out of these two clusters, Timtala cluster has shown good improvement in Kharif as well as Rabi season. Overall there is an increase of 15% in the gross area cultivated. In the same time, the Runmochan cluster has shown a 7.64% increase in gross area cultivated.

Share of people using micro-irrigation

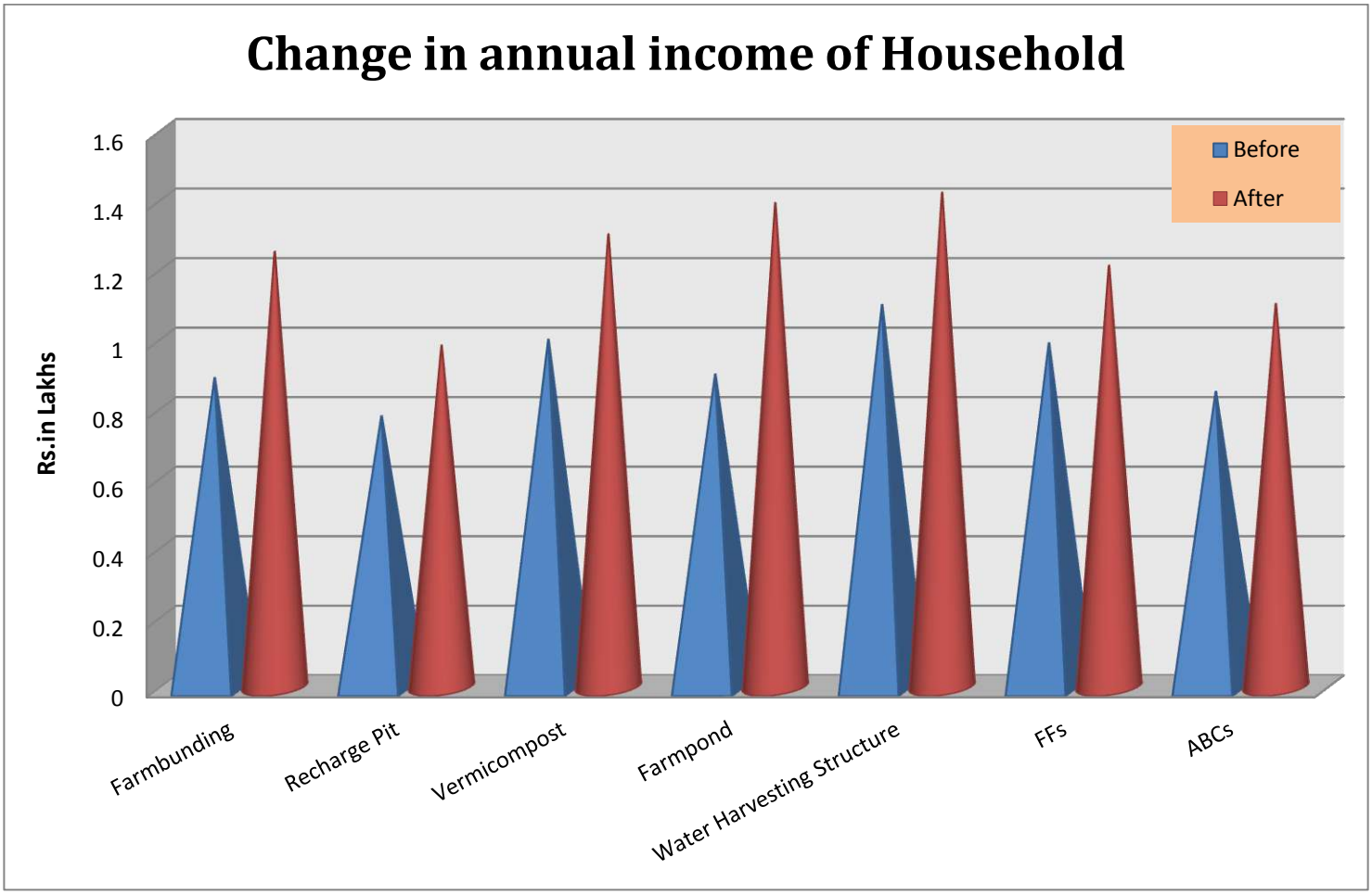


The judicious uses of water resources are very important in sustainable agriculture. Adoption of micro irrigation systems such as drip irrigation and sprinklers are helpful in optimum utilization of water in agriculture. Awareness created among the farmers through capacity building activities are encouraged them to adopt the micro irrigation system during the project.

Before the implementation of the project the adoption rate is just 8 percent in both clusters combined. The Timtala cluster it was 11% and in Runmochan cluster it was mere 2.9 % before implementation of project. The household survey has shown positive results in the adoption rate of these technologies in their farmland. The overall adoption of this technology has increased to 29% when both the clusters combined. But, there is a variation between the clusters in rate of micro irrigation technology adoption.

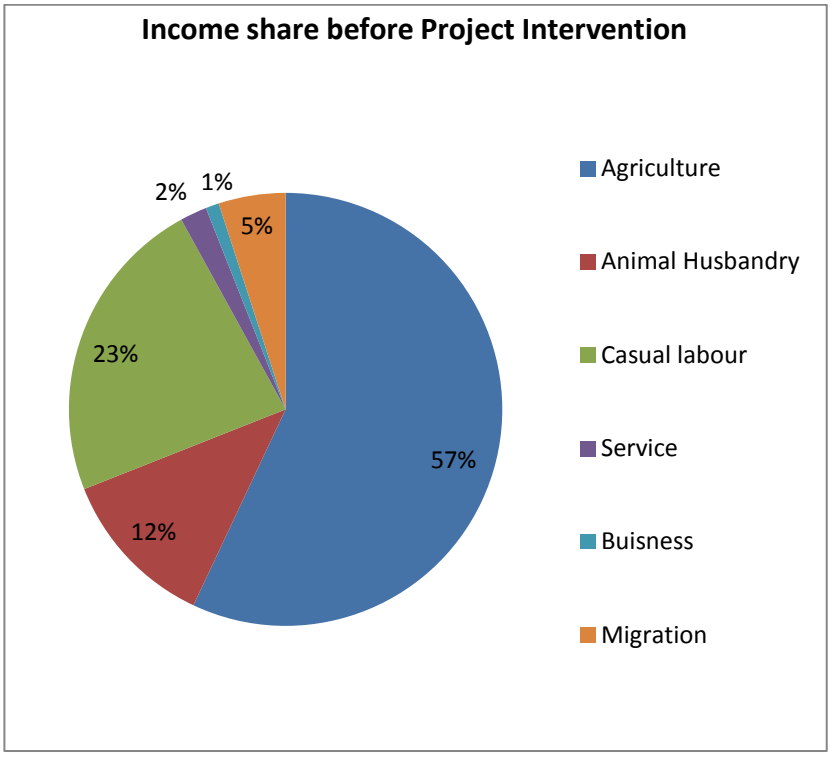
In Timtala, the adoption rate is 35% compared to 17% in Runmochan cluster. Reason behind difference can be due to limitation in resources and less impact in awareness programmes conducted. The project has created an impressive impact in the region in adoption of such water smart technologies. But , there is a potential of 71% of total farmers are yet to be introduced to micro irrigation.

