Scaling Up Resilient Agricultural Practices, Technologies and Services in Vulnerable areas of India

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PROJECT COMPLETION REPORT

SCALING UP RESILIENT AGRICULTURAL PRACTICES, TECHNOLOGIES AND SERVICES IN THE VULNERABLE AREAS OF INDIA

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BAIF

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Acronyms

AI	Artificial Insemination
ATMA	Agricultural Technology Management Agency
BAIF	Bhartiya Agro Industries Foundation
BBF	Broad Bed Furrow
BISA	Borlaug Institute for South Asia
BSM	BAIF Sustainability Model
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CDC	Cattle Development Center
CHC	Custom Hiring Center
CIMMYT	The International Maize and Wheat Improvement Center
COVID	Coronavirus Disease
CRP	Community Resource Person
CSA	Climate Smart Agriculture
CSR	Corporate Social Responsibility
CSV	Climate Smart Village
DAP	Diammonium Phosphate
DSR	Direct Seeded Rice
EMMP	Environmental Mitigation and Monitoring Plan
FAO	Food and Agriculture Organization
FFS	Farmer Field School
FPO	Farmer Producer Organization
FY	Financial Year
GHG	Green House Gas
GP	Gram panchayat
HDFC	Housing Development Finance Corporation
HP	Horsepower
ICAR	Indian Council of Agriculture Research
ICIMOD	The International Centre for Integrated Mountain Development
ICT	Information and Communications Technology
IEE	Initial Environmental Evaluation
IFFCO	Indian Farmers Fertilizer Cooperative Limited
IFPRI	The International Food Policy Research Institute
IGP	Ingo-Gangetic Plain
IKSL	IFFCO Kisan Sanchar Ltd
INPM	Integrated Nutrient & Pest Management
INR	Indian Rupee
IPCC	The Intergovernmental Panel on Climate Change
KVK	Krishi Vigyan Kendra
LCC	Leaf Color Chart
MNREGA	The Mahatma Gandhi National Rural Employment Guarantee Act
MNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MP	Madhya Pradesh
NABARD	National Bank for Agriculture and Rural Development
NAPCC	National Action Plan on Climate Change
NGO	Non-Government Organization

NICRA	National Innovations on Climate Resilient Agriculture
NMSA	National Mission for Sustainable Agriculture
PRI	Participatory Rural Appraisal
PVDP	Participatory Village Development Plan
SAARC	South Asian Association for Regional Cooperation
SAPCC	State Action Plan on Climate Change
SHG	Self Help Group
SRI	System of Rice Intensification
SSC	South-South Cooperation
UN	United Nation
USAID	The United States Agency for International Development
USD	United States Dollar
VCMC	Village Climate Management Committees
WASH	Water, Sanitation and Hygiene

Executive Summary

In the last few decades, India has made great strides in agriculture and food security. Despite this, the country has one-fifth of the world's hungry people and 40 percent of the world's malnourished children and women. A smallholder farmer in India faces unprecedented uncertainties as yields fluctuate and their incomes vary. This has far-reaching consequences on their long-term resilience. There are several reasons for this: small and fragmented land holdings, limited availability and poor quality of farm inputs, un-remunerative farm prices of several commodities and above all the increasing frequency of extreme weather events such as droughts, floods, heatwaves and hailstorms. Three consecutive droughts in 2014, 2015 and 2016, short flood periods, high temperatures and unseasonal heavy rains during the *rabi* (winter) season in these years resulted in excessive losses in food production at different scales and led to increased agrarian distress. This indicates the urgency of the problem at hand in addressing the increasing climatic risks that Indian agriculture is faced with.

USAID/ India partnered with CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), South Asia (CCAFS), for a four-year intervention (October 2016 – September 2020) to scale out resilient agricultural interventions through the Climate Smart Village (CSV) approach. The CSV approach promotes local, incremental adaptation and transformative options and builds local capacities to continue to innovate, experiment, and adapt. The CSV approach aims to have a positive impact on agriculture-dependent communities, and this includes ensuring the participation of women farmers and all social groups.

It aims to transform and reorient agricultural systems to support food security under the new realities of climate change. The focus is generally on a basket of synergistic options, rather than on single technology to improve cropping and livestock development in targeted areas as a means of enhancing resilience to climate variability. CCAFS provided technical leadership and overall guidance to BAIF (an NGO) to implement the project on the ground. The project demonstrated a portfolio of climate resilient technologies, practices and services in 75 villages of Uttar Pradesh (Mathura district), Bihar (Nalanda district) and Madhya Pradesh (Betul, a tribal district).

