NABARD

सत्यमेव जयते
हिमाचल प्रदेश सरकार

प्रकृति रक्षति रक्षितः
Nature Protects if She is Protected

REPORT ON MONITORING OF IMPLEMENTATION OF HORTICULTURE AND AGRICULTURE PLANS-POST TRAINING, UNDER SLADRC PROJECT, COMPONENT-III, SIRMAUR DISTRICT, HIMACHAL PRADESH

CTRAN CONSULTING

Department of Environment, Science Technology & Climate Change
Government of Himachal Pradesh

ACKNOWLEDGEMENT

We express our deep sense of gratitude & heart felt appreciation to Department of Environment Science and Technology- Himachal Pradesh for undertaking critical initiative for climate adaptation to safeguard rural livelihoods in the state of Himachal Pradesh. It would not have been possible to complete the assignment without their timely support and guidance. We express our gratitude to the Director, DEST, Principal Scientific Officer, Dr S Attri and other officials for technical guidance, extending support, providing information, and facilitating the process.

We extend our heartfelt gratefulness to the Deputy Commissioner, DDA, DDH, block level extension officers from Agriculture and Horticulture department, master trainers, lead farmers, and resource persons from Sirmaur district who have whole heartedly supported and participated in the implementation process and shared their valuable experience during the training of farmers, FPO formation and functioning. Their valuable information helped us in due and successful completion of the project.

Cooperation of the farmers and their families helped in understanding the project implementation and its impacts on their livelihood. We thank them for allocating their valuable time and information.

Last but not the least, we thank to all, who are not named here but their direct and/ or indirect support during the field assessment and implementation process helped in the successful completion of the project

CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

SLADRC project has played a critical role in enhancing the climate resilience of the agriculture dependent communities through its series of interventions. The project was implemented in 3 administrative blocks of Sirmaur district of Himachal Pradesh i.e. Pachhad, Paonta Sahib and Sangrah. Each intervention attempted under every component has brought forward a series of incremental positive changes significantly impacting the lives of farming communities of the state. The Monitoring and Evaluation of Agriculture/Horticulture schemes study has been performed to get a comprehensive idea about the project implementation and quantitatively determine the project impact on the beneficiaries. SLADRC project had several other interventions in place by other line departments but monitoring of schemes solely under the Agriculture and Horticulture department was under the agreement with CTRAN. The Department of Agriculture was implementing schemes under two thematic areas: SRI Cultivation in late but excess moisture condition (subdivided into 4 components- Intercropping of maize and pulses, introduction of legumes and green fodder, introduction of garlic, ginger and potato, and vegetable cultivation- which primarily involved distribution of seeds); and Moisture Management- which involved setting up of sprinkler systems for irrigation purposes with 90% subsidy. The Department of Horticulture was running schemes in two areas: Early on-setting cultivars of fruits (Distribution of kiwi, K.lime, strawberry, litchi and pomegranate seeds/seedlings); and Moisture management- which involved setting up of sprinkler and drip irrigation systems at 90% subsidy. The agriculture and horticulture interventions accounted to a total of 8623 beneficiaries and 160 beneficiaries respectively.

A sample survey consisting of 480 samples was undertaken attempting to evaluate the Department of Agriculture and Department of Horticulture scheme implementation and impacts. The crop production was observed to have increased between 19.23% and 33.07% and crop yield was observed to have increased between 18.75% and 32.5%. 234.96% of increase in area under strawberry cultivation was witnessed as the mean area under strawberry expanded from 0.163 acres to 0.546 acres. A total of 6.34 Hectares was irrigated (using sprinkler irrigation) under the moisture management scheme assisted by the Department of Agriculture and a total of 56 Hectares was irrigated under the moisture management scheme (using drip and sprinkler irrigation) assisted by the Department of Horticulture. Overall, the figures depict substantial improvement in the livelihoods of the project beneficiaries due to the interventions undertaken

ABBREVIATIONS

AF	Adaptation Fund
BDO	Block Development Officer
BoD	Board of Directors
CCA	Culturable Command Area
CRA	Climate Resilient Agriculture
CV	Coefficient of Variance
DEST	Department of Environment Science and Technology
DPMU	District Project Management Unit
FGD	Focussed Group Discussion
FIG	Farmer Interest Group
FPC	Farmer Producer Company
FPO	Farmer Producer Organization
FYM	Farmyard Manure
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoHP	Government of Himachal Pradesh
GP	Gram Panchayat
GSDP	Gross State Domestic Produce
GVA	Gross Value Added
IDP	Integrated Development Project
IMD	Indian Meteorological Department
INM	Integrated Nutrient Management
IPH	Irrigation and Public Health
IPM	Integrated Pest Management
IRR	Internal Rate of Return
JJAS	June July August September
KAP	Knowledge Attitude and Practice
KVK	Krishi Vigyan Kendra
LRP	Local Resource Person
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MoU	Memorandum of Understanding
NABARD	National Bank for Agriculture and Rural Development
NAFCC	National Adaptation Fund for Climate Change
NAPCC	National Action Plan on Climate Change
NFSM	National Food Security Mission
NICRA	National Innovations in Climate Resilient Agriculture
NIE	National Implementing Entity
NMAET	National Mission on Agriculture Extension and Technology
NMSA	National Mission for Sustainable Agriculture
O&M	Operation and Management
PKVY	Parampragat Krishi Vikas Yojana
PMFBY	Pradhan Mantri Fasal Beema Yojana
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana

PWD	Public Works Department
RAD	Rainfed Area Development
RCP	Representative Concentration Pathways
RKVY	Rashtriya Krishi Vikas Yojana
RWH	Rainwater Harvesting
SAPCC	State Action Plan on Climate Change
SHG	Self Help Groups
SHM	Soil Health Management
SLADRC	Sustainable Livelihood for Agriculture Dependent Rural Communities
SRI	System of Rice Intensification
THI	Temperature Humidity Index
TNA	Training Needs Assessment
TOT	Training of Trainers
WBCIS	Weather Based Crop Insurance Scheme
ZBNF	Zero Budget Natural Farming

BACKGROUND

3.1 NATIONAL ADAPTATION FUND FOR CLIMATE CHANGE[1]

The National Adaptation Fund for Climate Change (NAFCC) was established in August 2015 to demonstrate the adaptation to climate change for the State and Union Territories of India that are particularly vulnerable to the adverse effects of climate change. Government has set up a budget provision of Rs.350 crores for the year 2015-16 and 2016-17, with an estimated requirement of Rs. 181.5 crores for financial year 2017-18 for NAFCC. The project under NAFCC prioritizes the needs that build climate resilience in the areas identified under the SAPCC (State Action Plan on Climate Change) and the relevant Missions under NAPCC (National Action Plan on Climate Change). Considering the existing arrangement with NABARD as National Implementing Entity (NIE) for Adaptation Fund (AF) under Kyoto Protocol and its presence across the country, NABARD has been designated as National Implementing Entity (NIE) for implementation of adaptation projects under NAFCC by Govt. of India. Under this arrangement, NABARD would perform roles in facilitating identification of project ideas/concepts from State Action Plan for Climate Change (SAPCC), project formulation, appraisal, sanction, disbursement of fund, monitoring & evaluation and capacity building of stakeholders including State Governments.

3.2 HIMACHAL PRADESH

The state Himachal Pradesh with the geographical area of 55,673 Sq. km. situated between 30° 22' 40" to 33° 12' 20" north latitudes and 75° 45' 45" to 79° 04' 20" east longitudes in western Himalayas. It is divided into four agro- climatic zones viz. i) Sub- tropical, Sub- Mountain, Low Rural ii) Sub- tropical, Sub-humid, Mid-rural iii) Wet- Temperate High Rural and; iv) Dry Temperate High Rural & Cold Desert. Its Himalayan ecosystem which is considered as the storehouse of biodiversity forms catchment of various major rivers in North India like Ravi, Beas, Chenab, Satluj and Yamuna. It is a small hilly state and forms a part of the Northwestern Himalayas and the environmentally fragile and ecologically vulnerable Himalayan ecosystem. Further the study conducted by GIZ and the historical IMD Gridded data analysis on daily temperature (maximum and minimum) and rainfall from 1951-2013 for the State indicates that the mean annual maximum temperature for Himachal Pradesh is 25.9° C. (range 24.5°C to 27.1°C) and the temperature both annual maximum and minimum during the last 63 years shows an increasing trend. It is further projected that mean annual minimum temperature for RCP 4.5[2] scenario and RCP 8.5 scenario will increase by about 1.4 degrees Celsius and 1.6 degrees Celsius respectively by mid-century. Regarding rainfall, it has been observed that the average annual rainfall of Himachal Pradesh State is 1284.2 mm (range: from 704.7 mm - 2062.8 mm). The south-west monsoon (JJAS months) rainfall contributes the maximum to annual rainfall amounting to approximately 66 percent for the state. Further the analysis of annual rainfall data reveals a negative trend indicating

[1] NABARD

[2] Representative Concentration Pathways (RCP) refers to the GHG concentration trajectory adopted by the IPCC (in AR 5 report, 2014). There are 4 RCP situations- RCP 2.6, RCP 4.5, RCP 6, RCP8.5 where 2.6, 4.5, 6 and 8.5 represent the radiative forcing upon the earth in the year 2100.

that the total amount of rainfall and the number of rainy days received by the State have declined since 1951. It is apprehended that the implications of such climatic events may include heat stress related health impacts, increase in energy demand for cooling, additional evaporation and evapotranspiration losses resulting in enhanced irrigation water requirement for crops. Increase in intensity of rainfall events may lead to floods, urban storms, vector-borne diseases, loss of work, transport disruption, additional cost for flood proofing factories and warehouses pushing the state to a situation of more vulnerable due to climate change impacts. Further, Temperature Humidity Index (THI)[3] of the state is projected to rise in many parts of State during March–September with a maximum rise during April–July in 2030s with respect to 1970s and that again will lead to put negative impact on the livestock productivity of the State. Thus, climate change in the state is already affecting the food security, water security, food production systems, supply chains and livelihoods. It is envisaged that by end of the century, climate change may cause significant increases in inter-annual and intra-seasonal variability of monsoon rainfall. There are major problems before farmers of selected blocks in district Sirmaur. Non-judicious extraction of water through bore wells is contributing to a dint in the ground water level. Access and availability of resources due to the complexity of the geographical area adds up to further complications in the implementation of any developmental schemes.

Several Climate Change Adaptation options are suggested for reducing these vulnerabilities in the agriculture sector like:

1. Promotion of climate smart agriculture
2. Improvement of land management strategies
3. Establishment of FPOs
4. Promote sustainable agriculture practices
5. Testing of new machines
6. Sustainable use of fertilizers / Natural Farming
7. Water conservation and Micro Irrigation Program
8. Seed Certification Programs and many other activities

Thus, with this backdrop under the National Adaptation Fund for Climate Change (NAFCC), the Department of Environment and Science and Technology (DEST), Shimla, is implementing the "Sustainable Livelihoods of Agriculture-Dependent Rural Communities in Drought Prone District of Himachal Pradesh through Climate Smart Solutions (SLADRC)" project in Sirmaur district of Himachal Pradesh, which is one of the drought prone districts of the state and is highly vulnerable to climate change. The district is experiencing moisture stress with negative livelihood consequence for the agriculture and horticulture-based livelihoods. The drought history of the district indicates that most of the tehsil of this district were drought affected in 2002 and 2009 and the climatic pattern have pushed people more specifically the small and marginal farmers to a situation of deficit and erratic rainfall.

[3] THI indicates the combined effect of environmental temperature and relative humidity and is a useful way to assess heat stress. *THI =0.8*T + RH*(T-14.4) + 46.4, where T stands for temperature and RH stands for Relative Humidity*

3.3 AGRICULTURE IN HIMACHAL PRADESH

Himachal Pradesh is predominately an agricultural state where agriculture and allied sectors support 60 percent of the population and provides direct employment to almost 70 percent of the population[4]. 13.2 percent of the State's income (GSDP) comes directly from agriculture and allied sector. Small and marginal farmers have a landholding of 80.6 percent of the total landholdings, 10.84 percent of land holdings under semi-medium and medium farmers and just 0.30 percent by large farmers[5]. About 80 percent of the total cultivated area in the State is rainfed hence the agriculture production is dependent heavily upon the Southwest Monsoon. Rice, Wheat, and Maize are important cereal crops of the State. Groundnut, Soyabean and Sunflower in Kharif and Rapeseed / Mustard and Toria in the Rabi season are important oilseed crops. Urd, Bean, Moong, Rajmash (kidney bean) in Kharif season and Gram Lentil in Rabi are important pulse crops of the State. The Agro-climatic conditions in the State are favourable for the production of cash crops like potato, off-season vegetables and ginger. The agro-climatic zone is best suited for cultivation of mango and litchi which are the currently emerging markets due to better price opportunities fetched by these two crops. Kiwi, olive, pomegranate, pecan and strawberry are also some other crops which are suitable for Himachal Pradesh's climatic condition. Animal husbandry and fisheries also generate wealth and employment for the agrarian population. However, the state has a high reliance on agriculture which has a direct bearing on it from climate variations. Climate change poses additional challenges in the sector as temperatures increase and decrease in rainfall leads to scarcity of water and stress on crops. It is anticipated that there may be an all-round decrease in horticultural-agricultural production in the region in long-term, and the line of production may shift to higher altitudes. Apple production in the Himachal Pradesh region has decreased between 1982 and 2005 as the increase in maximum temperature has led to a reduction in total cumulative chilling hours in the region-a decline of more than 9.1 units per year in last 23 years. With almost 763,000 Ha of the State's area under the food grain production, the targeted yield for the year 2020-21 was fixed at 2.19 M.T. per Hectare[6]. Various agricultural schemes have been implemented at the state level to increase crop production like High Yielding Variety .Program, providing 50 percent subsidies on plant protection measures to marginal and small farmers to tackle the insect and pest problem (Plant Protection Program), free testing of soil and suggestions based on the results (Soil Testing Program), emphasising the benefits of natural farming to bring down the production costs (Prakrit Kheti Kushal Kisan Yojna, under ZBNF), fertilizer consumption subsidy with special focus to water soluble fertilizers distributed at almost 25 percent subsidy, providing institutional credit for small and marginal farmers through Agriculture Credit Societies, insurance schemes compensating for a bad harvest of paddy and maize in Kharif season & wheat and barley in Rabi season (PMFBY), 85 percent subsidies for setting up a polyhouse (Mukhya Mantri Nutan Polyhouse Yojna), setting up of pre and post agriculture infrastructure and livelihood diversification activities (RKVY), farmer driven system of technology dissemination (NMAET), development of agricultural productivity in rainfed areas under schemes like Rainfed Area Development (RAD), Soil Health Management (SHM) and PKVY (under NMSA), increased production of rice, wheat and pulses (NFSM), expand area under

[4] Economic Survey, Himachal Pradesh (2020-21)
[5] Agriculture Census (2015-16)
[6] Economic Survey, Himachal Pradesh (2020-21)- Table 7.5

irrigation (PMKSY), prevent damage to certain horticultural crops like apple, kiwi, peach etc. due to weather related atrocities (Weather Based Crop Insurance Schemes), provisioning of minimum support price to mango, apple & some citrus fruits (Market Intervention scheme) and others. Livelihood based skill development program for Persons with disability (PWD) in agriculture and food processing sector along with retail and hospitality sector is under process. For the various key line departments (including agriculture) to be in touch with the village level situation it was made mandatory for the village level functionaries to attend the gram sabha meetings in their posted area of jurisdiction. Based on tentative assessments for 2020-21 maize was the highest produced cereal in Himachal Pradesh followed by wheat[7] in Sirmaur. The Gross Value Added (GVA) by the agricultural and allied sector to the state is on a decline with a total GVA contribution of 13.62 percent, which according to the Economic Survey of Himachal Pradesh (2020-21) is due to development process leading to faster growth of non-agricultural sector.