Change in annual income of Household

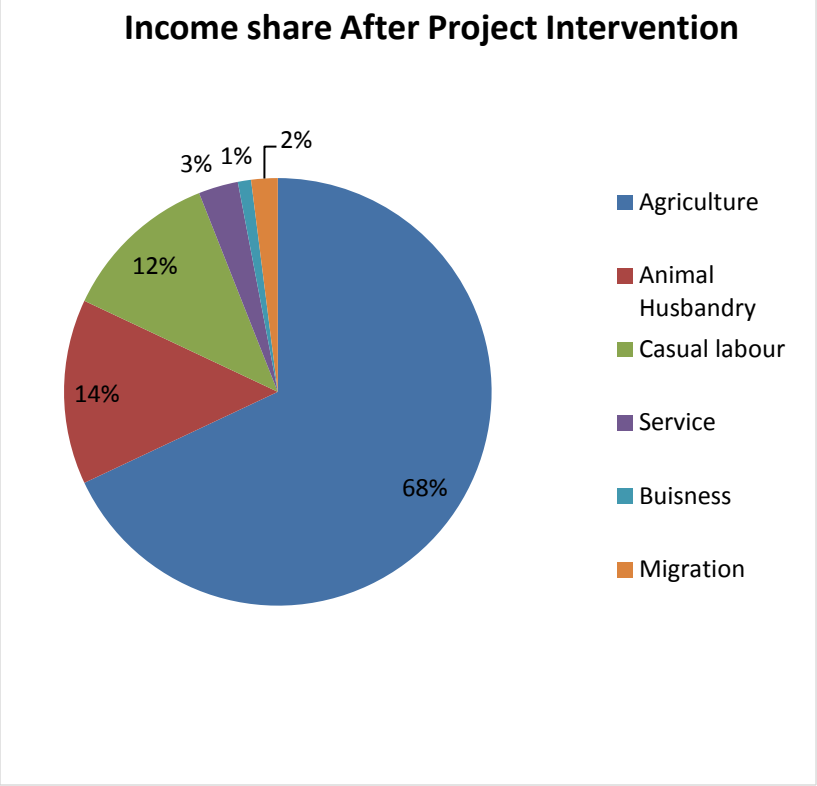


The change in agriculture income against each intervention is a measure to assess the impact and benefits for the farmers. The average change in the gross income of the household has categorized as per the various interventions are done in the project. The beneficiaries of Farmbunding and Farmpond activity have shown an increase in their gross income by 40% and 54% respectively. The income has shown an increase of 25% among beneficiaries of recharge pit. For interventions such as water harvesting structures, FFs, and ABCs their overall income has increased by 29%,22%, and 29% respectively. The farmers of

Source wise annual income of the Surveyed household

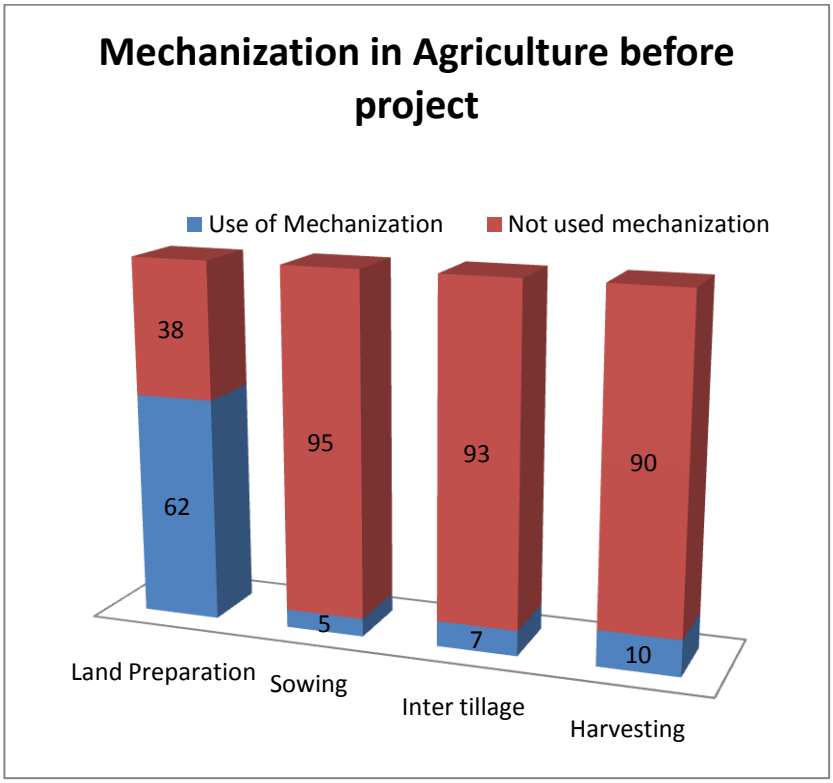


The major source of income is from agriculture. From the survey, it is observed that the share of agriculture income in gross income is less because the majority of farmers practice rain-fed agriculture. Productivity is less due to various reasons associated with traditional farming methods. Such as non-mechanization, not use of improved seed varieties, Hence, they are compelled to depend on other income sources like casual labour or migration to the nearby town.