In the four years of the project (2016-2020), more than 11,250 farmers were able to access climate resilient agricultural technologies and best practices in 75 clusters of villages in eastern India (Bihar, Uttar Pradesh, and Madhya Pradesh). A suite of 16 technologies, practices, and services were targeted at 75 super champion, 1,050 champion and 10,125 CSA farmers in three districts. The project's intervention and achievements have aimed at building three types of resilience namely, economic resilience (improving yield and household incomes), social resilience (building capacity of farmers, developing farmer-based institutions and strengthening stakeholder relationships) and environmental/system resilience (improving resource use efficiency and reducing emissions along with scaling and

sustaining adaptation interventions). This report therefore attempts to bring out the key interventions and resulting outcomes viewed from a resilience lens, as summarized below:

Improvements in yields and incomes: The project established 4,200 demonstration plots covering 627 Ha of agricultural land for the evaluation of climate resilient technologies during the project period. Seed replacement with improved seeds, seed treatment before sowing, change in sowing/transplanting methods, Integrated Nutrients and Pest Management (INPM), new water management techniques and agronomic practices such as direct seeded rice (DSR), system of rice intensification (SRI), and alternate wetting and drying method in rice helped to improve crop yields in the project areas. On an average, yields have increase by 69% over baseline in the last three years in the demo plots. For instance, yields of wheat, paddy, gram and pearl millet have improved by 52%, 87%, 73% and 66%, respectively. Similarly, incomes from the demo plots have also improved by 96% (Rs. 60,142 per hectare or approx. USD 819 per hectare). As an example, farmer incomes have improved by 67%, 115%,94% and 109% for wheat, paddy, gram and pearl millet respectively. The adoption of improved seed, Integrated Nutrient and Pest Management (INPM) as well as ICT based weather and agro-advisories have been found to be most useful to farmers

Additionally, improved agronomic practices like minimum tillage, soil test based integrated nutrient and pesticide application encouraged reduction in urea input and replacing it with organic manure and biopesticides. Consequently, nutrient use efficiency increased by 140% on an average over baseline in all three districts for all crops. The adoption of INPM practices has also resulted in an average of 55% reduction in overall CO_2 emission per ton of crop production over the project duration by reducing the amount of Urea inputs. These have been the maximum for Rice crop showing 70% reduction. The reduction in GHG emissions is also being augmented by the establishment of 34 biogas plants, some of which have replaced fuelwood as the energy source, thereby reducing emissions while also improving health conditions of household members, especially women.

Gender integration: The project developed a very gender inclusive approach from the very beginning. More than 4,500 women farmers, majorly from the tribal dominated Betul district, across a diversified set of interventions including institutional initiatives such as Village Climate Management Committees VCMCs (25 in Betul) and CHCs (total 13 across the three districts), promotion of women friendly CSA technologies and practices, training and capacity building exercises, and promotion of entrepreneurial activities. A key outcome of these efforts has been improved agency, and community participation for these women farmers. The group-based approaches have provided them a unique platform to improve their confidence and be important stakeholders in driving adoption of climate smart technologies. Women farmers have increasingly shown interest in learning new skills and gaining knowledge, evident through their increased participation (from 17% in Year 2 to 40% in Year 4) during the trainings conducted. These trainings have enabled 318 women farmers to get engaged in entrepreneurial activities through 182 enterprises related to renting agricultural machinery, cultivation and sale of vegetables, production and sale of organic

pesticides and fertilizers as well as sale of seeds of improved crop varieties. This in turn has led to increased incomes for these women farmers.

Building institutional models: Combining global scientific knowledge with local needs and priorities, the project has made climate smart technologies, practices and services available to all farmers through innovative local institutions such as the Custom Hiring Center (CHC) and Cattle Development Center (CDC). The project established 13 Custom Hiring Center (CHC) involving 136 women farmers to provide farm machinery to farmers at affordable rental rates, thereby facilitating technology transfer to the local community through an institutional and business-oriented approach. The CHCs services were utilized by more than 800 farmers and covered 387 hectares of area across all the three districts. This enabled the centers to earn an income of INR 1.35 lakhs (USD 1,851) during the project duration, while helping farmers provide access to climate-smart technology.

These community led institutions also contribute to building community resilience towards external shocks. An example of this was seen during the COVID-19 induced lockdown in India from March to May 2020. In the absence of required labor for harvesting of the winter crop, these women run CHCs continued to provide farm machinery on hire and in several instances, they demonstrated entrepreneurial acumen by making large farm machinery accessible to farmers in the village, by linking them with district-level equipment service providers.