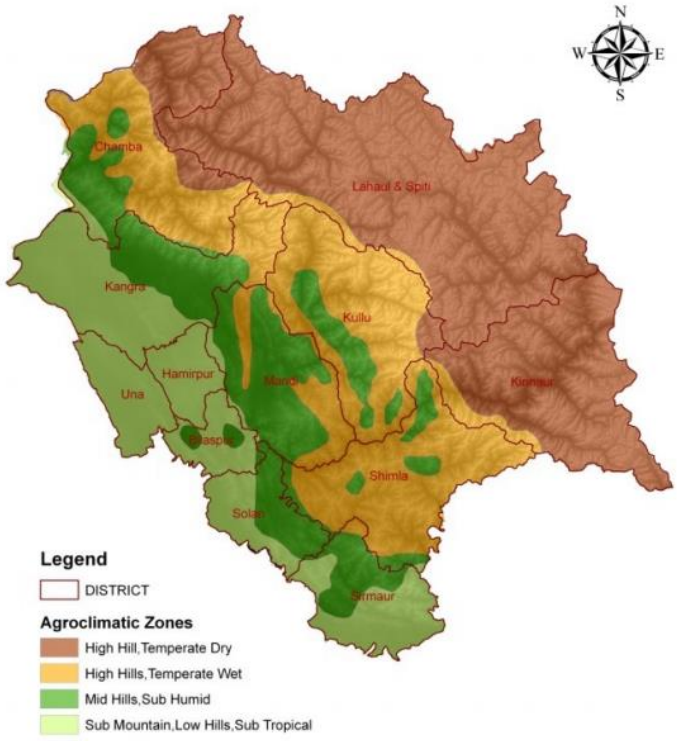


Figure 1: Agroclimatic zones of Himachal Pradesh

[7] Directorate of Agriculture, Himachal Pradesh

3.4 PROJECT AREA PROFILE

The project execution was done in 3 Developmental blocks of Sirmaur district namely Pachhad, Paonta Sahib and Sangrah. The data has been sourced from the Social Mapping Report of Vulnerable Households of District Sirmaur, Himachal Pradesh.

3.4.1 PACHHAD BLOCK

The Pachhad Block fall in Northwest direction if district Sirmaur. Total geographical area of this block is 406.50 sq. kms. 100percent area of this block falls under rural category. As per the 2011 Census total population of Pachhad block is 53,800 persons (27,912 males & 25,888 females). Geographically Rajgarh block fall in Northeast direction, Sangrah Block falls in East direction and Nahan block falls in Northwest direction of the Pachhad block. There is total 263 census villages in this block. The count of the employed/ self-employed person of the block is 35352 out of which 20300 persons are solely dependent on farming for their livelihood. The number of unemployed persons in the block was 18448. The block has 30 panchayats. Shallow and narrow 'Jalal' river rises near village Bain below Nehi in tehsil Pachhad which forms a dividing line between the Sain and the Darthi ranges. The Jalal River falls into the Giri river at Dadahu losing its entity. The popular varieties of plum namely Santa Rosa, Meriposa are being grown in the block. Huge wild trees of walnut are also seen growing in this block. Wild pomegranates growing in some pockets have national importance as dry seed spices. The ginger of Ghaad area is most famous for seed and saunth purpose. In Ginni area of Pachhad, irrigation facilities are not assured. Recently, mango cultivation through in-situ method is gaining popularity in the block due to its success. The climate of the Pachhad block is sub-tropical to sub-temperate where winters are cold, foggy and summers are hot reaching temperature up to 35-40°C during day and 10-15°C during night. The south-west monsoon, which contributes 90 percent, sets in last week of June and withdraws in the middle of September. July and August are the rainy months. Rest 10 percent of the rainfall received in non-monsoon months, in the wake of western disturbance and thunderstorms. Soil texture is mainly the outcome of forest soils resulting in sandy loam to clay loam soils, which is highly suitable for cultivation of wide varieties of crops ranging from sub-tropical to sub-temperate crops of fruits, vegetables, flowers etc. Remunerative horticultural crops of the blocks are plum, ginger, peas, capsicum, garlic, tomato, beans, carnation, marigold, gladiolus, roses, etc. Milch cattle are mostly found in every household for sustaining livelihood.

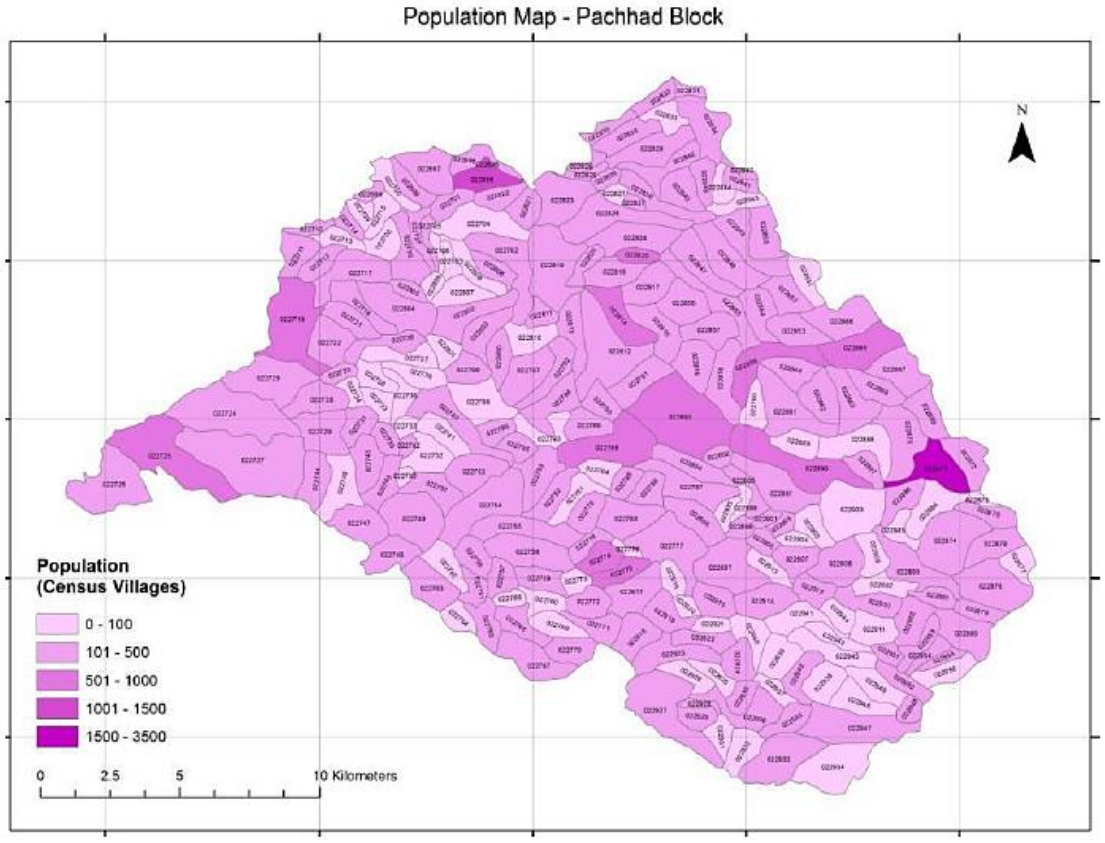


Figure 2: Population map, Pachhad block

3.4.2 PAONTA SAHIB BLOCK

The Paonta Sahib Block fall in Southeast direction of district Sirmaur. Total geographical area of this block is 366.34 sq. kms. Out of total 6.20 sq. kms area of this block falls under urban category(Paonta Sahib Municipal Council) and rest is in rural category. As per the 2011 census total population of Paonta Sahib block is 1,69,682 persons (89,150 males & 80,532 females). Geographically Nahan block fall in West direction, Shilai block falls in East direction of the Paonta Sahib block. There are total 191 census villages in this block. It is situated 45 km away to the East of the district headquarter and enshrined with the historical paga-arpann of Shri Guru Gobind Singh Ji, in the 16th century. The river Yamuna surrounds the city from the S-E and S-W directions. There are two other rivers viz. The Batta and The Giri, originating from the North and terminating into the Yamuna in the S-W end of the block. The reserved saal forests are the beauty of the block. It has attached boundaries to Uttarakhand and Haryana. The block has 64 panchayats. Geographical area in Paonta block is accommodating 399 persons per sq. km. Net sown area in the block is 14572 ha. Topographically, it is plain, and land can be easily cultivated, and bestowed with 100 percent electrification and drinking water facility. The block is consolidated into 64 panchayats Agriculture has emerged as the main stay of the block which has 50.3 percent area under active cultivation; hence, cultivable land holding is computed to be 4.05 bighas per family. The climate of the area is sub-tropical. The winters are cold, foggy too and summers are very hot. The Southwest monsoon, which contributes 90 percent, sets in last week of June and withdraws

in the middle of September. July and August are rainy months. Rest 10 percent of the precipitation occurs in the non- monsoon months, in the wake of western disturbances and thunderstorms. Soil texture is mainly the outcome of forest-soil, sharpening into sandy loam to clay loam soils. Gravels predominate in the vicinity of rivulets/khads. Topography is generally undulating and rugged. The special character of the block is the fertile soil supporting the cultivation of diverse crops. Sugarcane is the predominant crop covering 51percent area of net cropped area.

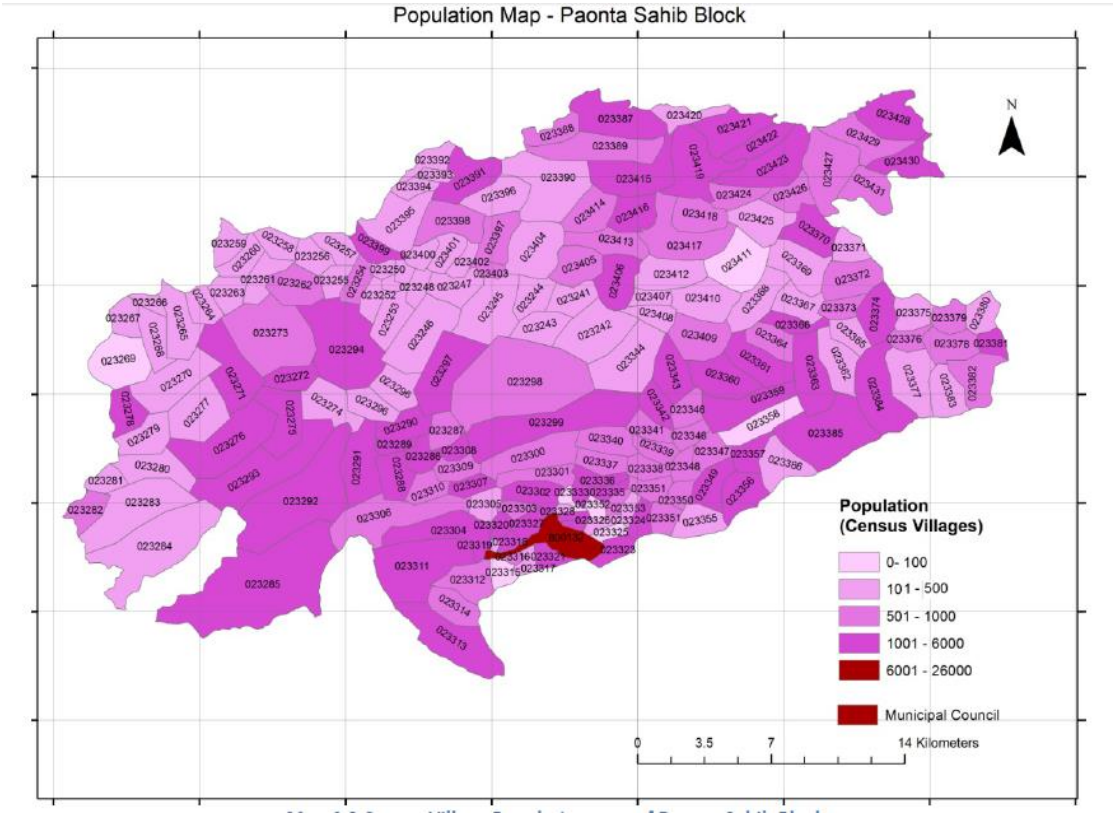


Figure 3: Population map, Paonta Sahib block

3.4.3 SANGRAH BLOCK

The Sangrah Block fall in North direction of district Sirmaur. Total geographical area of this block is 486.28 sq. kms. 100percent area of this block falls under rural category. As per the 2011 census total population of Sangrah block is 70,410 persons (35,951 males & 34,459 females). Geographically Rajgarh block fall in Northwest direction, Nahan Block falls in Northwest direction, Shilai block falls in East direction, Pachhad block falls in West direction and Paonta Sahib block falls in Southeast direction of the Sangrah block. There are total 122 census villages in this block. It is situated 61.5 km away to the North- East of the district headquarter. The block has 41 gram panchayats. Net sown area in block is 6066 ha. Topographically, it is the hardest block, but bestowed with 100percent electrification and drinking water facility. Women have been the main labour force. There exist 2818 families, of which 972 belong to scheduled caste and 482 belong to other backward classes. Agriculture has emerged as the main stay of the block which has 71.37 percent area under active cultivation; hence, culturable land holding is computed to be 3.11 bighas per family. The climate of the area varies from sub-tropical to sub-temperate. The winters are cold, foggy too and summers are very hot. Snow is confined to the higher reaches and upper part of the block. The southwest monsoon, which contributes 90 percent, sets in last week of June and withdraws in the middle of September. July and August are rainy months. Rest 10 percent of the precipitation occurs in the non-monsoon months, in the wake of western disturbances and thunderstorms. Soil texture is mainly the outcome of forest-soil, sharpening into sandy loam to clay loam soils. Gravels predominate in the vicinity of rivulets/khads. Topography is generally undulating and rugged. The special character of the block is the fertile soil supporting the cultivation of diverse crops. Ginger, peas and chilli have been the major cash crops of the block, which has been replaced with more remunerative crop i.e., garlic.

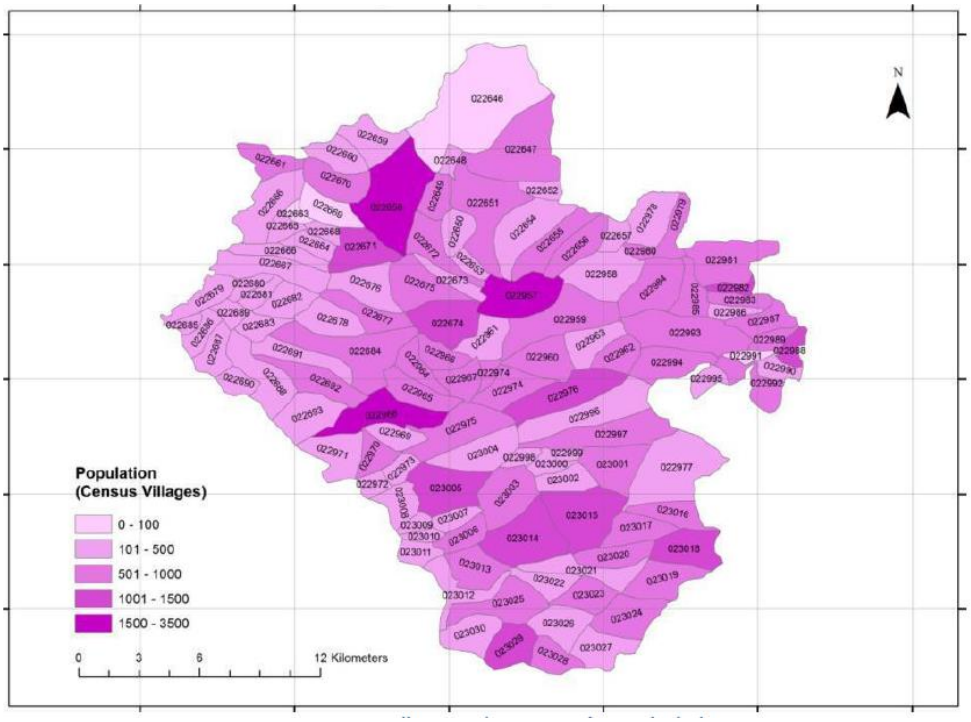


Figure 4 Population Map, Sangrah block

OBJECTIVE OF THE STUDY

The objective of the study is to monitor and evaluate the implementation of the Horticulture and Agriculture plans under the SLADRC project post-training in three blocks of Sirmaur district where the project has been implemented i.e., Pachhad, Paonta Sahib and Sangrah.