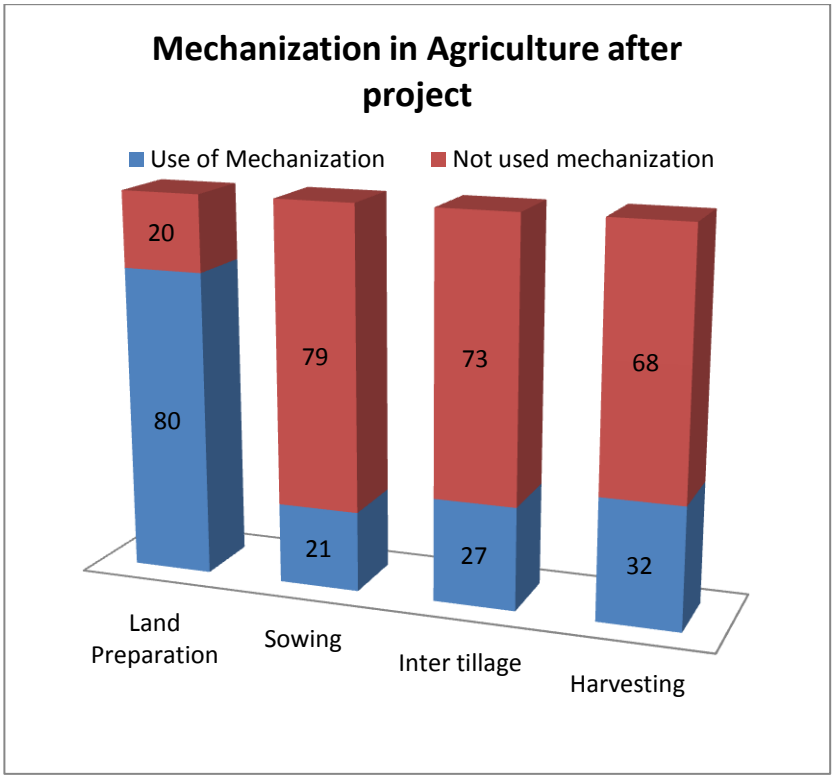


The result of the household survey shows that after the project intervention there has been a change in the income generation. The share of agriculture income has increased gradually. The discussion with the farmers indicates that the improvement in moisture in the soil has helped to take crops in Rabi season. The construction of water harvesting structures with the introduction of new farming techniques and improved seed varieties helped in the increase in agricultural income.

Change in the utilization of modern farm machinery and implements



The agriculture practices are traditional. The landholding is very small, the Majority of farmers are in the small and marginal farmer category. The mechanization in agricultural operations is not largely in use before starting the project in the area. From the graphical representation based on the survey results, it is clear that mechanization is limited to Land preparation, 62% of farmers use some kind or other types of machine in land preparation. But for other operation its role is small.



The use of mechanization in various stages of agriculture cultivation is largely promoted during the project. Through ABCs and FFs it has been ensured that the awareness of modern farming technologies and the availability of agriculture implements and machinery in the villages. The results of this intervention has been positive. In land preparation 12% more farmers adopted mechanization. In operations such as sowing and inter tillage has shown increase of 16 and 20% respectively.

Groundwater recharge

The improvement in groundwater recharge has resulted in soil moisture conservation activities, recharge, and water harvesting structures. The calculation based on the various activities implemented in the project area is shown below.

Table: Details of Ground water recharge during project period

Sr.No	Activity	Storage Capacity (cmt)	Rainy days(2017,2018)	Interval	Percolation(cmt)
1	Farmpond	13850	84	2-3 days	290850
2	Recharge Pit	30007	84	2-3 days	630147
3	Farmbund	318000	84	2-3 days	6678000
4	Checkdam/Doha	11186	84	2-3 days	234906
	Total	**373043**	**84**		**7833903**

The total storage capacity of the structures in the project area is 3.73 Lakh cubic meter. Considering the 2 years period of the project, the total rainy days are 84 with an interval of 2 to 3 days in monsoon. The average percolation period for each structure is assumed as 4 days considering the soil strata and rate of evaporation. Hence, through the project interventions 78.34 Lakhs cubic meter water has been recharged in the project area.

Community-based Institutions

The role and involvement of the community is key to accomplishing the aim of projects based on participatory sustainable natural resource management and agriculture. At various levels, community-based institutions are developed to supplement the interventions. These institutions have a multi-dimensional role to play in each segment to accomplishing the goals. The Farmer Field Schools (FFS) will serve as a medium to disseminate technology, technical knowledge and scientific inputs for increasing farm productivity, improving crop varieties to make agriculture more sustainable and climate resilient. The aim of developing these institutions is to enable the local community to achieve sustainable inclusive growth, better livelihood opportunities, gender equality, and women economic empowerment. To strengthen

the participation of women in agriculture, skill development is done through capacity building activities. Agri-Business Centres (ABCs) are established to provide agriculture based services such as providing farm machinery and agriculture implements on hire, promotion of seed production and act as a bank, manufacturing organic manure and biopesticides. The ABCs help in the creation of the necessary socio-economic infrastructure to work towards sustainable agriculture practices in the region.

Discussion and Recommendation

1. Sustainable agriculture development depends on the wise utilization of resources. In the rainfed area, water is precious as its availability is limited for a period of time. Hence, there is an investment of time and money is needed for irrigation. This results in increases the input cost in agriculture. There is a huge potential in adopting sustainable irrigation technologies in the project area. Interventions such as drip irrigation and sprinkler need to be promoted. It is found that after the implementation of the project the awareness and newly developed water sources along with an increase in availability has motivated the farmer to adopt these micro-irrigation techniques. The promotion of micro irrigation need to be crop specific and awareness to be created among farmers for the proper utilization and maintenance of the irrigation system.
2. Climate change and the harsh and adverse conditions affect crop productivity. The loss in agriculture crop and its productivity may lead to extreme conditions like poverty and starvation in case of small and marginal farmers. This, in turn, keeps the farmers away from indulging in cultivation in next season. The gross cultivable area and the agriculture potential of the region will be heavily affected due to such reasons. Hence, the dissemination of knowledge and promotion of climate-resilient agriculture and the crop verities need to upscale. A detailed strategy with a target of covering all the farmers in the region and the time frame required to be fixed.
3. Sustainable agriculture involves improving the agriculture practices and find out ways for additional income from the agriculture land. Agroforestry is one such method for additional income for farmers. It needs to be promoted and combined with soil moisture

conservation activities in and around farmland such as farm bunding, loose boulder checks, gabion structure, etc. The result of border plantation carried out by the individual farmers on the farm bunding activity has shown positive results. For species selection and good quality, saplings can be obtained from the nurseries of social forestry or with the help of farmer nurseries in the region.