Three Cattle Development Centers (CDC) helped to scale out livestock focused interventions at community level benefitting more than 6,200 farmers. Promotion of improved (and more climate-resilient) breeds through Artificial Insemination technology has been the most beneficial intervention for farmers, enabling better cattle yields. A total of 5,541 Artificial Insemination (AI) were conducted in the cattle resulting in a total of 1,300 new improved breed cow/buffalo calves being born. In addition, farmers benefitted from improved goat breeds, and high yield fodder varieties such as BAIF Bajra, BAIF hybrid Napier, Makkhan Grass, and Berseem, ensuring year-round availability of green fodder. Azola cultivation and mineral mixture further added nutrition source to the feed of livestock enabling increase in milk yield.

Strengthening community ownership: The project worked in partnership with the farming community to encourage their active involvement for successful implementation of the Climate Smart Village model. For instance, community-based institutions such as CDCs and CHCs will continue to provide services to farmers to help them access climate-smart technologies and services. The BAIF Sustainability Model (BSM) of CDC will ensure that the AI Technicians (usually a village youth) earn money through the services he/ she offers, thereby ensuring sustainable climate-smart livestock intervention. Similarly, the financial stake of CHC members (10% of total cost) along with the women empowerment outcomes will be important factors driving the continuity of these centers. The initiation of entrepreneurship activities as a result of training and capacity building exercises are also proof of the knowledge built during the project duration which will continue to benefit farmers in future.

Community ownership was also evident during the nationwide COVID-19 induced lockdown which upended agricultural supply chains and weakened markets. Collective action by farmers associated with the project's Village Climate Management Committees, Self Help Groups, and Custom Hiring Centers (CHC) helped in finding localized solutions to their problems. Timely coordination with stakeholders in the agriculture department and supply chain actors enabled farmers' access seeds, farm machinery, market information, and financial resources to become more resilient as they developed adaptive strategies to cope with adversities.

Capacity building: The project organized several training and capacity building exercises for farmers on new technologies, practices and services; and to strengthen their relationships with government and private sector stakeholders. The project held 444 trainings and 84 farmer field schools (FFS), farmer fair and exposure visits activities. The trainings mainly included implementation of CSA package of practices in the farmers' field, preparation of organic fertilizers, pesticides and vermicompost, as well as livestock related activities. As part of these activities, organization of insurance awareness camps enabled the enrollment of 3,314 farmers in the crop insurance scheme for key crops including Rice, Wheat, Gram, soybean and maize.

Other than farmers, the project implementation staff was also trained on various aspects through technical experts and resource agencies. During these training, focus was also on training a cadre of 18 community resource persons (CRP) enabling them access to information, skills and resources that are essential to support communities beyond the project life.

Engaging private stakeholders: Across the three districts, several private players supplied different technologies and services through the CHCs and CDCs. A key partnership was one with IFFCO Kisan Sanchar Ltd, a private sector ICT provider, which disseminated weather and climatic information using existing scientific knowledge and farm conditions to 11,250 project farmers. The information provided by IFFCO was highly appreciated by farmers in the three districts as it was used by them to change sowing dates and use natural fertilizers and pesticides.

Convergence with government programs: Building and strengthening relationship with government stakeholders was identified as a critical pathway to amplify climate-smart interventions. Convergence brings together funds, institutions and human resources of various schemes and programmes of the government (central, state, gram panchayat) to sustainably scale out climate smart agriculture (CSA) approach for beneficiary farmers in the three project districts.

The project converged an amount of approximately INR 3.9 crores (USD 537,478) through several national flagship programs like *Mahatma Gandhi National Rural Employment Guarantee Scheme* (MNREGS), and *National Mission for Sustainable Agriculture* (NMSA), and *Kapil Dhara Scheme for beneficiary farmers*. Of this, the government contribution has been an average of 93.6% while the farming community has also contributed an average of 6.4% of the total amount (approx. INR 25.05 lakhs). About 12,786 households benefitted by

convergence in both agriculture and livestock related activities during this period. Additionally, water structures such as wells, farm ponds and check dams constructed through convergence have benefitted 301 households by adding 143 new structures/equipment's and expanded irrigated area by 182.4 hectares. These structures will continue to benefit farmers beyond the life of the project.

Schemes across several departments at district levels play an important complementary role in promoting climate change adaptation intervention at the village level. Mainstreaming adaptation into planning implementation of these can, therefore, provide a means to scale up local adaptation actions at district level. CCAFS has developed detailed post-project convergence plans, by assessing all 75-project villages for climate adaptation and overlaying it with the types of interventions, and finally aligning it to the level of investments required from on-going government programs to climate proof all three districts.