SCHEME BRIEF

Schemes by the Department of Agriculture and Department of Horticulture constituted under SLADRC project was monitored as a part of this study. The schemes by Department of Agriculture were categorized into two areas: SRI cultivation in late but excess moisture condition and Moisture management scheme. Under the SRI cultivation in late but excess moisture condition scheme seed distribution was done under four schemes:

- Introduction of garlic, ginger and maize in which garlic, ginger, maize and turmeric seeds were distributed free of cost from NAFFC funds.
- Intercropping of maize and pulses in which maize, mash, mustard, wheat and pea seeds were distributed on 50% basis from NAFCC funds.
- Vegetable cultivation in which tomato and potato seeds were distributed on 50% basis NAFCC funds.
- Introduction of legumes and green fodder in which Berseem, bajra, mash, sorghum, lentil, gram, and oat seeds were distributed free of cost from NAFCC funds.

Under moisture management scheme by the Department of Agriculture, sprinklers were provided to the farmers with 90% of the costs covered from the NAFCC project funds and 10% farmer share (beneficiary share).

The schemes by Department of Horticulture were categorized under two areas: Early on-setting cultivars of fruits and Moisture management. Under the Early on-setting of cultivars strawberry, litchi, K.lime, pomegranate and kiwi was distributed. And, in the moisture management component of Department of Horticulture drip systems and sprinkler systems were provided to the beneficiaries with 90% subsidy provided from the NAFCC funds and 10% of the cost bore by the beneficiary.

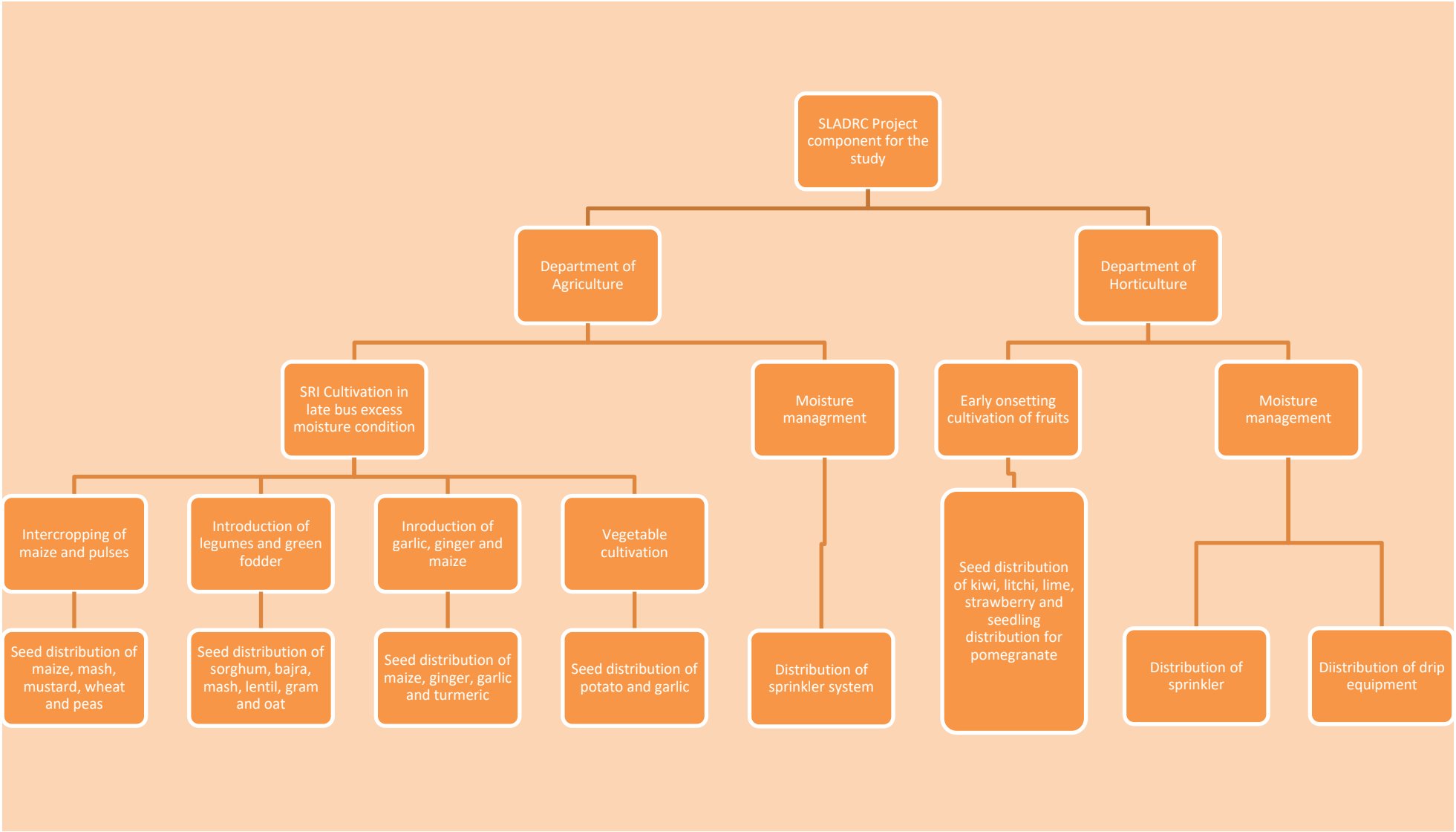


Figure 5: Agriculture and Horticulture scheme breakdown

METHODOLOGY

For developing the Horticulture and Agriculture plan monitoring post-training report data were collected from the primary as well as secondary sources, majorly extracted from primary sources. Secondary sources such as agriculture and horticulture line departments facilitated understanding the department level interventions and provided us figures on production, area expansion, number of units installed (under Micro-Irrigation Scheme), quantity of seeds distributed etc. These data were used to triangulate and verify the primary data. A complete dataset of all the beneficiaries for both horticulture and agriculture interventions were created to get a holistic view of the intervention benefits scheme-wise, block-wise, crop-wise, and department-wise.

To understand the impact of the interventions upon the beneficiaries a random sample was generated from the pool of beneficiaries and a questionnaire-based survey was undertaken. The questionnaire-based survey considered the pre-post scenario and various socio-economic indicators in order to receive a comprehensive view of the project impact on various livelihood aspects of the beneficiaries. The following are the steps followed in evaluation of the project impact amongst the beneficiaries. Stratified random sampling technique was used for the sample selection, and attempt was made to cover all the crops distributed under the project.

The primary survey focussed on the post-intervention situation and data was collected from the sampled beneficiary from all 3 blocks covering all the schemes performed by the Department of Agriculture and Horticulture. Focussed Group Discussions and informal interviews were also performed to map the scheme impact, local understanding of the project and the ways in which the scheme implementation could be increased to maximize benefits.

Data cleaning and standardization was done, and a central dataset was created for the analysis purpose. Different measures were used to calculate impact of different data types.

FOR CROP BENEFICIARY SCHEMES (SRI CULTIVATION IN LATE BUT EXCESS MOISTURE CONDITION & EARLY ON-SETTING CULTIVARS OF FRUITS

1. Crop-wise secondary data was referred to cross-check the existing data and create a control group[8] which was used to calculate the impact of the schemes. Double-difference method (also known as difference-in-difference method) combined with pre-post analysis was used in this study to evaluate the project impact. The control group in this study was the block average of the variable under consideration. For instance, while measuring changes in the yield parameter we compare the yield of that particular crop of the SLADRC beneficiaries from the yield of that particular crop from the block average. The difference in yield between the block average and that of the SLADRC beneficiaries is what the true impact is.

[8] Control group is created to understand how a particular population would have behaved in the absence of an intervention. The establishment of a control group serves as a relative baseline to observe the changes in the group that was benefitted (also called Treatment Group)

2. Ex-post facto assessment was performed by sourcing data from a combination of primary and secondary data sources to determine the crop yields before the project initiated. This would serve as a baseline to the analysis. Ex-post facto analysis helps us understand the trend and also provides us a projection range within which the data would vary in the future. For this study the past data were used to project the variable magnitudes to the time when the study was undertaken (i.e. 2021). This was done since not all agricultural statistics at block level was available for annual intervals.

3. Based on FGDs and trend analysis a mean estimate of the crop yield was determined for the year 2021 for the project blocks. Since there are several other interventions going on parallel to SLADRC which are working towards the betterment of the agricultural communities and has the possibility of affecting the outcome indicators, it is necessary to carefully identify the impact caused solely due to SLADRC interventions The crop-wise yield and production estimated from the block level data would serve as a control group estimate to the intervention. The control group would represent the value of the outcome indicators had the intervention not taken place. The control group was generated by analysing the crop-wise yield observed at the block level and using the yield to calculate the production values for the same gross cropped area as present in the sample. Hence we extrapolated the production values that the sample would have had the intervention not taken place. Hence we created a pseudo-counterfactual for the purpose of the impact study.

4. Maturation effect of the yield[9] was critical in understanding the impact of this study, because if not considered then the true impact would not be reported. For calculating the increase in yield irrespective of the project intervention the yield in the project blocks in the year 2021 was compared to the yield of the project block in the pre-project initiation stage. Data pertaining to production and yield of crops were taken from secondary sources for this step.

$$\textit{Increase in yield irrespective of project intervention} = \textit{Crop yield in } 2021 - \textit{Crop yield before project intiated}$$

5. The increase in yield was then calculated for the sampled beneficiaries from whom both pre-project initiation data and post-project implementation data were collected.

$$\textit{Increase in yied for the SLADRC beneficiaries} = \textit{Crop yield of beneficiaries in } 2021 - \textit{Crop yield of beneficcciaries before project intiated}$$

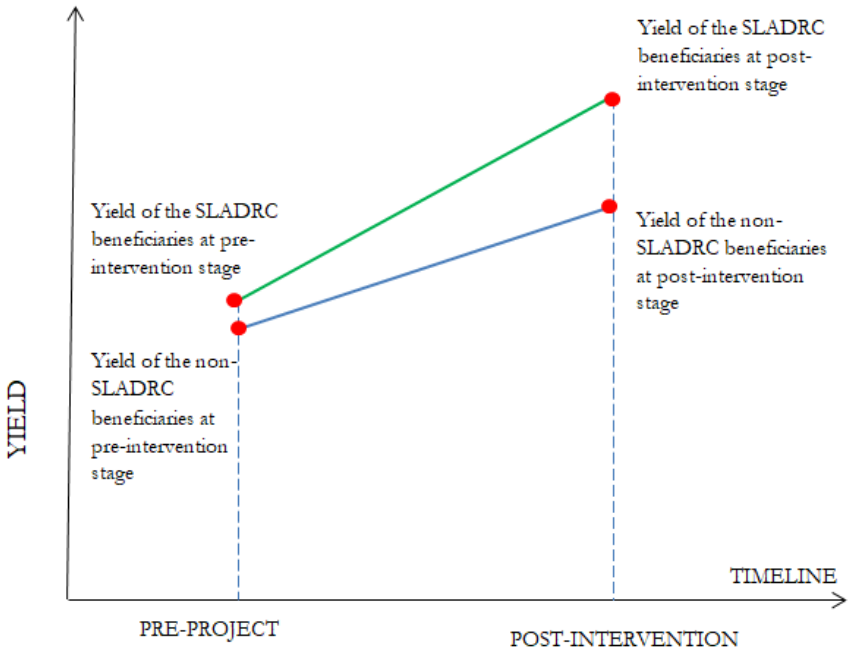
6. The true impact of the project is calculated by subtracting the increase in yield irrespective of the project intervention from the increase in yield for the SLADRC beneficiaries.

[9] The maturation effect is any biological or psychological process that systematically varies with the passage of time, independent of specific external events. Yield of crops vary with time and hence it is necessary to take into account the trend of yield in order to estimate the true impact.

SLADRC impact on Crop Yield
= Increase in yield for SLADRC beneficiaries
– Increase in yield irrespective of the project intervention

7. Since crop yields are directly related to production amount, thus we get the crop-wise impact magnitudes of the production values as well.

8. Other questions in the primary study were framed to get a holistic purview of the scheme implementation and similar statistical analysis was performed on need-to-know basis based on the indicator to be calculated.



FOR AREA EXPANSION SCHEMES LIKE EARLY ONSETTING CULTIVARS OF FRUITS

9. Pre-post survey based on the total cropped area of strawberry plant was done to understand the change in the area under horticultural crops amongst the beneficiaries and calculate the effect size of the change

FOR MOISTURE MANAGEMENT SCHEMES

10. Since the number of beneficiaries were lower as compared to the seed beneficiaries hence even without sampling the true figures for the area irrigated can be obtained. But to understand the impact of irrigation on crop yields the sampled beneficiary data was collected to understand the impact of yield post-provisioning of proper moisture management resources.

OBSERVATIONS

6.1 AGRICULTURAL INTERVENTIONS UNDER THE SLADRC PROJECT

6.1.1 SRI CULTIVATION IN LATE BUT EXCESS MOISTURE CONDITION

The System of Rice Intensification or SRI is a climate-smart and agro-ecological methodology to increase the productivity of irrigated rice (and, more recently, other crops) by changing the management of plants, soil, water, and nutrients. Using the SRI methodology, yields are increased by 20-50% or more, while reducing inputs: seed by 90%, irrigation water by 30-50%, chemical fertilizer by 20-100%, and usually reduced need for pesticides. For the farmer, SRI brings greater returns to labour, land and capital. SRI methodology is based on **four main interacting principles**:

- Establishing plants early and quickly, to favour healthy and vigorous root and vegetative plant growth.
- Maintaining low plant density to allow optimal development of each individual plant and to minimize competitions between plants for nutrients, water and sunlight.
- Enriching soils with organic matter to improve nutrient and water holding capacity, increase microbial life in the soil, and to provide a good substrate for roots to grow and develop,
- Reducing and controlling the application of water, providing only as much water as necessary for optimal plant development and to favour aerobic soil conditions.

The total beneficiary count in SRI cultivation in late but excess moisture condition is 8592.

In the **intercropping of maize and pulses** a total of 1038.4 Quintal seeds of maize, mash, mustard, wheat, and pea seeds were distributed amongst 4301 beneficiaries (602 beneficiaries from Pachhad block, 1347 beneficiaries from Paonta Sahib block and 2352 beneficiaries from Sangrah block) covering a total area of 2290 Hectares. The highest distributed crop in this scheme by quantity is maize.