4. The surface water harvesting interventions are carried out in the project. But in the development of community-based natural resources and its utilization is largely on an individual basis, water resources are limited and the sharing of those resources need to be locally in a transparent manner. The farmers should be sensitized on the use of water budgeting tools and the exercise need to be carried out and properly documented with the help of village institutions. This, in turn, will help farmers to understand and identify the cropping area and type of crops that will be compatible with water availability.
5. The soil organic matter is very important for plant growth and productivity. To maintain the optimum level of organic matter in the soil, it should make as a practice in agriculture to inculcate recycling of matter in the soil. A crop-based chart on an average rate of absorption of micronutrients needs to be developed for the region and the quantity and source of organic matter in which these nutrients are available need to be listed. This in turn help to improve the health of the soil as well as a reduction in the use of chemical fertilizer and cost associated with it.
6. The use of composting, biofertilizer and bio-insecticides are promoted in the project area. But it is not used widely in the region. Hence, the calculations on its effectiveness and cost benefits need to be discussed at farmer based institutions. This will improve the adoption of these techniques and the use of these interventions along with natural insect traps will help in beneficial insects in agriculture.
7. The modern harvesting techniques and the machinery/implements required for that are introduced in the project villages. Such services through Agribusiness center (ABC) need to be streamlined. For example, the type and number of machinery and implements required to be identified and the requirement of these services in the region should be calculated based on the agriculture history of the region based upon various factors that maybe influence in the hiring mechanism. A strategy need to be developed to reduce the idle time of machinery. For this, a platform that integrates all these services available in

project villages can be developed. This will help the ABCs to work in a more effective manner.

8. The biodiversity of the region depends on agricultural practices. Because the land under agriculture use encompasses more than 90% of the geographical area. The biodiversity indicators are to be prepared along with measures and best practices to improve the biodiversity in the agriculture area need to be defined. This should involve increasing bund Plantation etc.
9. Community-based institutions are established at the village level for farmers and women. The aim of developing these institutions is to enable the local community towards sustainable inclusive growth, gender equality and women economic empowerment. The sustainability of these institutions to be ensured with regular up gradation of skills and developing models for regular revenue generation. Financial stability and independence will help these institutions to take decisions without ease.
10. In an agriculture-based community, gender equality, women empowerment and financial inclusion can be achieved by exposure to mode technology and equipment along with developing agriculture-based skills. The portfolio of services that are provided by Agri-Business Centers or Custom hiring centers needs to be diversified. These institutions can work as an agriculture task force in the region, that can cater to areas such as providing labour services in the season to carry out contract farming in the region.

Conclusion

The ITC- Mission Sunehra Kal sustainable agriculture project implemented in Timtala and Runmochan clusters are targeted to achieve and inclusive growth for the marginalized and poor while creating better agriculture-based livelihood opportunities. The blend of use of technology with skill development ensures women empowerment, gender equality. The project has made a big leap in identifying the major target areas and issues associated with it. The interventions and measures to address these issues are developed and implemented on the based on technology and knowledge to serve better to the community in natural resource management.

The agricultural land-based activities related to soil moisture conservation in natural resource management has shown positive outcomes in the area. The interventions were able to succeed to accomplish the goals of soil moisture conservation and groundwater recharge. The water harvesting structures created has increased the surface water storage and also helped in providing critical time support irrigation. The community-based institutions developed and established during the project act as a catalyst while supplementing the agriculture sector with skill development and knowledge dissemination. These institutions also act as a link in technology transfer and crop development while adopting climate resilient agriculture practices.

Case Studies

Women Agri-Business Center

Agribusiness center is an initiative by ITC in the villages of Amravati district in Maharashtra. They are developed to ensure the improvement in the agriculture sector and enable women to work as strong pillars for sustainable agriculture practices in the region. The rural economy and employment are largely depended on agriculture and associated works, hence it is considered as the backbone of the rural economy. But in the past few decades, there has not been much improvement in the agriculture sector in rural areas. There is a need to increase the efficiency of agricultural practices to improve productivity and income for small and marginal farmers. The facilities, other associated skills of the farmers and labor are to be developed along with the introduction of new cropping practices.

The women are the major contributors in the agriculture sector as labor. And there is a need to improve the skills and economic empowerment of them along with equipping the farmers with modern agricultural facilities. The custom hiring centers (CHC) are developed with a new vision that is the empowerment of women in rural areas. Through establishing the CHC facilities in each village, ITC has given a substantial contribution to the society in terms of woman empowerment by bringing them to the mainstream agriculture by introducing features associated with SHGs such as social investment, collective decision making, and administration management. These skills, along with their traditional knowledge in agriculture and natural resource management has helped them to take up livelihood options and income generation opportunities through agricultural farm implements/machinery services hiring center.

Custom Hiring Center

Custom hiring center is an initiative by ITC to improve the Indian agricultural landscape through women entrepreneurs. It brought in a new dimension to the economic empowerment of women. This initiative targeted the most economically disadvantaged women among agricultural communities. The mission aimed at unlocking their true potential in transforming mainstream agriculture.

The major issues that were to be addressed by the women entrepreneurs in of the project areas were listed below

- Unavailability of modern agricultural tools and equipment

  farmers in the project area mainly used traditional farming methods before the initiative and the output of their efforts were very low. Traditional methods also took their precious time and it was mostly used by men since they are labor intensive.
- Lack of timely labor which results in delay in schedule, low productivity, and eventual economic loss and in some cases fallow lands.

  The youth of the project areas preferred to work out of the villages so that they can earn more. The labor intensiveness of traditional methods is also playing a part in their migration for work.