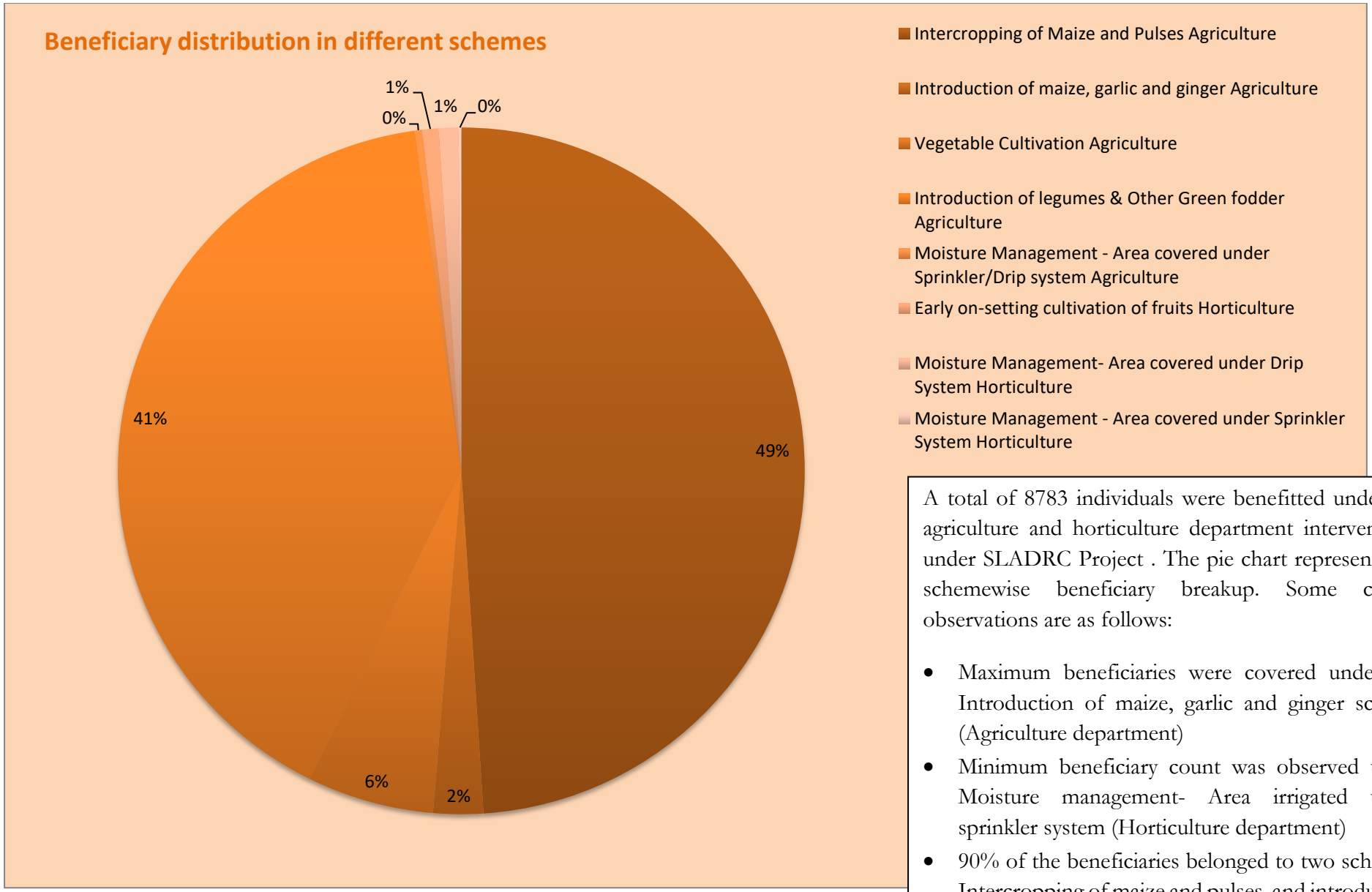
In the **introduction maize, garlic and ginger**, a total of 54.38 Quintal seeds of maize, garlic, ginger, and turmeric were distributed amongst 206 beneficiaries (68 beneficiaries from Pachhad, 45 beneficiaries from Paonta Sahib and 93 beneficiaries from Sangrah) covering a total area of 96.64 Hectares. The highest distributed crop in this scheme is maize.

In the **vegetable cultivation** scheme a total of 657.35 Quintal seeds of potato and tomato were distributed amongst 525 beneficiaries (29 beneficiaries from Pachhad,139 beneficiaries from Paonta Sahib and 357 beneficiaries from Sangrah) covering a total area of 72 Hectares. The highest distributed crop in this scheme is potato.

In the **introduction of legumes and green fodder** scheme a total of 571.26 Quintals of seeds of Sorghum, bajra, lentil, gram, mash and oat were distributed to 3560 beneficiaries (1448 beneficiaries from Pachhad, 324 beneficiaries from Paonta Sahib and 1788 beneficiaries from (Sangrah) covering a total area of 1079 Hectares. The highest distributed crop in this scheme is Sorghum.

Table 1: Agriculture and Horticulture scheme beneficiary distribution

Thematic area of scheme	Scheme	Department	Pachhad	Paonta Sahib	Sangrah	Total	Abstract
SRI Cultivation in late but excess moisture condition	Intercropping of Maize and Pulses	Agriculture	602	1347	2352	4301	TOTAL BENEFICIARIES FROM AGRICULTURE INTERVENTION = **8623**
	Introduction of maize, garlic and ginger	Agriculture	68	45	93	206	
	Vegetable Cultivation	Agriculture	29	139	357	525	
	Introduction of legumes & Other Green fodder	Agriculture	1448	324	1788	3560	
Moisture Management	Moisture Management - Area covered under Sprinkler/Drip system	Agriculture	12	7	12	31	
Early on-setting cultivars of fruits	Early on-setting cultivars of fruits	Horticulture	1	42	24	67	TOTAL BENEFICIARIES FROM HORTICULTURE INTERVENTION = **160**
Moisture Management	Moisture Management- Area covered under Drip System	Horticulture	72	10	0	82	
	Moisture Management - Area covered under Sprinkler System	Horticulture	6	5	0	11	
TOTAL			**2238**	**1919**	**4626**	**8783**	TOTAL BENEFICIARIES FROM THE PROJECT = **8783**



A total of 8783 individuals were benefitted under the agriculture and horticulture department interventions under SLADRC Project . The pie chart represents the schemewise beneficiary breakup. Some critical observations are as follows:

- Maximum beneficiaries were covered under the Introduction of maize, garlic and ginger scheme (Agriculture department)
- Minimum beneficiary count was observed under Moisture management- Area irrigated under sprinkler system (Horticulture department)
- 90% of the beneficiaries belonged to two schemes: Intercropping of maize and pulses, and introduction of legumes and other green fodder

Table 2: Scheme-wise crop seed distribution by Department of Agriculture for SRI Cultivation in late but excess moisture condition (Source: DDA Office, Nahan)

Scheme	Input	Quantity (Quintals)	Area covered (Hectare)
Intercropping of Maize and Pulses	Maize	319	1276
	Mash	54	270
	Wheat	658	658
	Mustard	5	83
	Peas	2.4	3
Introduction of maize, garlic and ginger	Maize	22.78	91
	Ginger	6.6	0.44
	Garlic	20	5
	Turmeric	5	0.2
Vegetable Cultivation	Potato	591	55
	Garlic	66.35	17
Introduction of legumes & Other Green fodder	Sorghum	241	603
	Bajra	128	35
	Mash	14.5	72
	Berseem	44.8	179
	Gram	84	105
	Lentil	11.76	26
	Oat	47.2	59
TOTAL		**2321.39**	**3537.64**

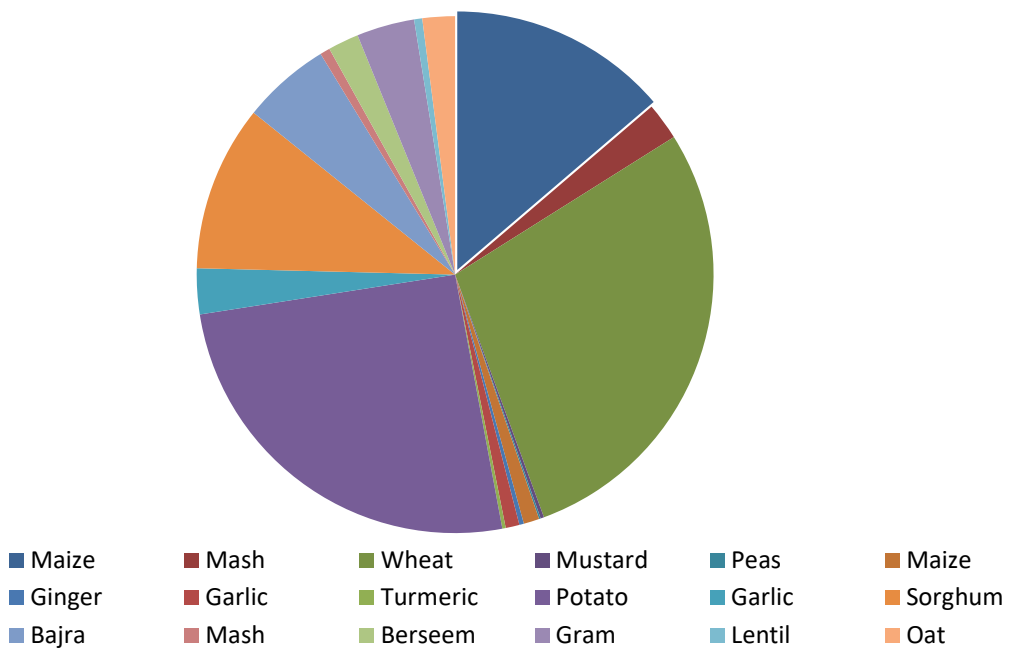


Figure 6: Crop distribution in agriculture scheme

Table 3: Schemewise beneficiary distributoin in SRI cultivation in late but excess moisture condition

Scheme	Crop	Pachhad	Paonta Sahib	Sangrah	Total
Intercropping of Maize and Pulses	Maize	251	620	2120	2991
	Wheat	331	166	212	709
	Pea	0	20	0	20
	Mash	0	531	0	531
	Mustard	20	10	20	50
	Sub-Total	**602**	**1347**	**2352**	**4301**
Introduction of maize, garlic and ginger	Maize	42	0	0	42
	Ginger	17	0	6	23
	Garlic	9	35	87	131
	Turmeric	0	10	0	10
	Sub-Total	**68**	**45**	**93**	**206**
Vegetable Cultivation	Garlic	0	0	40	40
	Potato	29	139	317	485
	Sub-Total	**29**	**139**	**357**	**525**
Introduction of legumes & Other Green fodder	Mash	947	0	65	1012
	Gram	83	0	1125	1208
	Bajra	170	0	0	170
	Lentil	129	0	0	129
	Oat	33	0	0	33
	Berseem	86	324	0	410

	Sorghum	0	0	598	598
	Sub-Total	**1448**	**324**	**1788**	**3560**

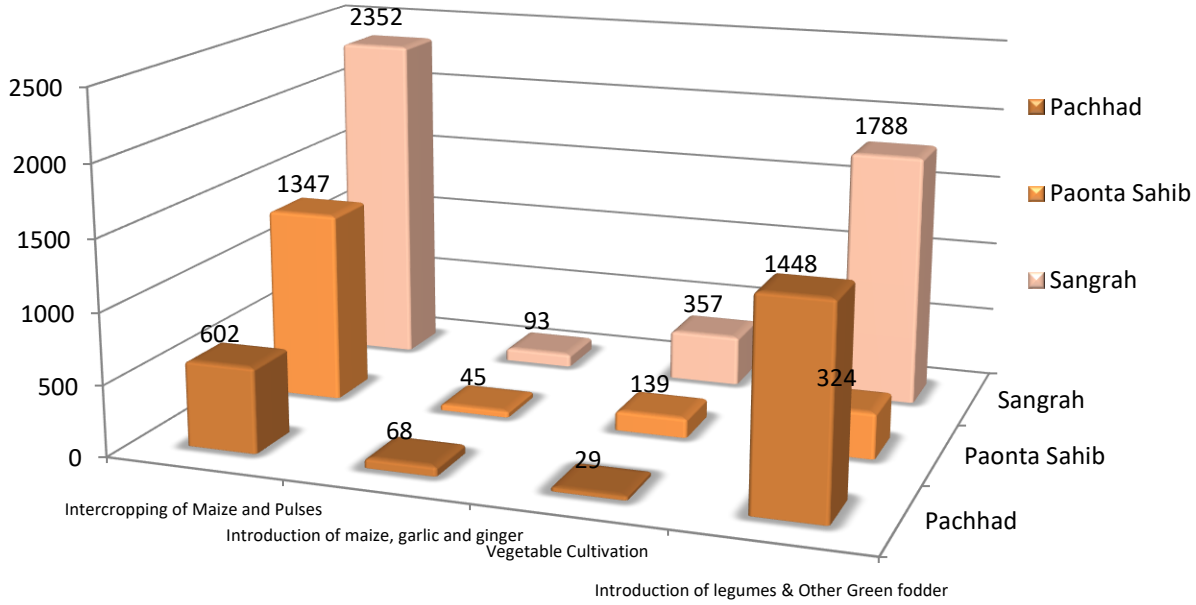


Table 4: Total cropwise seeds distributed by Department of Agriculture

Crop	Pachhad	Paonta Sahib	Sangrah	Total
Turmeric	0	10	0	10
Pea	0	20	0	20
Ginger	17	0	6	23
Oat	33	0	0	33
Lentil	129	0	0	129
Garlic	9	35	127	171
Mustard	190	10	20	220
Berseem	86	324	0	410
Potato	29	139	317	485
Sorghum	0	0	598	598
Wheat	331	166	212	709
Gram	83	0	1125	1208
Mash	947	531	65	1543
Maize	293	620	2120	3033
Total	**2147**	**1855**	**4590**	**8592**

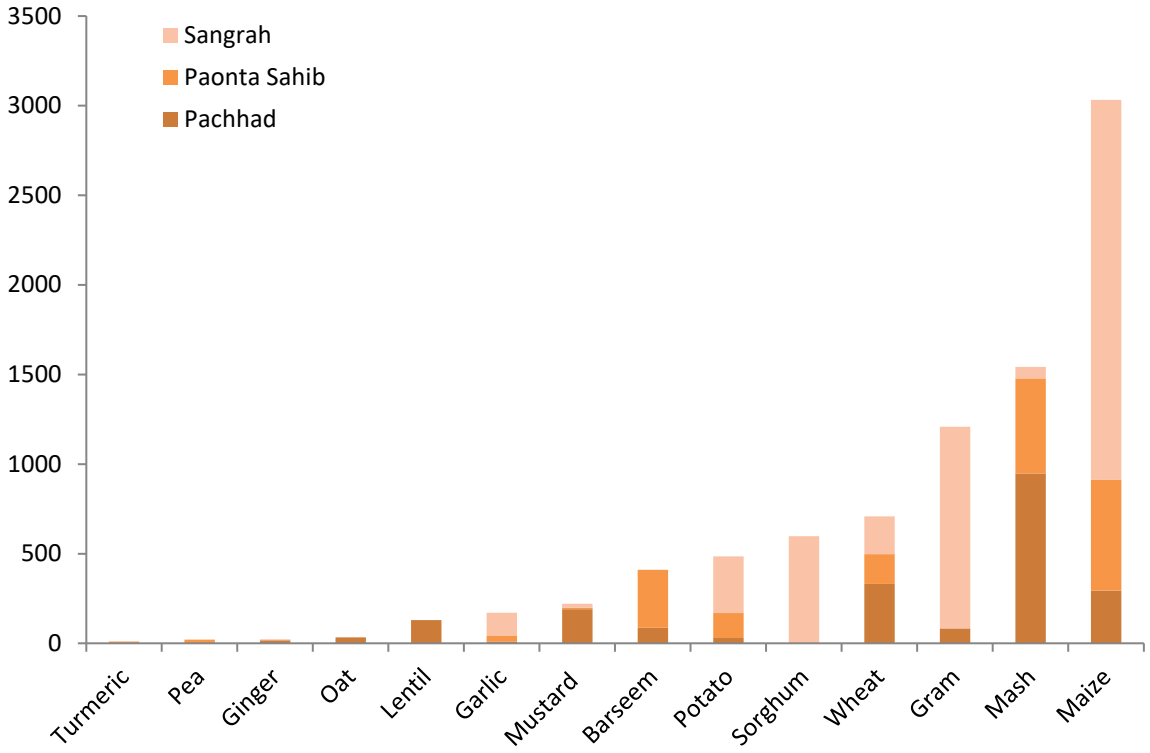


Figure 7: Cropwise and blockwise seed distribution undertaken by Department of Agriculture

6.1.2 MOISTURE MANAGEMENT

The aim of the moisture management intervention is to increase the water-use efficiency by decreasing excessive wastage of water and to provide the appropriate amount of water required for optimum crop growth. Under the Department of Agriculture intervention for moisture management component sprinklers were provided to 31 beneficiaries (12 from Pachhad, 7 from Paonta Sahib and 12 from Sangrah) covering a total Culturable Command Area[10] (CCA) of 6.34 Hectares. Sprinkler systems were provided to the beneficiaries under this scheme.

Table 5: CCA covered under moisture management scheme, Department of Agriculture

BLOCK	Number of beneficiaries	CCA Covered (in Hectare)
Pachhad	12	1.92
Paonta Sahib	7	2.5
Sangrah	12	1.92
TOTAL	31	6.34

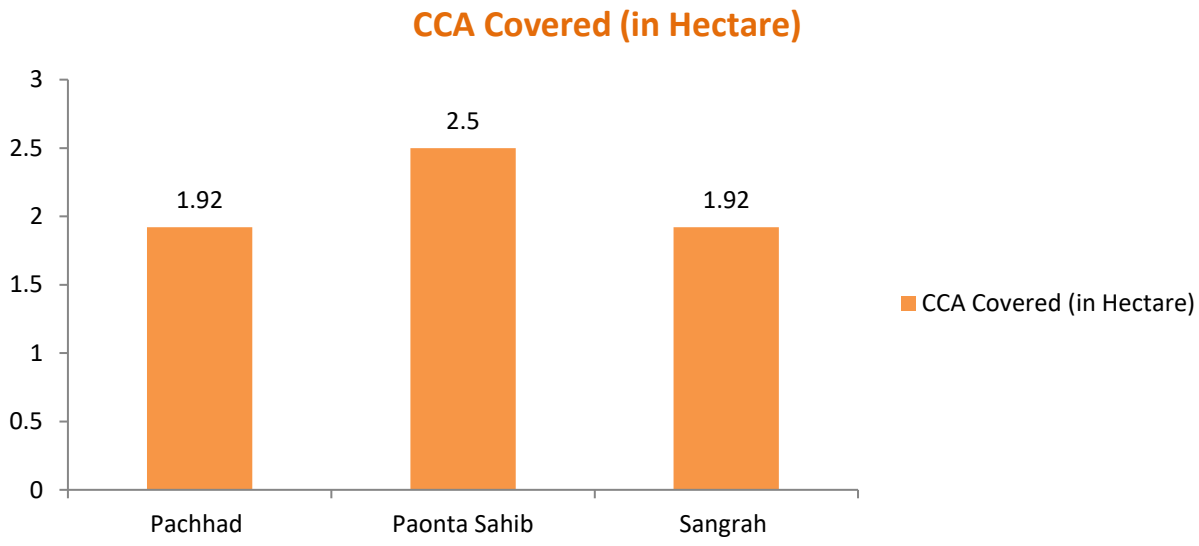


Figure 8: Block-wise CCA distribution under moisture management scheme, Department of Agriculture

[10] Cultuable Command Area (CCA) is the area in which crop is grown at a particular time or a season. It is the difference of Unculturable Area from the Gross Command Area(GCA)
CCA = GCA – Uncultivable area
CCA are of 2 types : Culturable Cultivable Area (Area which is cultivable and cultivation is presently done) and Culturable Uncultivable area (Area which is cultivable but cultivation is not currently practiced)

6.1.3 PHYSICAL AND FINANCIAL TARGETS

Name Of Component	Budget (in Lac)	Budget after re-appropriated	Expenditure	Executed by	Subsidy Proposed	Input given	Area covered (in Ha.)	Farmer covered
MIS	6.32	6.32	6.32	Sub-divisional Soil Conservation officer	90% from SLADRC Project and 10% farmer share	Portable Sprinkler System	6.34	31
Promotion of inter-cropping of maze and pulses and SRI Cultivation in late but excess moisture condition								
Inter-cropping of maze and pulses	26.6	25.34	26.6	Development block Paonta Sahib, Pachhad and Sangrah	50% Basis from NAFCC	Maze-319 Qtls	1276	4301
						Mash-54 Qtls	270	
						Wheat-658 Qtls	658	
						Mustard-5 Qtls	83	
						Peas-2.40 Qtls	3	
Vegetable cultivation	14.8	14.8	14.8		50% Basis from NAFCC	Hybrid veg. Seeds seed potato-591 Qtls	55	525
						Garlic-66.35 Qtls	17	
Introduction of legumes and green fodder	19	20.26	19		Free Of Cost From NAFCC Funds	Surghum-241 Qtls	603	3560
						Bajra-128 Qtls	35	
						Mash-14.5 Qtls	72	
						Berseem-44.80 Qtls	179	
						Gram-84 Qtls	105	
						Lentil-11.7 Qtls	26	

					Qat-47.20 Qtls	59	
Introduction of Maze Garlic and ginger	6	6	6	Free Of Cost From NAFCC Funds	Maize-22.78 Qtls	91	206
					Ginger-6060 Qtls	0.44	
					Garlic-20 Qtls	5	
					Turmeric-5 Qtls	0.2	
Total Budget Received	72.72	72.72				3544	8623

6.2 HORTICULTURAL INTERVENTIONS UNDER THE SLADRC PROJECT

6.2.1 EARLY ONSETTING CULTIVARS OF FRUITS

Under the early on-setting cultivars of fruits scheme seeds of strawberry, K lime, litchi, pomegranate, and kiwi seeds have been distributed to 67 beneficiaries (24 in Sangrah, 42 in Paonta Sahib and 1 in Pachhad). Under this intervention the area under the horticultural crop is estimated to increase by 12.71 Hectares (5 Hectares in Sangrah, 7.59 Hectares in Paonta Sahib and 0.12 Hectares in Pachhad).

Table 6: Cropwise seeds/seedlings distributed under early onsetting cultivars of fruits scheme

Fruit	SANGRAH	PAONTA SAHIB	PACHHAD	Total
Pomegranate	24	0	0	24
Lime	0	1	0	1
Kiwi	0	0	1	1
Litchi	0	2	0	2
Strawberry	0	39	0	39
Total	**24**	**42**	**1**	**67**

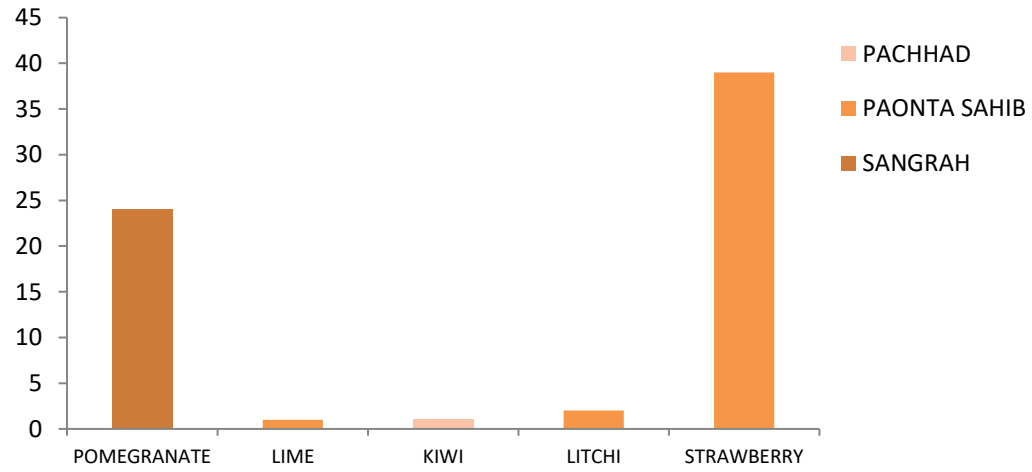


Figure 9: Cropwise seeds/seedlings distributed under early onsetting cultivars of fruits scheme

Table 7: Total area covered by horticutural crops under early onsetting cultivars of fruits scheme (in Hectare)

Fruit	SANGRAH	PAONTA SAHIB	PACHHAD	Total
Pomegranate	5	0	0	5
Lime	0	0.4	0	0.4
Kiwi	0	0	0.12	0.12
Litchi	0	1	0	1
Strawberry	0	6.19	0	6.19
Total	**5**	**7.59**	**0.12**	**12.71**

6.2.2 MOISTURE MANAGEMENT FOR VEGETABLES AND FRUITS

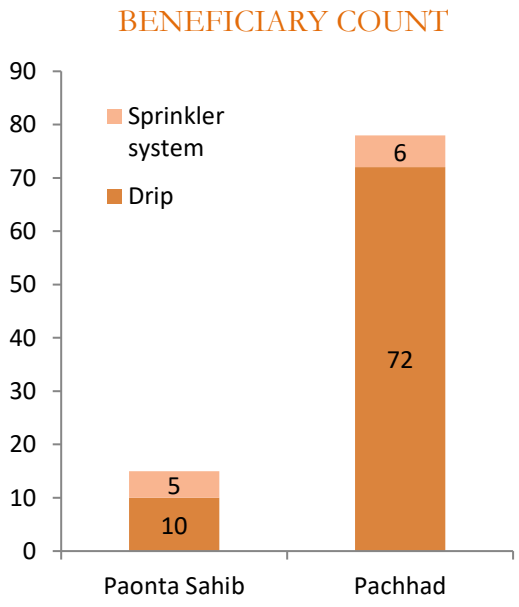
In the moisture management for vegetables and fruits scheme of the Department of Horticulture 82 drip irrigation systems and 11 sprinkler irrigation systems have been provided to the beneficiaries covering a CCA of 56.4 Hectares (9.7 Hectares in Paonta Sahib and 46.7 Hectares in Pachhad). The scheme was implemented in Pachhad and Paonta Sahib blocks of Sirmaur district. The below tables represent the beneficiary-wise and area-wise distribution of the scheme benefits in the project area.

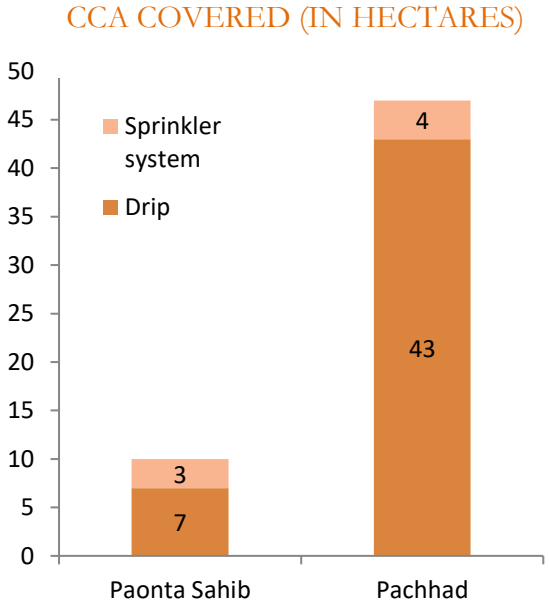
Table 8: Beneficiaries under moisture management scheme, Department of Horticulture

Irrigation facility provided	Paonta Sahib	Pachhad	Total
Drip	10	72	82
Sprinkler system	5	6	11
Total	15	78	93

Table 9: CCA coved by horticultural crops under early on setting cultivars of fruits scheme (in Hectare)

Irrigation facility provided	Paonta Sahib	Pachhad	Total
Drip	7.02	42.5	49.52
Sprinkler system	2.68	4.2	6.88
Total	9.7	46.7	56.4





6.2.3 PHYSICAL AND FINANCIAL TARGETS

SL NO.	Name of the Scheme	Type of MI System	Targets Physical (Ha)	Targets Financial (Rs)	Achievent Physical (Ha)	Achievent Financial (Rs)
1	Moisture Management and area to be covered under drip irrigation	Close spread drip irrigation (1.2m*0.6m)/ Micro Sprinkler Irrigation System (8m*8m)	72	₹ 6,970,331.00	72	₹ 6,970,331.00
2	Early on Setting Cultivars of Fruits	**Name of Fruit Plants**	**Targets Physical (Ha)**	**Targets Financial (Rs)**	**Achievent Physical (Ha)**	**Achievent Financial (Rs)**
		Pomegrante/Kiwi/Starwberry/Guava/Litchi	12.34	₹ 679,669.00	12.34	₹ 679,669.00
		Grand Total	**84.34**	**₹ 7,650,000.00**	**84.34**	**₹ 7,650,000.00**

EVALUATION OF SCHEME IMPACT

7.1 SAMPLE BRIEF

Household level helps us gain more insight into the day-to-day operations of all the individuals within the household, and the impact of various exposure events on individual as well as household level. A total of 480 respondents have ben sampled to understand the horticulture and agriculture scheme interventions under the SLADRC project. The sample pool constituted 267 marginal farmers, 186 small farmers and 27 semi-medium farmers. Both female and male respondents have been surveyed in the study- 20% female respondents and 80% male respondents. Caste distribution of the sample constituted 281 individuals (58.54%) from General category, 104 individuals (21.66%) from OBC and 95 individuals (19.79%) from SC. Overall, roughly equal number of samples were chosen from every block- 162 from Pachhad, 162 from Paonta Sahib and 156 from Sangrah.

The scheme-wise sample distributions are as follows-

Agriculture schemes with a total of 369 sampled beneficiaries-

- 22 beneficiaries from Vegetable Cultivation covering samples of garlic and potato
- 172 beneficiaries from Intercropping of maize and pulses covering samples ofmaize, mash and wheat
- 154 beneficiaries from Introduction of legumes and green fodder covering samples of bajra, Berseem, lentil, gram, mash and sorghum
- 19 beneficiaries from Introduction of maize, garlic and ginger covering samples of maize, garlic and bajra.
- 2 beneficiaries from Moisture management using sprinkler system

Horticulture schemes with a total of 111 sampled beneficiaries-

- 48 samples for early on-setting cultivars of fruits covering samples of strawberry and pomegranate.
- 63 samples for moisture management- 61 samples for drip system and 2 samples for sprinkler system

Table 10: Caste distribution of the sampled beneficiaries

Block	General	OBC	SC	Total
Sangrah	94	31	31	156
Paonta Sahib	55	65	42	162
Pachhad	132	8	22	162

Total	281	104	95	480

Table 11: Gender distribution of the sampled beneficiaries

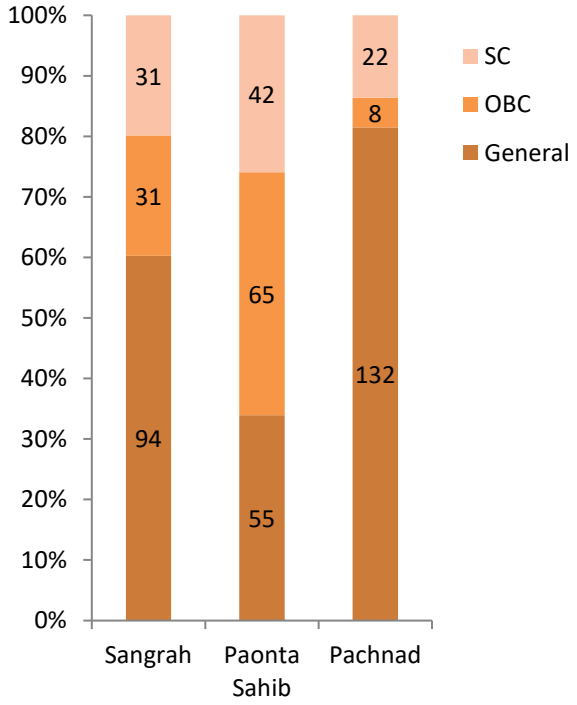
Block	M	F	Total
Sangrah	76	80	156
Paonta Sahib	153	9	162
Pachhad	155	7	162
Total	384	96	480

Table 12: Farmer category distribution of the sampled beneficiaries

Block	Marginal	Small	Semi-medium	Total
Sangrah	111	42	3	156
Paonta Sahib	84	68	10	162
Pachhad	72	76	14	162
Total	267	186	27	480

Table 13: Land irrigation status of sampled beneficiaries

Block	Non-irrigated land (acre)	Irrigated land (acres)	TOTAL
Sangrah	243	31.2	274.2
Paonta Sahib	400	10	410
Pachhad	421	10.3	431.3


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
31
31
94
42
65
55
22
8
132
SC
OBC
General
Sangrah
Paonta Sahib
Pachnad