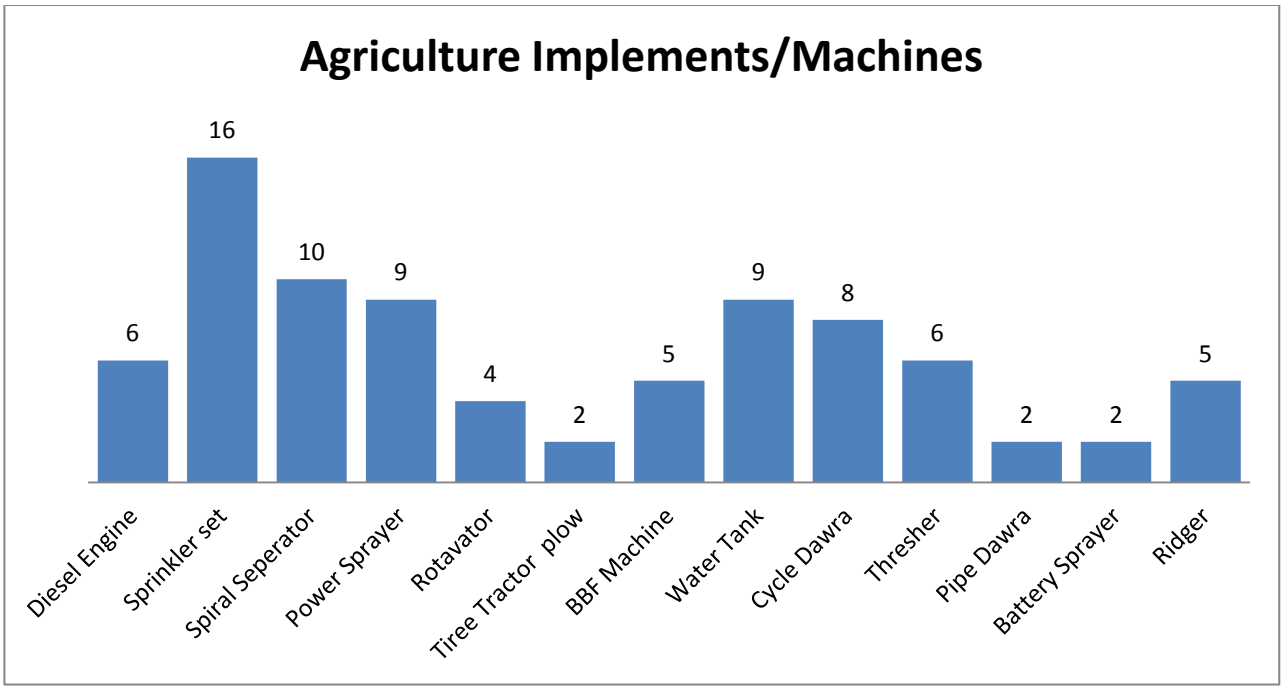
- Modern agricultural technologies are not used effectively

  Even when the farmers have all the techniques, the crop can fail to bring in the expected outputs if they don't know how and when to apply them to get the maximum benefit out of them. This can only be achieved when the farmers follow a scientific way of farming with the timely sowing, weeding, fertilizing and irrigation. Fertilization should be carried out only after checking the soil profile of the area so that only the nutrients that are lacking in the soil are added instead of everything in excess. They should be also added in the proper limit according to the crop variety and the climatic conditions of the area as well to reduce wastage.

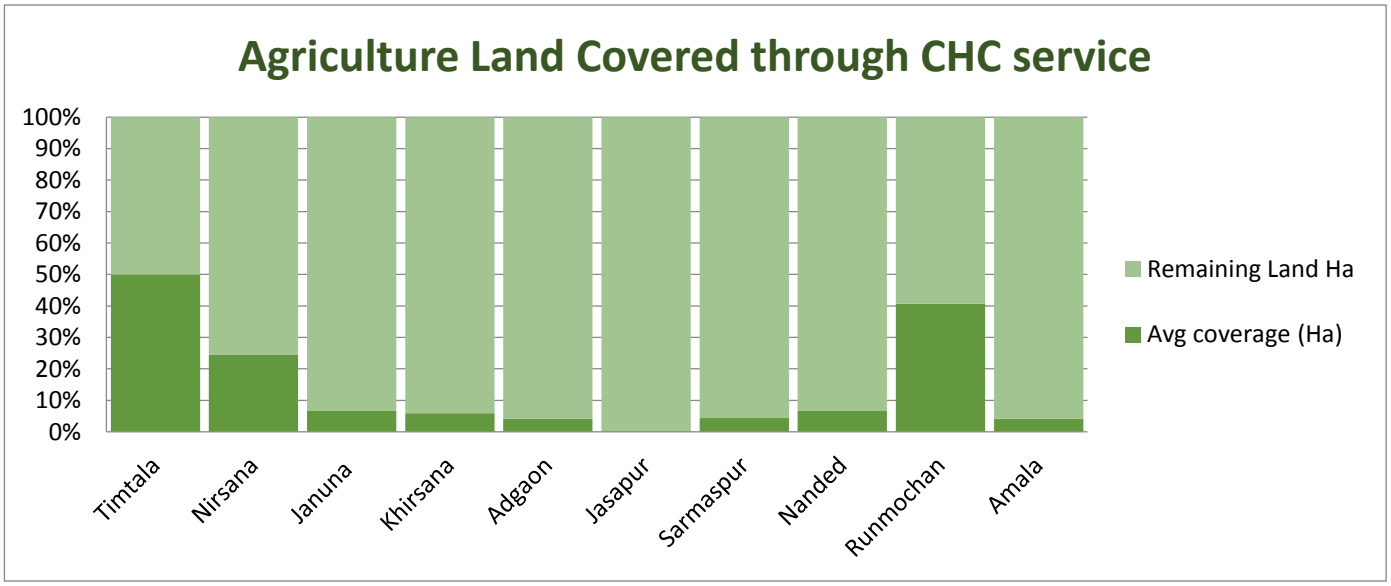
- Lack of awareness about the new high yielding varieties among farmers.