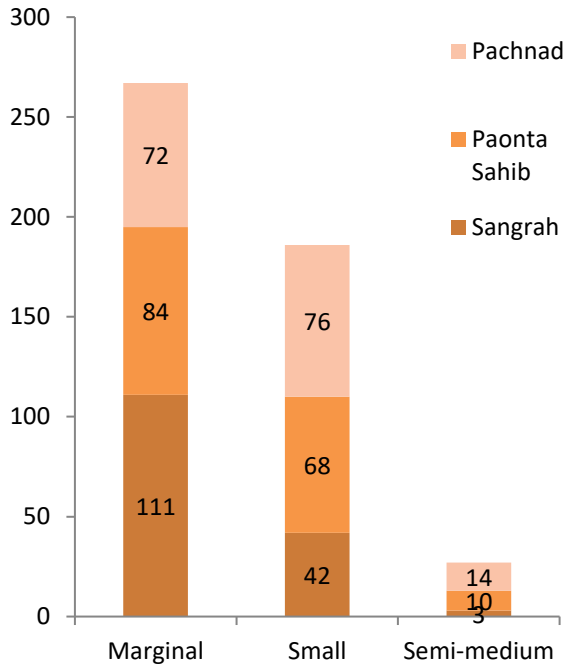

300
250
200
150
100
50
0
72
84
111
76
68
42
14
10
3
Pachnad
Paonta Sahib
Sangrah
Marginal
Small
Semi-medium

Table 14: Scheme-wise sample distribution

Thematic area of scheme	Scheme	Department	Pachhad	Paonta Sahib	Sangrah	Total
SRI Cultivation in late but excess moisture condition	Vegetable cultivation	Agriculture	10	4	8	22
	Intercropping of Maize and Pulses	Agriculture	42	65	65	172
	Introduction of legumes and green fodder	Agriculture	54	44	56	154
	Introduction of maize, garlic and ginger	Agriculture	5	9	5	19
Moisture management	Moisture Management - Area covered under Sprinkler System	Agriculture	0	2	0	2
Moisture Management for vegetables and fruits	Moisture Management - Area covered under Sprinkler System	Horticulture	2	0	0	2
	Moisture Management- Area covered under Drip System	Horticulture	51	10	0	61
Early on-setting cultivars of fruits	Early on-setting cultivars of fruits	Horticulture	0	26	22	48
Total			**164**	**160**	**156**	**480**

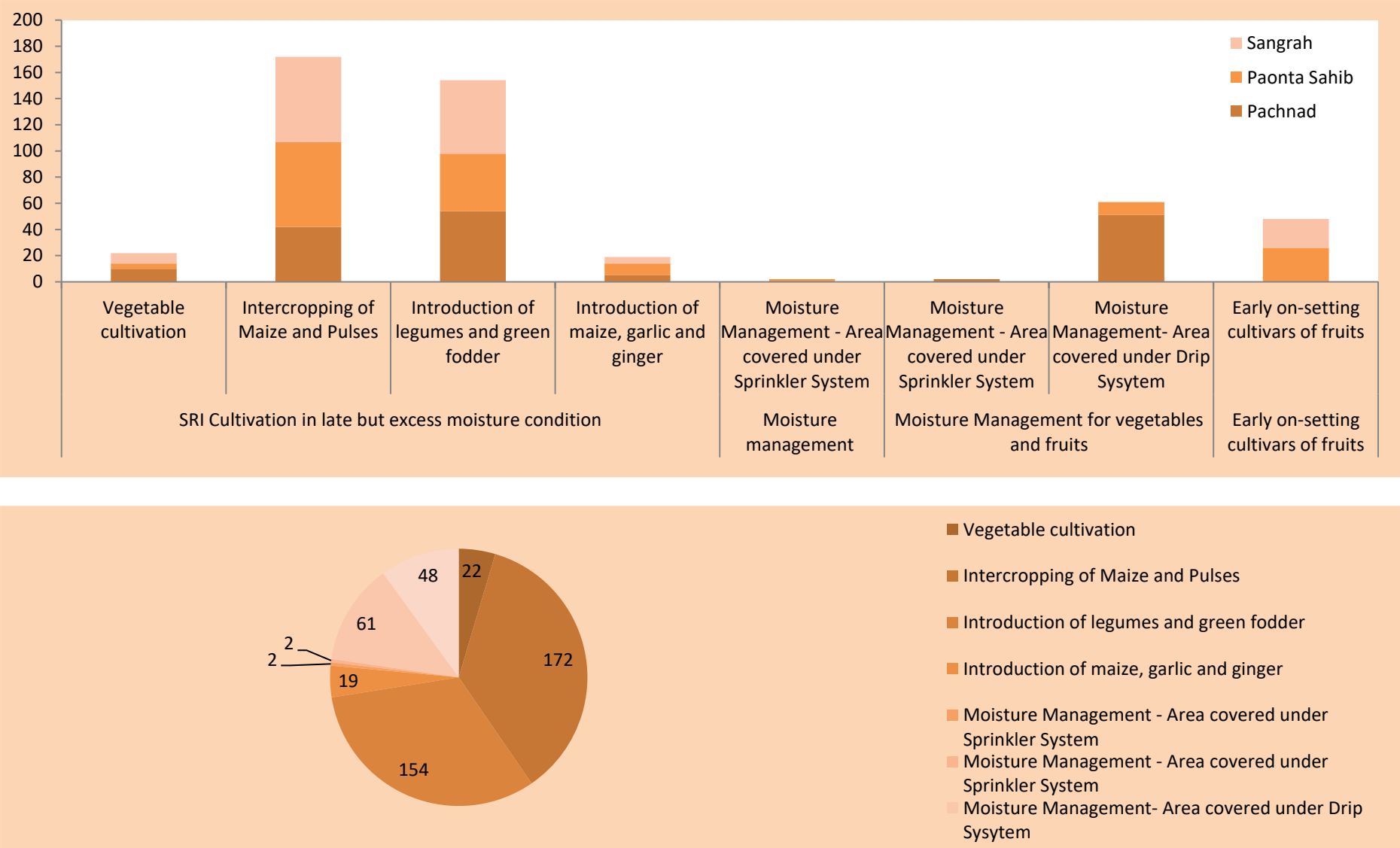


Figure 10: Scheme-wise sample distribution

Table 15: Crop-wise and block-wise distribution of sampled beneficiaries

Scheme	Department	Crop	Pachhad	Paonta Sahib	Sangrah	Total
Early on-setting cultivation of fruits	HORTICULTURE	Pomegranate	0	0	22	22
		Strawberry	0	26	0	26
Intercropping of Maize and Pulses	AGRICULTURE	Maize	6	29	39	74
		Mash	36	9	0	45
		Wheat	0	27	26	53
Introduction of legumes and green fodder	AGRICULTURE	Bajra	0	0	46	46
		Berseem	36	44	0	80
		Gram	11	0	1	12
		Lentil	3	0	1	4
		Mash	4	0	0	4
		Sorghum	0	0	8	8
Introduction of maize, garlic and ginger	AGRICULTURE	Garlic	1	9	5	15
		Ginger	3	0	0	3
		Maize	1	0	0	1
Vegetable cultivation	AGRICULTURE	Garlic	1	4	0	5
		Potato	9	0	8	17

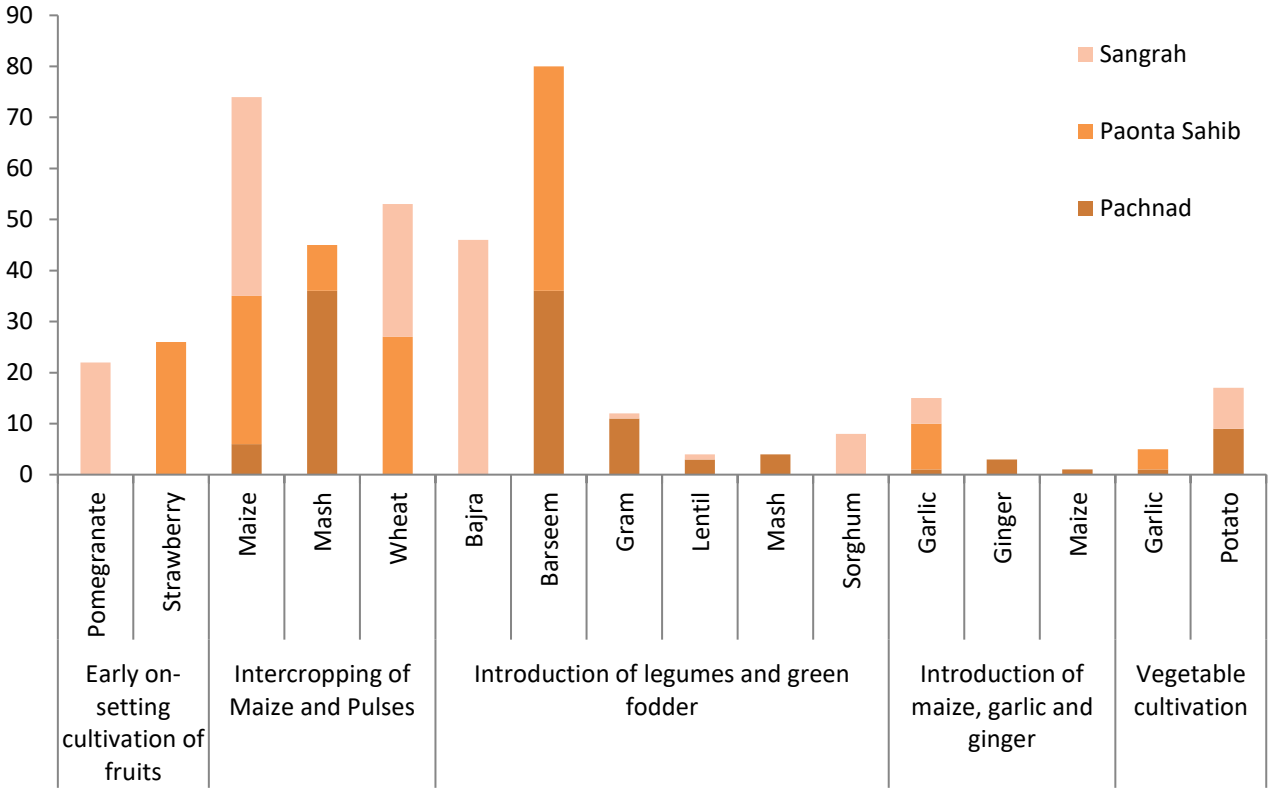


Figure 11: Crop-wise and block-wise distribution of sampled beneficiaries

7.2 SAMPLE OBSERVATIONS

7.2.1 FOR CROP BENEFICIARY SCHEMES (SRI CULTIVATION IN LATE BUT EXCESS MOISTURE CONDITION & EARLY ON-SETTING CULTIVARS OF FRUITS

The crop wise observations of the SLADRC interventions are as follows-

1. **Bajra**- The total production reported by the sample before the intervention was 9,403 Kg with a yield of 529 Kg per Acre and in the post-intervention phase was reported to have 11,429 Kg with a yield of 643 Kg per acre. In the post-project period beneficiaries had produced a total of 333 Kg of Bajra more as compared to a situation in which they did not receive the intervention and the average yield was 18 Kg per acre higher. The total production is projected to increase by 19.67% and the average yield is projected to increase by 18.75%.

2. **Berseem** - The total production reported by the sample before the intervention was 5,81,836 Kg with a yield of 24294 Kg per acre and in the post-intervention phase was reported to have 707163 Kg with a yield of 29527 Kg per acre. In the post-project period beneficiaries had produced a total of 20597 Kg of Berseem more as compared to a situation in which they did not receive the intervention and the average yield was 860 Kg per acre higher. The total production is projected to increase by 19.67% and the average yield is projected to increase by 19.67%.

3. **Garlic** - The total production reported by the sample before the intervention was 2450 Kg with a yield of 5868 Kg per Acre and in the post-intervention phase was reported to have 3673 Kg with a yield of 8797 Kg per acre. In the post-project period beneficiaries had produced a total of 240 Kg of garlic more as compared to a situation in which they did not receive the intervention and the average yield was 576 Kg per acre higher. The total production is projected to increase by 24.42% and the average yield is projected to increase by 24.48%.

4. **Ginger**- The total production reported by the sample before the intervention was 4804 Kg with a yield of 3431 Kg per Acre and in the post-intervention phase was reported to have 5326 Kg with a yield of 3804 Kg per acre. In the post-project period beneficiaries had produced a total of 104 Kg of ginger more as compared to a situation in which they did not receive the intervention and the average yield was 75 Kg per acre higher. The total production is projected to increase by 24.88% and the average yield is projected to increase by 25.17%.

5. **Gram**- The total production reported by the sample before the intervention was 3953 Kg with a yield of 395 Kg per Acre and in the post-intervention phase was reported to have 4804 Kg with a yield of 3804 Kg per acre. In the post-project period beneficiaries had produced a total of 140 Kg of gram more as compared to a situation in which they did not receive the intervention and the average yield was 13 Kg per acre higher. The total production is projected to increase by 19.69% and the average yield is projected to increase by 18.31%.

6. **Lentil**- The total production reported by the sample before the intervention was 430 Kg with a yield of 299 Kg per Acre and in the post-intervention phase was reported to have 523 Kg with a yield of 364 Kg per acre. In the post-project period beneficiaries had produced a total of 15 Kg of lentil more as compared to a situation in which they did not receive the intervention and the average yield was 11 Kg per acre higher. The total production is projected to increase by 19.23% and the average yield is projected to increase by 20.37%.

7. **Maize**- The total production reported by the sample before the intervention was 86495 Kg with a yield of 1106 Kg per Acre and in the post-intervention phase was reported to have 133676 Kg with a yield of 1710 Kg per acre. In the post-project period beneficiaries had produced a total of 9902 Kg of maize more as compared to a situation in which they did not receive the intervention and the average yield was 127 Kg per acre higher. The total production is projected to increase by 26.56% and the average yield is projected to increase by 26.62%.

8. **Mash**- The total production reported by the sample before the intervention was 5721 Kg with a yield of 257 Kg per Acre and in the post-intervention phase was reported to have 6953 Kg with a yield of 312 Kg per acre. In the post-project period beneficiaries had produced a total of 202 Kg of mash more as compared to a situation in which they did not receive the intervention and the average yield was 9 Kg per acre higher. The total production is projected to increase by 19.61% and the average yield is projected to increase by 19.57%.

9. **Potato**- The total production reported by the sample before the intervention was 38.7 Kg with a yield of 5001 Kg per Acre and in the post-intervention phase was reported to have 62.6 Kg with a yield of 8086 Kg per acre. In the post-project period beneficiaries had produced a total of 5.7 Kg of potato more as compared to a situation in which they did not receive the intervention and the average yield was 735 Kg per acre higher. The total production is projected to increase by 31.32% and the average yield is projected to increase by 31.28%.

10. **Sorghum**- The total production reported by the sample before the intervention was 9098 Kg with a yield of 5055 Kg per Acre and in the post-intervention phase was reported to have 11058 Kg with a yield of 6144 Kg per acre. In the post-project period beneficiaries had produced a total of 322 Kg of sorghum more as compared to a situation in which they did not receive the intervention and the average yield was 179 Kg per acre higher. The total production is projected to increase by 19.66% and the average yield is projected to increase by 19.67%.

11. **Strawberry**- The total production reported by the sample before the intervention was 6322 Kg with a yield of 403 Kg per Acre and in the post-intervention phase was reported to have 7163 Kg with a yield of 456 Kg per acre. In the post-project period beneficiaries had produced a total of 209 Kg of strawberry more as compared to a situation in which they did not receive the intervention and the average yield was 13 Kg per acre higher. The total production is projected to increase by 33.07% and the average yield is projected to increase by 32.5%.

12. **Wheat**- The total production reported by the sample before the intervention was 18531 Kg with a yield of 423 Kg per Acre and in the post-intervention phase was reported to have 23319 Kg with a yield of 532 Kg per acre. In the post-project period beneficiaries had produced a total of 896 Kg of strawberry more as compared to a situation in which they did not receive

the intervention and the average yield was 21 Kg per acre higher. The total production is projected to increase by 23.02% and the average yield is projected to increase by 23.86%.

13. **Pomegranate**- Pomegranate data was not captured yet since pomegranate take 2-3 years to bear fruits hence the production benefits awaited to be yielded after a year. The beneficiaries expect a yield between 12-15 Kg per plant yield during the first year of fruit bearing and expect it to increase till 20 Kg per plant as the plant grows older.