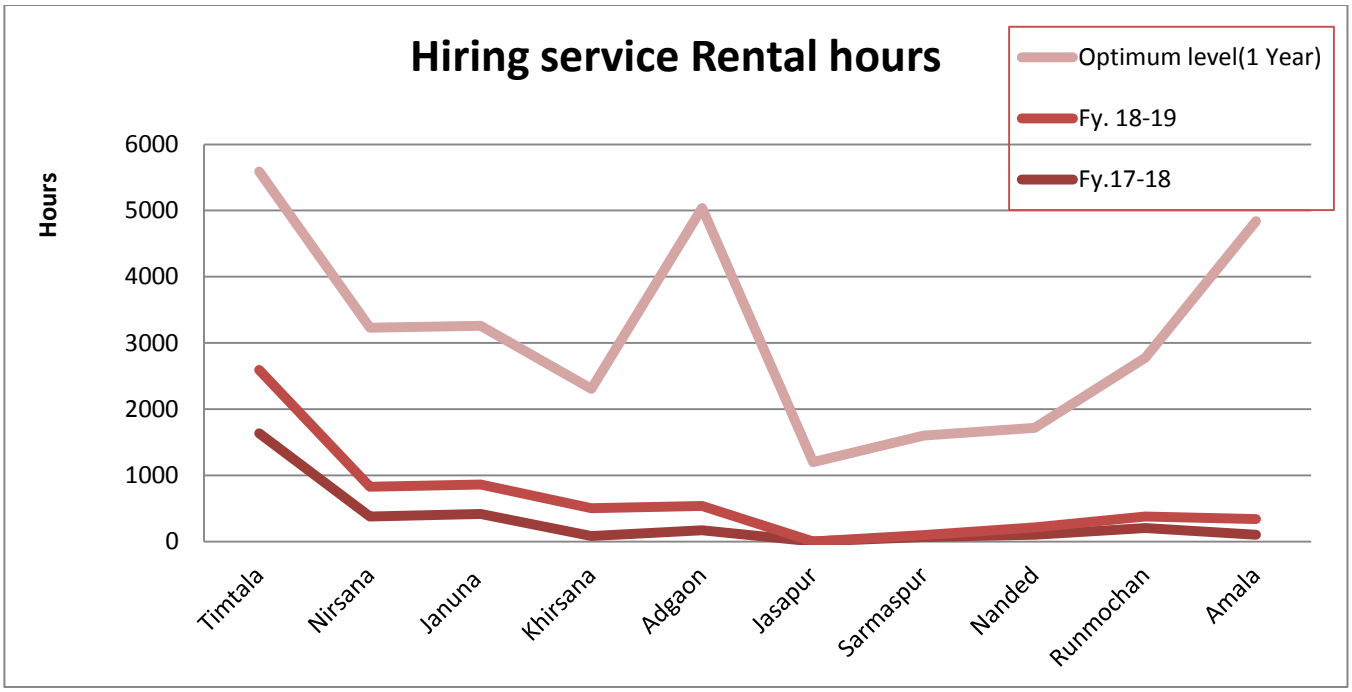
  Using traditional variety seeds are always a good idea but when it doesn't give expected outcomes, one can opt for the new hybrid varieties those are suitable for their regions. There are area specific hybrid seeds all over India but the lack of awareness among farmers of rural areas regarding high yielding seeds prevents their wide usage.
- Lesser participation of women in agriculture and decision making/no inclusive agriculture practices

  Traditional agricultural methods those are practiced by the farmers of India are very labour intensive thus making unfit for women to be participated in.



To address these shortcomings, the entrepreneurs of CHCs with the help of ITC Limited, started providing modern equipment, those can be used from sowing to harvest were given on hire to the farmers. A training program to empower the women micro-entrepreneurs to access and run the farm machinery was also designed. Many awareness programmes were conducted by KrishiVigyanKedras(KVK) for the farmers on the improved high yielding varieties so that the overall output from each season could be increased.




Hiring service Rental hours
Optimum level(1 Year)
Fy. 18-19
Fy.17-18
Hours
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5000
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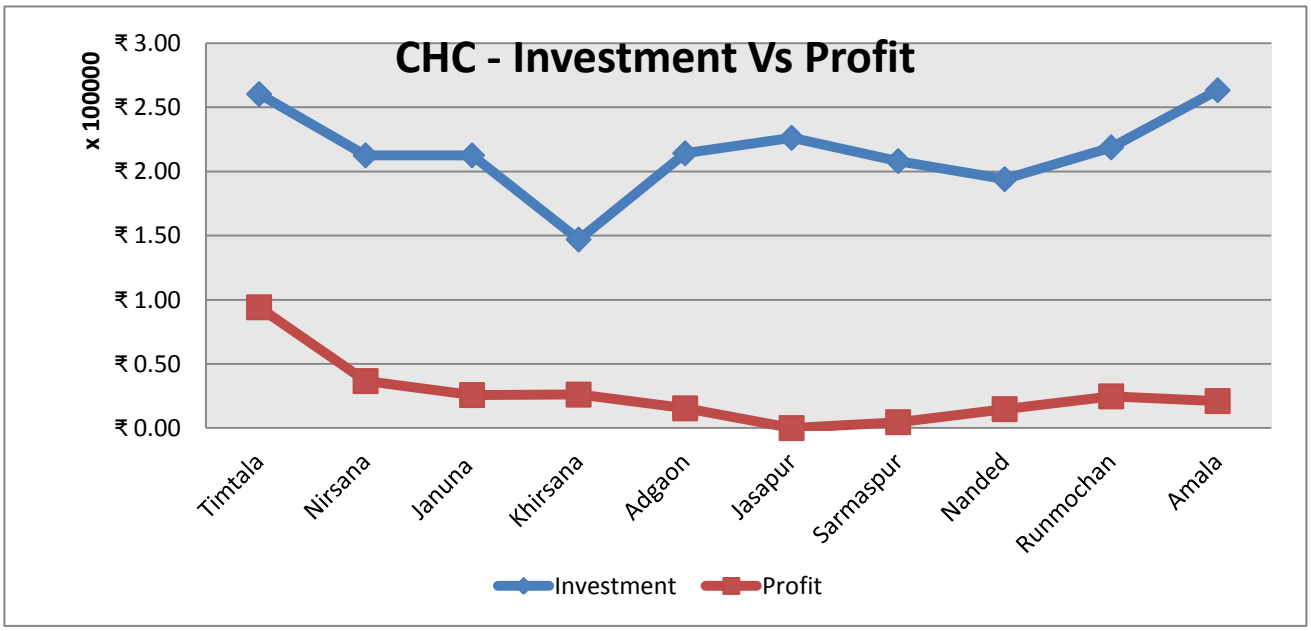
Timtala
Nirsana
Januna
Khirsana
Adgaon
Jasapur
Sarmaspur
Nanded
Runmochan
Amala


CHC - Investment Vs Profit
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Khirsana
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Jasapur
Sarmaspur
Nanded
Runmochan
Amala
Investment
Profit

Climate-smart agriculture

Climate-smart agriculture is an approach that helps in reorienting the existing agricultural system in a way that it promotes the development and ensure food security in a changing climate. The major objectives of climate-smart agriculture are sustainably increasing agricultural productivity and incomes, adapting and building resilience to climate change, and reducing greenhouse gas emissions. CSA helps in finding agricultural practices suitable for each and every type of regions worldwide.

Few farmers from the project clusters were selected for a trial of climate-smart agriculture in their farmlands and were given improved and resilient varieties of wheat and soybean along with proper training for improved farming techniques. The program included modern farming machinery and seeds of high yielding variety crops that require only minimal irrigation. The project was successful and resulted in a better harvest and increased income for the farmers.

As part of the research, two new varieties of wheat named MACS6222 with the help of RRC, Amaravati, and MACS6478 by KVK, Durgapur were given to three farmers belonging to Januna and Timtala villages for demonstration. The seeds were treated with beneficial bacteria before sowing but with different composition for each farmer. Two beneficial bacteria and 'xelora, a seed treatment mix were used. The beneficial bacteria were acetobacter and PSB (phosphate solubilizing bacteria) The phosphate solubilizing bacteria helps in solubilizing inorganic phosphorus from insoluble compounds and acetobacter helps in

Both the improved varieties of wheat were given a pre-treatment of acetobacter and PSB but only one variety, MACS6222 was given "xelora" a seed treatment containing Trichoderma which meant to prevent fungal diseases. In the variety MACS6222, the one where xelora used was shown to produce the maximum yield of 18 qtl/acre.

To make sure the survival of plants and to avoid waterlogging, new farming techniques like broad bed and furrow(BBF) was used. In order to increase the germination rate, survival rate and to avoid soil born diseases, bio-fertilizers and pesticides like acetobacter, Trichoderma and PSB were used. Along with beneficial micro-organisms, organic products like jivaamrit, cow dung slurry, and vermicompost were used in the study areas. The application of other fertilizers was based on a detailed soil testing report so that the crop meets its nutrient demands.

Sowing was done using the drilling method to maintain proper spacing between the plants. Proper spacing along with the timely doses of fertilizing resulted in vigorous vegetative growth of wheat. These varieties formed 6-7 clutches per plant with each ear bearing 25-35 grains.

Application of pesticides on time resulted in controlling diseases. Both the varieties were grown with limited irrigation but gave a great output.

Mr.Amol Dawre of Timtala village is one of the farmers who is part of FFS and developed crop demonstration plot of wheat.His own words, "I could able to increase the productivity in the first year itself. It has increased from 8 qtl to 14 qtl. As well as there is a good demand for the seeds. Hence, I could able to generate good income from selling seeds of the new variety.

Biodiversity promotion

Biodiversity means the variety and variability of life on earth. Every organism on earth is depended on each other for their survival in one way or other. It shows the importance of protecting that variability on earth by any means. Biodiversity conservation has been an important agenda from the last several decades worldwide due to the rapid decline of it and increasing pressure on it from the ever-growing human population. Consider the various environmental values and resource services that are obtained from vegetative landscapes. The only way to conserve biodiversity is through the active participation of human beings.

In India. The central and state governments, several NGOs, private companies and communities have several schemes and programs that aim at promoting and conserving biodiversity. Most of their works are based on improving the vegetative cover by afforestation of wastelands. It is due to the fact that by creating a forest, we can recover the lost habits of fauna and flora. Since the pressure on land recourses by human beings is tremendous, it is not practical that we let nature take its course of succession in time. It will take forever for such places to reach climax

stage and if it is in a human-dominated landscape like in most parts of India, the succession will never cross the second stage because of high cattle population and unregulated grazing. Thus, without timely interventions by the people who care about diversity, most degraded lands will remain that way without a chance for recovery.

Under the ITC initiative “Sunehrakal", the farmers from the project are have proved the biodiversity of degraded or wastelands from deforestation. Creating small water trenches and planting trees along the sides of them is the main activity that had been done in these areas. These trenches retain moisture for the plants to survive about three months so that they have a chance at survival.

The trenches could able to recharge the water in the region where the runoff is high due to the sloppy and undulated terrain. The plantation activity is carried out in convergence of forest departments. The species selection is carried out based on local verities. The plot is planted with 5500 plants. The plants are shown good survival rate.

Recharge and Soil Moisture conservation Percolation pit and Farmbunding

The agricultural activity and its success are depending largely on soil and water availability. These two components decide the land that can be brought under agriculture cultivation as well as the gross sown area. The depletion of groundwater level and erosion of topsoil are major reasons for low productivity that leads to keep agriculture land fallow for a long duration. The agriculture practices are rain-fed and largely based on traditional systems. Hence, the availability of water for the entire area is limited to the monsoon season. But the water holding capacity and amount of water can be harvested is less in natural conditions due to the period and duration of rainfall is so less and the intensity of rainfall is so high. This leads to high runoff and less water harvesting and recharge of water in the land.

The groundwater level can be maintained by the judicious use of water and sustainable land management practices. The land under agriculture use in the project area is 89.52% of total geographical area. Hence, the focus and various measures need to be integrated with farming practices. In agriculture land, soil moisture conservation activities have a major role in keeping a check on erosion and runoff. These activities along with water recharge activities in the farmland ensure water conservation in the region.

The major challenges in the villages of Timtala and Runmochan clusters are limited availability of water during Rabi and nonavailability for summer crops. The area receives an average rainfall of 700-800 m.m during the southwest monsoon. During summer the temperature reaches up to 48^0 C. Hence, the evaporation rate is so high in the region. The groundwater is depleting in the region due to the gap in demand and supply.

To address these problems in natural resource management, the land development and soil moisture activities such as farm bunding and recharge pits are implemented for groundwater

recharge in individual farmlands. The farm bundings are implemented in a cluster and though this water is stored for more elongated time period than usual. This has resulted in a reduction in runoff as well as the gradual percolation of water into the ground. The reduction in runoff also resulted in the retention of organic matter in the soil.

Sunil Keshaorao Daware a resident in Timtala village of Nandgao Khandeshwar taluka is a marginal farmer. He was concerned about the depletion of water level and the water availability for irrigation. This was limiting him to grow crops in other seasons than Kharif. To retain moisture level and water recharge in the soil recharge pit is constructed in the field. The intervention of recharge pit in the field has shown results in the first season itself. He says, "in the first year itself the changes have been observed. The improvement in groundwater level by one to 2feet against the similar time last year and water harvested in the structure is used for some support irrigation." In Rabi season compared to previous years, he got a good harvest of chickpea after the implementation of the activity.