Table 16: SLADRC impact on total production (cropwise)

CROP	PRE-PROJECT EXPTECTED PRODUCTION (Kg)	POST-PROJECT PRODUCTION FOR NON-BENEFICIARIES (Kg)	POST-PROJECT PRODUCTION FOR SLADRC BENEFICIARIES (Kg)	PRE-POST DIFFERENCE IN PRODUCTION FOR NON-BENEFICIARIES	PRE-POST DIFFERENCE IN PRODUCTION FOR SLADRC BENEFICIARIES	IMPACT	IMPACT %
Bajra	9403	11096	11429	1693	2026	333	+19.67
Berseem	581836	686566	707163	104730	125327	20597	+19.67
Garlic	2450	3433	3673	983	1223	240	+24.42
Ginger	4804	5222	5326	418	522	104	+24.88
Gram	3953	4664	4804	711	851	140	+19.69
Lentil	430	508	523	78	93	15	+19.23
Maize	86495	123774	133676	37279	47181	9902	+26.56
Mash	5721	6751	6953	1030	1232	202	+19.61
Potato	38.7	56.9	62.6	18.2	23.9	5.7	+31.32
Sorghum	9098	10736	11058	1638	1960	322	+19.66
Strawberry	6322	6954	7163	632	841	209	+33.07
Wheat	18531	22423	23319	3892	4788	896	+23.02

Table 17: SLADRC impact on total yield (cropwise)

CROP	PRE-PROJECT EXPTECTED YIELD (Kg/Ac)	POST-PROJECT YIELD FOR NON-BENEFICIARIES	POST-PROJECT YIELD FOR SLADRC BENEFICIARIES	PRE-POST DIFFERENCE IN YIELD FOR NON-BENEFICIARIES	PRE-POST DIFFERENCE IN YIELD FOR SLADRC BENEFICIARIES	IMPACT	IMPACT %
Bajra	529	625	643	96	114	18	+18.75
Berseem	24294	28667	29527	4373	5233	860	+19.67
Garlic	5868	8221	8797	2353	2929	576	+24.48
Ginger	3431	3729	3804	298	373	75	+25.17
Gram	395	466	479	71	84	13	+18.31
Lentil	299	353	364	54	65	11	+20.37
Maize	1106	1583	1710	477	604	127	+26.62
Mash	257	303	312	46	55	9	+19.57
Potato	5001	7351	8086	2350	3085	735	+31.28
Sorghum	5055	5965	6144	910	1089	179	+19.67
Strawberry	403	443	456	40	53	13	+32.50
Wheat	423	511	532	88	109	21	+23.86

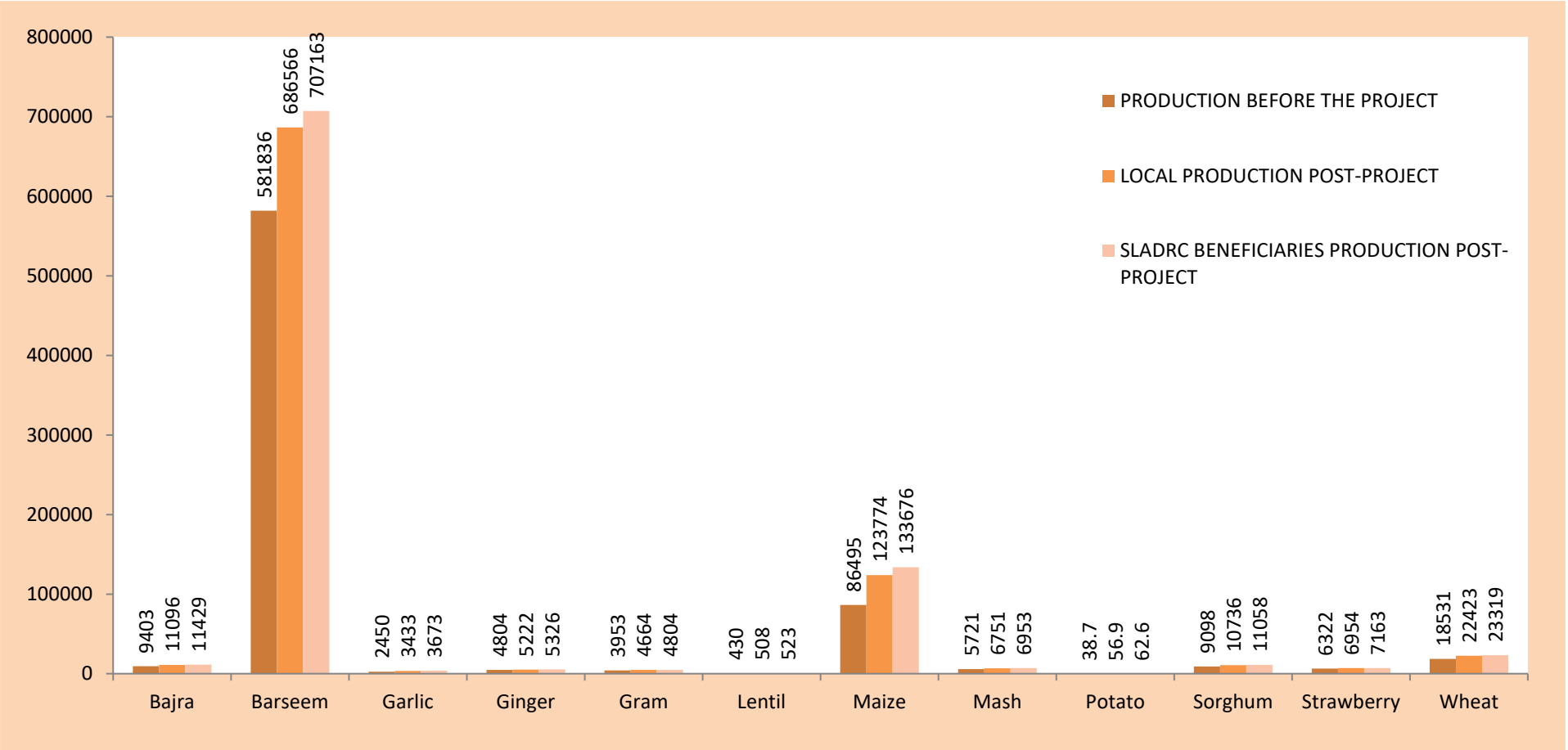


Figure 12: Production (in Kg) before and after the project intervention

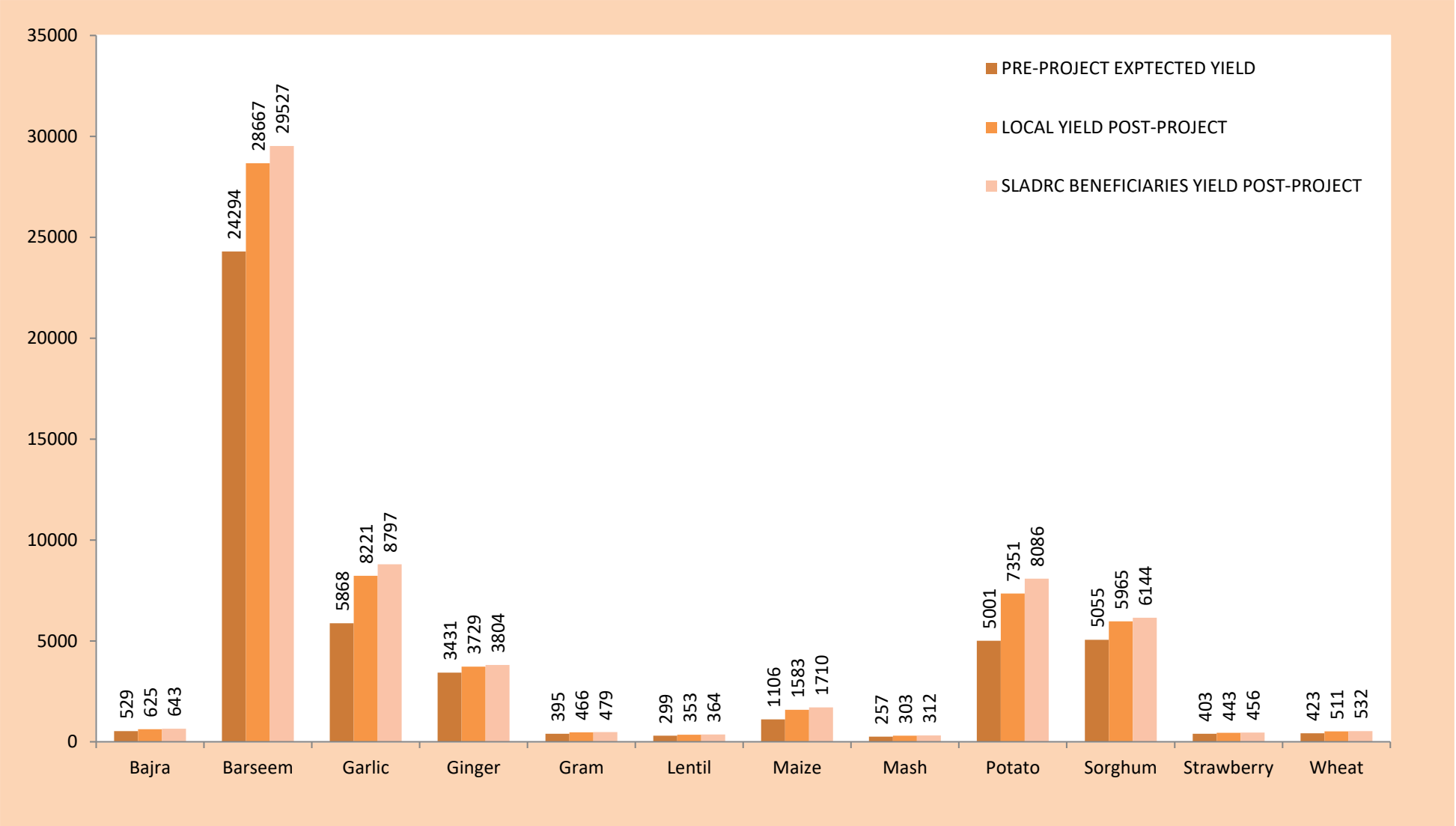


Figure 13: Yield (in Kg/acre) before and after the project intervention

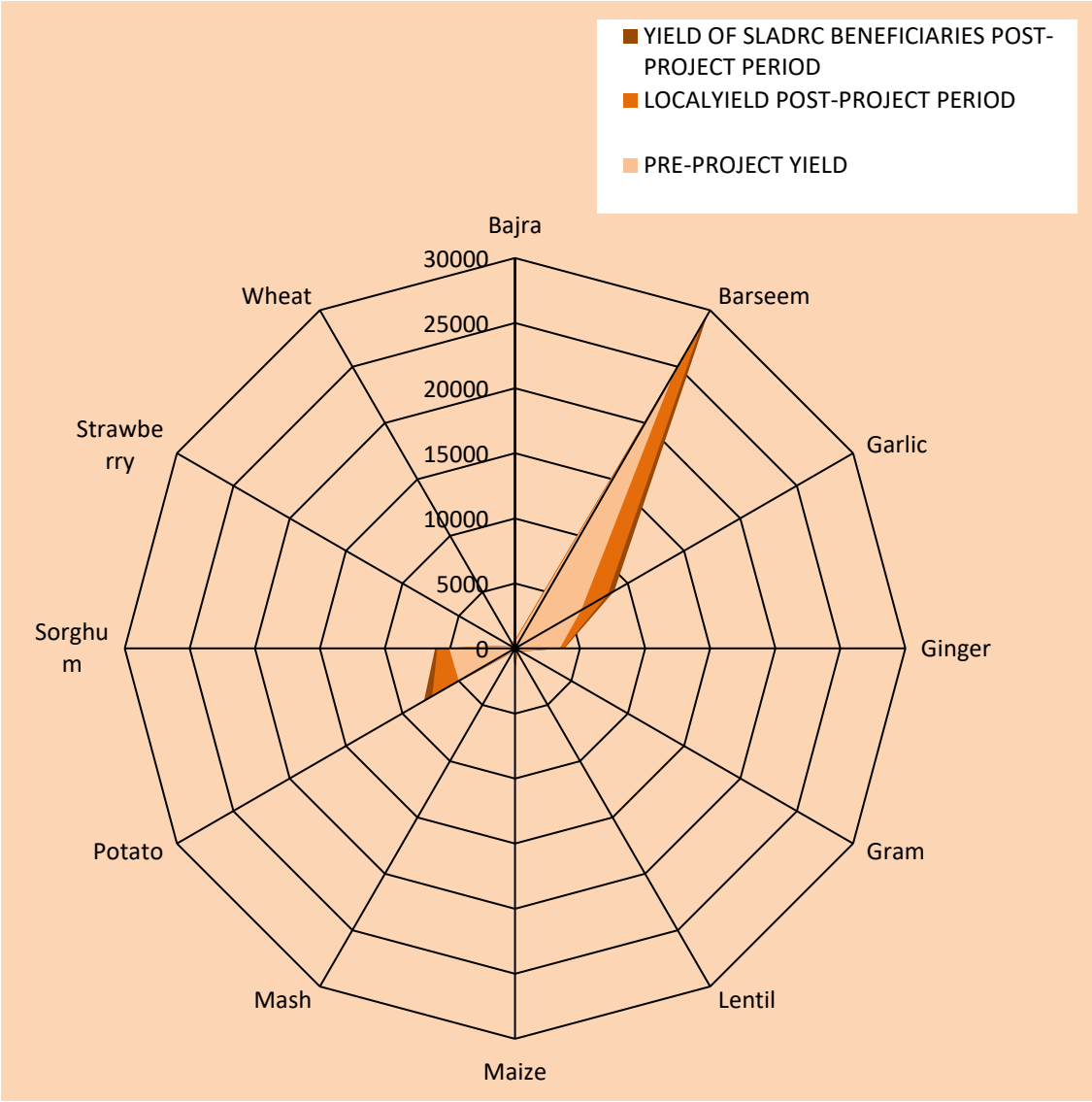


Figure 14: Cropwise variation in yield pre-project vs post-project

YIELD

Increase in yield is also attributed to the training programs undertaken as a part of SLADRC interventions which has led to judicious use of resources without compromising upon the quality, and use of accurate techniques for optimal crop growth. Based on the yield data it was observed that the highest increase in yield was observed in strawberry and potato which has crossed 30% increase in the yield. At least 18% of increase in yield was observed in all other crops. The increasing yield is a proof of incrementing knowledge bank, adaptation of training techniques, proper resource management, ultimately leading to financial safeguarding of the agricultural community through progressive interventions.

PRODUCTION

Highest increase in production was observed in strawberry and the least increase in production was observed in mash. At least 19% of increase in production was seen in all crops, which has directly increased the subsistence stock and marketable surplus along with greater returns for the produce because of the newly established market linkages through the formation of FPO. Even if the FPO does not deal in a particular commodity several collateral benefits of an established FPO such as market insights, bargaining power, bulk transportation etc. have helped the farmers in achieving huge benefits from the project interventions.

7.2.2 FOR AREA EXPANSION SCHEMES LIKE EARLY ONSETTING CULTIVARS OF FRUITS

Area expanded under the sampled strawberry farmers obtained from the primary survey before the project and after the project was being compared. 234.96% of increase in area under strawberry cultivation was witnessed as the mean area under strawberry expanded from 0.163 acres to 0.546 acres. To calculate the effect size of the change, the before-after area data was compared using Mann Whitney U test which yielded us an effect size of 0.655[11]. The statistical test was found significant ($U= 117$, $p < 0.001$), suggesting that a statistically significant large increase has occurred in the area under the horticultural crops due to the intervention. The below radar plot represents the pre-post status of area under strawberry cultivation of all the sampled beneficiaries[12].

Group	N	MEAN AREA (In acres)	MEDIAN AREA (In acres)
BEFORE	26	0.163	0
AFTER	26	0.546	0.5

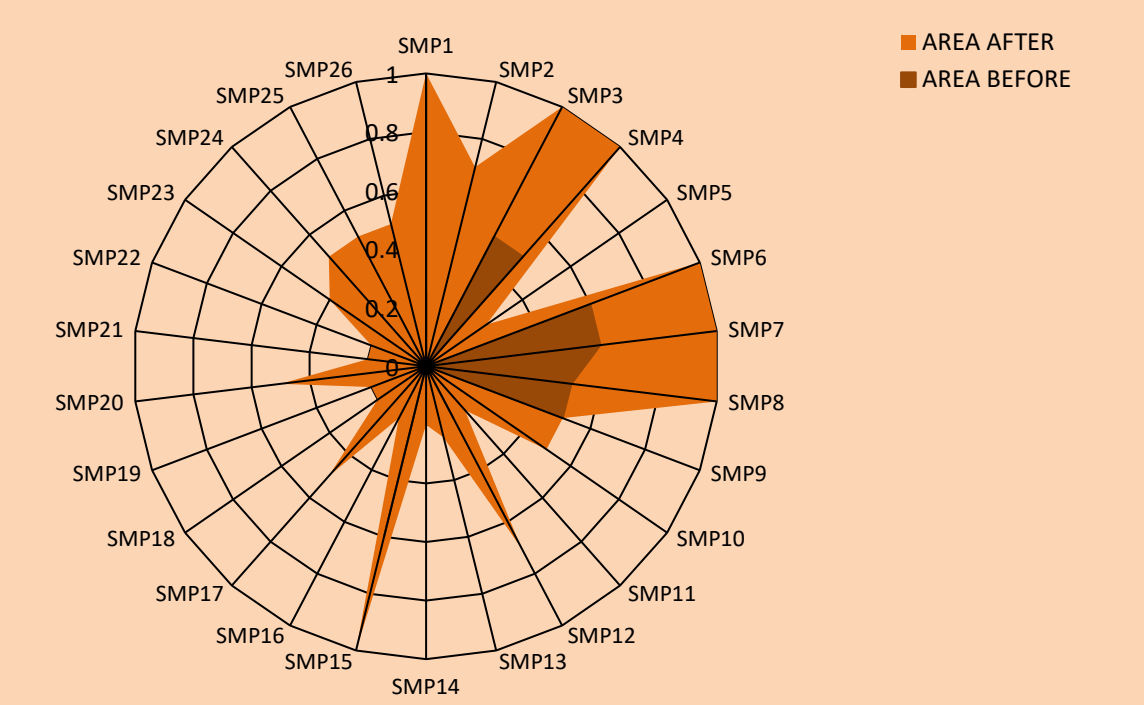


Figure 15: Samplewise representation of area expansion under early onsetting cultivars of fruits scheme, Department of Horticulture

[11] Effect size greater than 0.5 denotes large effect. Mann Whitney U test was used since the data was non-parametric and the distribution showed heteroscedasticity

[12] SMP denotes sample number. SMP ranges from SMP1 to SMP26 since there are 26 samples under this scheme.

7.2.3 MOISTURE MANAGEMENT SCHEMES

Department of Agriculture: The aim of the moisture management intervention is to increase the water-use efficiency by decreasing excessive wastage of water and to provide the appropriate amount of water required for optimum crop growth. Under the Department of Agriculture intervention for moisture management component sprinklers were provided to 31 beneficiaries (12 from Pachhad, 7 from Paonta Sahib and 12 from Sangrah) covering a total Culturable Command Area[13] (CCA) of 6.34 Hectares. Sprinkler systems were provided to the beneficiaries under this scheme.

Department of Horticulture: In the moisture management for vegetables and fruits scheme of the Department of Horticulture 82 drip irrigation systems and 11 sprinkler irrigation systems have been provided to the beneficiaries covering a CCA of 56.4 Hectares (9.7 Hectares in Paonta Sahib and 46.7 Hectares in Pachhad). The scheme was implemented in Pachhad and Paonta Sahib blocks of Sirmaur district. The below tables represent the beneficiary-wise and area-wise distribution of the scheme benefits in the project area.

A total of 65 samples (63 from Horticulture and 2 from Agriculture) were taken for the purpose of the impact study. The benefits attained as opined by the sampled beneficiaries because of the project intervention are as follows:

1. 100 % of the beneficiaries claimed to have an increase in yield and production of the crops planted in the irrigated area. The increase in production has contributed towards greater marketable surplus and income enhancement. The increased income has further led to asset creation (reported by 61.5% of beneficiaries), use of better quality agriculture inputs (reported by 86.15% of beneficiaries), agriculture machineries and farm equipment (reported by 40% of beneficiaries) and buying of livestock (reported by 4.6% of beneficiaries)
2. 100% of the beneficiaries reported having reduced water-use and increased water-use efficiency thus the crops are being irrigated with the precise amount of water required for optimum crop growth. An MIS system was observed to irrigate approximately 10% more area as compared to conventional flooding irrigation, for the same amount of water as reported by the drip beneficiaries.
3. 100% of the beneficiaries claimed that the time to irrigate their croplands have reduced significantly
4. 96.9% beneficiaries claimed having a reduction in the electricity cost and consumption after the installation of the micro-irrigation systems. Most of the systems are gravity-driven system hence once the water reservoir is full, the same water can be used for

[13] Cultuable Command Area (CCA) is the area in which crop is grown at a particular time or a season. It is the difference of Unculturable Area from the Gross Command Area(GCA)
CCA = GCA – Uncultivable area
CCA are of 2 types : Culturable Cultivable Area (Area which is cultivable and cultivation is presently done) and Culturable Uncultivable area (Area which is cultivable but cultivation is not currently practiced)

multiple rounds of irrigation based on the crop water requirement without the use of electricity.

5. 92.3% beneficiaries agreed that the area under irrigation has been drought proofed due to the instalment of the micro-irrigation systems which would be crucial in irrigating the cropland during times of drought and water-stress periods.
6. 96.9% of the beneficiaries reported an increase in cropping intensity because after the installation of micro-irrigation systems the dependency on rain-fed agriculture has decreased significantly.
7. 84.6% of the beneficiaries have reported a decrease in the fertilizer-use
8. 78.4% reported having diversified to cash crops such as capsicum, tomato etc. after the installation of MIS. The rest 21.6% of the beneficiaries were growing cash crops even before the MIS installation but in limited quantities (mostly for self-sustenance purpose) but after the installation of MIS the cash crop production has increased significantly.

7.3 KEY INFORMANT INTERVIEW

The Key Informant Interview (KII) involved a total of 23 officials-

BLOCK LEVEL

1. Assistant Agriculture Officer (AAO) - 3 nos. (1 per block)
2. Agriculture Extension Officer (AEO) - 3 nos. (1 per block)
3. Horticulture Development Officer (HDO) – 3 nos. (1 per block)
4. Assistant Horticulture Development Officer (AHDO) – 3 nos. (1 per block)
5. Subject Matter Specialist (SMS) - 3 nos. (1 per block)

HEADQUARTERS

6. Deputy Director of Agriculture- 1 no.
7. Agriculture Officer- 1 no.
8. Assistant Agriculture Officer – 1 no.
9. Scheme Officer, Agriculture Department- 1 no.
10. Deputy Director of Horticulture- 1 no.
11. Horticulture Development Officer – 1 no.
12. Assistant Horticulture Development Officer – 1 no.
13. Scheme officer, Horticulture Department – 1 no.

OBSERVATIONS-

1. 100% of the officials agreed that the agriculture and horticulture schemes have been implemented as the per the SLADRC project objectives
2. 91.3% of the officials agreed that the production and productivity of the crops grown by beneficiary farmers have increased due to the scheme implementation.
3. 95.7% of the officials opined that the implementation of schemes has promoted secure livelihood options for the agricultural community
4. 95.7% of the officials agreed that the scheme intervention had increased access to technology for the farmers. The farmer level training programs imparted as a part of the project has also helped in introducing the technologies to the farmers and the ways in which they can be accessed.
5. 100% of the officials opined that the sprinkler and drip system has helped in crop diversification and shifting from mono-cropping to multi-crop. As per the data presented in the previous chapters it was seen that many have successfully adopted cash crops and are generating substantial marketable surplus to be financially benefitted from the intervention.
6. 91.3% of the officials claimed that the interventions had led to an increase in the farmer income. The remaining 8.7% claimed that certain horticulture crops such as pomegranate which require approximately 2-3 years to start fruiting, those beneficiaries have not immediately been financially benefitted but they would definitely be benefitted in the near future as the fruiting period begins.

7. 100% of the officials agreed that the installation of MIS systems has led to reduced dependency on rainfall for irrigation. Due to the increased water security farmers are more willing to adapt rabi and zaid crops.
8. 100% of the officials agreed that the SLADRC project is very much appropriate and need based to enable farmers to cope with climate change.
9. 95.7% of the officials opined that additional fund should be allocated for undertaking numerous other Agriculture and Horticulture schemes, and also expand the current program to a larger geographic range and increase the penetrability of the scheme further to the agricultural dependent sections which are highly vulnerable to the impacts of climate change and need them the most.

Table 18: Opinions and suggestions of Line Department Extension Officials on SLADRC supported Agriculture & Horticulture Scheme Implementation and further Improvement

SL. No.	Opinion/Suggestion/Description	Number of KII	% of KII
1	The agriculture and horticulture schemes have been implemented successfully as per the SLADRC project objectives	23	100.0
2	Due to implementation of schemes production and productivity have been increased	21	91.3
3	Implementation of schemes has promoted secure livelihood options for the agricultural community	22	95.7
4	Due to scheme intervention farmers had increased access to technology	22	95.7
5	Farmer due to adaptation of sprinkler and drip system could grow more than one crop in a year	23	100.0
6	The agriculture and horticulture scheme interventions have contributed to an increase in the income of the beneficiaries	21	91.3
7	Dependency on rain-fed irrigation reduced due to adaptation of MIS	23	100.0
8	The SLADRC project is very much appropriate and need based to enable farmers to cope with climate change	23	100.0
9	Additional funds should be allocated for undertaking numerous other Agriculture and Horticulture schemes	22	95.7

SUMMARY OF FINDINGS AND WAY FORWARD

With the support of SLADRC project, while the schemes like Moisture Management for vegetable cultivation through Portable sprinkler and promotion of Inter-cropping of Maze and pulses and SRI cultivation in late but excess moisture condition have been implemented by Agriculture department, Moisture Management through promotion of Drip Irrigation system and Early on setting cultivars of fruits have been implemented by Horticulture department of Sirmaur district in three project Blocks. All these schemes and sub schemes/components have been implemented successfully as per the set objectives of the project with climate proofing focus and synergistic approach.

Under SLADRC Project the agriculture department has incurred expenditure of Rs.6.32 lakhs on moisture management for vegetable (Portable Sprinkler), Rs. 26.60 lakhs for Intercropping of Maze, Rs14.80 lakhs for Vegetable cultivation and for introduction of legumes and introduction of maze, garlic and ginger Rs. 19.00 lakhs and Rs. 6.00 lakhs respectively. Under different agriculture schemes/ component in total it has incurred expenditure of Rs. 72.72 lakhs under SLADRC project. The scheme/component on moisture management for vegetable-portable sprinkler has been implemented through Soil Conservation subdivisions of Paonta Sahib and Rajgarh. The agriculture department of Sirmaur district has utilised all the allocated funds under SLADRC project as per the target.

Like the agriculture department, the district horticulture department has also utilised Rs.76.50 lakhs in implementation of different horticultural schemes in all three project blocks. It has incurred expenditure of Rs. 6970331/ for Moisture Management and area to be covered under drip, micro and mini sprinkler irrigation system and Rs.679669/ for Early-on-setting cultivars of climate resistant fruits like pomegranate, strawberry, Kiwi and Litchi etc. It has utilised all the allocated funds under SLADRC and has brought 72 ha of land under different irrigation system and grown climate resilient fruit plants in 12.34 ha of land with the active participation of farmer beneficiaries.

During field study attempt was made to capture the opinion of the beneficiaries on the seed quality and its germination. After having discussion with the sampled beneficiaries, it was observed that only 11 beneficiaries (2.99 %) reported that the seed quality is poor and the germination rate is less than 75%. They were of opinion that they received the seeds after the sowing season had passed away. Nearly 97 % of sample beneficiaries expressed the seed quality is good and the seed germination rate is more than 90%. All most all the beneficiaries opined that they have received the seed on time for sowing.

Further it is studied that all most all the beneficiaries of both agriculture and horticulture schemes are well aware of the scheme provisions and their objectives. They are aware of subsidy provisions provided under the SLADRC components and also about the beneficiary contribution. At the field level by and large all these schemes have been implemented in consultation with local PRI members and beneficiaries' farmers. However, during field study some of the sampled out beneficiaries (9.09%) opined that in complete installation of MIS (Drip & Sprinkler) system the empanelled/allotted companies take 8-12 months' time and even some times they do not provide timely services. Hence steps may be taken at appropriate level for timely installation of MIS and

some provisions may be made for imparting tailor made training to the beneficiaries on operation and maintenance of the system.

During field study, effort was also made to study the perception of agriculture and horticulture extension officials on the scheme implementation supported under SLADRC Project. For the purpose consultation meetings with 23 KIIs were organized covering all the three study blocks. Almost all the line department officials expressed that the scheme components were in tune with the SLADRC Project objectives, due to adaptation of sprinkler and drip system farmers are growing more than one crop in a year and they have diverted their cropping pattern and their dependency on rain fed agriculture have been reduced. The project intervention is very much appropriate and need based to enable farmers to cope with climate change. Further more than 95 per cent of extension officials opined that due to scheme intervention farmers have increased accesses to technology and they have adopted new method of cropping practices. Nearly 91 per cent of KIIs reported that due to scheme implementation crop production and productivity has been increased and this has contributed to an increase in the income of the beneficiaries. The remaining 9 % claimed that certain horticulture crops such as pomegranate which require approximately 2-3 years to start fruiting, those beneficiaries have not immediately been financially benefitted but they would definitely be benefitted in the near future as the fruiting period begins.

Almost all the extension officials opined that additional fund should be allocated for Agriculture and Horticulture schemes scale-up and coverage and the program should be continued in future to promote adoptive capacity of farmers to combat climate change impacts

Overall, SLADRC project has played a critical role in enhancing the climate resilience of the agriculture dependent communities through its series of interventions. The Monitoring and Evaluation of Agriculture and Horticulture scheme study was performed to get a comprehensive idea about the project implementation and quantitatively determine the project impact on the beneficiaries. Based on the observations of the assessment multitudes of benefits both direct as well as indirect were observed happening as a result of the SLADRC interventions. The crop production was observed to have increased between 19.23% and 33.07% and crop yield was observed to have increased between 18.75% and 32.5%. 234.96% of increase in area under strawberry cultivation was witnessed as the mean area under strawberry expanded from 0.163 acres to 0.546 acres. A total of 6.34 Hectares was irrigated (using sprinkler irrigation) under the moisture management scheme assisted by the Department of Agriculture and a total of 56 Hectares was irrigated under the moisture management scheme (using drip and sprinkler irrigation) assisted by the Department of Horticulture which has led to numerous benefits ranging from decrease in fertilizer inputs, electricity use, crop diversification, drought-proofing, increased income and marketable surplus. Based on the output figures it is highly evident that the SLADRC project interventions has significantly impacted the life of the agricultural communities in a positive way by strengthening their existing livelihood mechanisms and introducing them to the climate change adaptive measures in the agriculture and horticulture sector. In order to increase the efficacy of the scheme implementation in the future it is necessary to understand the downsides of the current implementation process so that these points can be taken into consideration while drafting a project in similar lines or replicating the same project on a larger scale. Based on the study it was understood that even though the seed distribution had successfully taken place and people were introduced to good quality seeds yet seeds were distributed at times after the sowing season had

passed. A few individuals claimed receiving lower quality seeds and they had to incur additional expenses to buy higher quality seeds from the market. The beneficiaries of Micro-Irrigation scheme (entitled to pay 10% of the installation cost) wanted more transparency in understanding the cost-breakdown of the MIS system installation. Overall, the figures depict substantial improvement in the livelihoods of the project beneficiaries due to the interventions undertaken. Such projects if replicated on a larger scale while adapting to the social and geographic variations would immensely accentuate the livelihoods of the rural communities and increase their resilience against climate induced disasters/risks in the future and help them to adapt to it faster and in a more sustainable way. It can thus be concluded that the SLADRC project has stood by its objective of creating sustainable livelihood models for agriculture dependent rural communities through its gamut of interventions.

Department of Environment, Science Technology & Climate Change
Government of Himachal Pradesh