The estimation of the benefit through groundwater recharge is given in the table below.

Table: Detail of Recharge Pit

Sr. No	Village	Recharge Pit	Avg Storage Capacity (cmt)/Structure	Percolation time(days)	Rainy days(2017, 2018)*1	Interval	Storage	Percolation (cmt)
1	Timtala	51	140	4	84	2-3 days	7140	149940
2	Nirsana	32	145	4	84	2-3 days	4640	97440
3	Januna	78	139	4	84	2-3 days	10842	227682
4	Khirsana	35	148	4	84	2-3 days	5180	108780
5	Adgaon	15	147	4	84	2-3 days	2205	46305
6	Jasapur	0	142	4	84	2-3 days	0	0
7	Sarmaspur	0	145	4	84	2-3 days	0	0
8	Nanded	0	147	4	84	2-3 days	0	0
9	Runmochan	0	144	4	84	2-3 days	0	0
10	Amala	0	143	4	84	2-3 days	0	0
	Total	**211**	**146**	**4**	**84**	**2-3 days**	**30007**	**630147**

The implementation of recharge pits in the project villages has shown impacts in the region. During the field visits, the farmers shared that they have observed that the groundwater level is gradually increased in nearby water sources. The estimation shows the substitutable amount of water could be recharged through this activity. The average water harvesting capacity of each pit is around 146 cmt. The estimation shows that the total storage capacity of all the structures constructed in the region is 30007 cmt. While considering the time taken for percolation and rainy days it can be estimated that total 630147 cmt rainwater has been percolated in agriculture land. The average life period of the structure can be calculated as 4 years by considering small maintenance in terms of small de-silting required in each year.

[1] Average Rainy days in 2017 are 95 and in 2018 it is 73 days, Hence average is taken as 84 days for both these years

The farmbunds were helpful in improving the moisture level of the region. The farmers could able to cultivate chickpea and ground nut in the Rabi season. They also stated that, they have seen change in crop productivity in Kharif season, as the applied manure and fertilizers retained in the farm because of construction of bund prevented heavy runoff during monsoon. The bunds enabled percolation of the rain water into the farmland. The improvement in rain water recharge in the farmland has shown results in improvement in watertable in well and borewell.

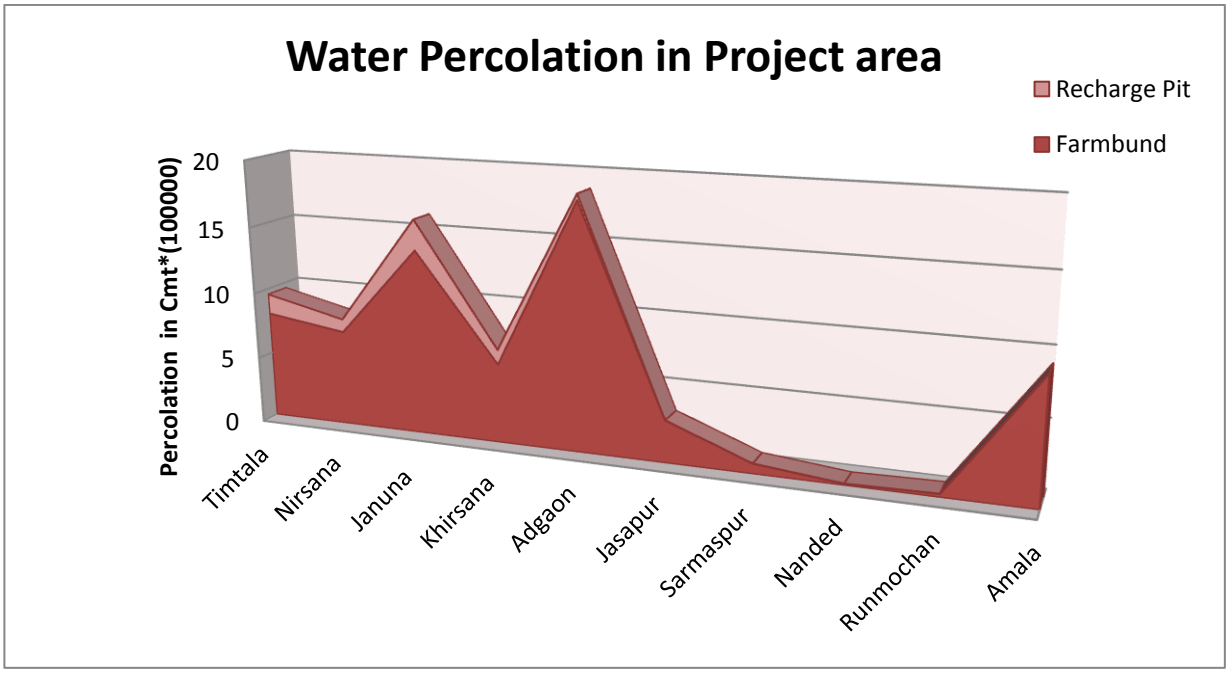
The construction of farmbunds also encouraged the farmers to plant horticulture trees such as Mango, Guvava, Lemon on the bunds. The farmers are utilizing the loose soil on the bunds and it provides good moisture level near the bunds. The survival rate is good in plants. The border plantation also improves the horticulture development in the region and in turn an additional income to the farmers and diversity in the region.

The estimation of water harvested and percolated through farm bunding activity in the farmland is estimated in the table below. The graph shows the total benefit in terms of percolation through interventions such as farm bunding and percolation pit is shown below.

Table: Details of water percolation Farmbunding

Sr.No	Village	Farm Bunding (Nos)	Rainy days(2017,2018)	Interval	Percolation(cmt)[2]
1	Timtala	64	84	2-3 days	806400
2	Nirsana	57	84	2-3 days	718200
3	Januna	110	84	2-3 days	1386000
4	Khirsana	47	84	2-3 days	592200
5	Adgaon	145	84	2-3 days	1827000
6	Jasapur	25	84	2-3 days	315000
7	Sarmaspur	6	84	2-3 days	75600
8	Nanded	1	84	2-3 days	12600
9	Runmochan	2	84	2-3 days	25200
10	Amala	73	84	2-3 days	919800
	Total	**530**	**84**		6678000

Fig: Gross Water Percolation in the project area



[2] The average height of farmbund is taken as 0.50m