A key activity for convergence was the development of 75 village level climate resilience plans in all three districts, which were then collated to develop three district level convergence plans in the last year of project implementation. These plans proposed a total convergence of approximately INR 6.1 crore (approx. USD 0.8 mil) from on-going government programs for the 75 project villages across 3 districts. Out of this, 5.7 crores (93%) can be utilized from existing government schemes and programmes. The plan also highlights a gap of 7% (INR 41.6 lakhs) between the total amount required and the support available from the government. This indicates a potential for collaborative efforts between the government departments and private agencies, NGOs and development funds to partake in this activity (by way of co-financing and replicating existing plan) and further strengthen as well as scale out the convergence process in and beyond these villages. By implementing these plans at the district level, the project promoted adaptation interventions have the potential to reach 3,247 villages covering at least 4,87,050 households through a convergence amount of INR 272.3 crores (approx. USD 37mil). The plans received positive response from government stakeholder during district-level project closeout meeting, highlighting potential for implementation.

There are several potential opportunities for BAIF to pursue collaboration with organizations such as NABARD, KVKs, Agricultural Universities and locally relevant NGOs/ CSR agencies. These linkages have been emphasized during the convergence workshops conducted in all the three districts and therefore show potential for promoting the project interventions beyond the project areas.

Dissemination and Outreach: The project developed a grounds-up approach to engage with internal and external stakeholders for dissemination of climate-smart technologies as well as for the dissemination of results through on-line and offline mediums. This included village-level awareness campaigns, farmer field demonstration plots, placement of banners at strategic locations in Climate Smart Villages to Climate-Smart Village' concept appreciation programs, programme based trainings and planned exposure visits for the district-level functionaries and farmers. Several communication materials in the form of boards, and messages on walls are also present in the villages and will continue to inform

farmers about the project's intervention and its benefits. Additionally, the project has developed numerous digital outreach and communication materials for external audiences such as a project webpage, articles, info-notes and blogs on CCAFS website and publications which were re-printed or hosted on other websites. Other than that, project site of Betul was showcased as a case study in multiple high impact international publications, which helped in disseminating project results to neighboring countries and encourage further discussions on scaling CSA interventions.

South-south cooperation: The objective of south-south cooperation aimed to enable cross-border learning with other developing countries, especially Nepal and Bangladesh, on climate smart interventions. To facilitate this, two key approaches were adopted, including planned interactions with key stakeholders of South Asian countries and communication of project results to global audiences through and conferences as well as publications. The project organized a knowledge exchange program for 15 government delegates from Nepal to India in October 2018. A two-day workshop was held to share livestock development and cropping best practices from India with different stakeholders (Nepal policymakers and scientists) while also focusing on highlighting several climate-smart interventions. The workshop included a visit of Nepali delegates to the project villages in Mathura district in Uttar Pradesh. As a second step of stakeholder interactions, a South-South learnings session was organized in Bali in October 2019 wherein project interventions were presented along with an insightful discussion among over 60 participants (scientists and policymakers) from several South Asian countries, including those from India, Nepal, Bangladesh, and Bhutan. A few additional planned activities under south-south cooperation could not take place as a result of the COVID-19 pandemic towards the end of the project.

In addition to the above, the project team presented project results and learnings to external scientific audiences, and development players. several newsletter articles were produced highlighting project activities and circulated amongst CCAFS partner organizations in South Asia. These include scientific community members, NGOs, Private sector players and government representatives from countries including India, Nepal, Bangladesh and Sri Lanka among others. The project site of Betul was also represented as a case study in multiple international publications. These have also helped in showcasing the project activities to neighboring countries and encourage further discussions on scaling CSA interventions.

Overall, project related innovations like commercialization of small-scale mechanization through Custom Hiring Centers, eco-system required to promote Artificial Insemination for livestock improvement, engagement with tribal communities (especially women farmers), and convergence activities have generated interest among the participants of these activities. It is therefore expected that the project's efforts will promote a better understanding of its approach and learnings to its participants of the South-South cooperation activity and encourage them to adopt similar interventions for scaling out Climate-Smart interventions in their respective regions.

Scalability and sustainability: Sustainability and scalability of the project has been one of the most important indices while ideating the project. Factors supporting both horizontal and vertical scaling of the project were incorporated in the project design stage itself. The project has ensured engagement of all the relevant stakeholders to establish a sense of ownership amongst local stakeholders, especially farmers. This instilled their active engagement throughout the implementation phase as well as facilitated participatory monitoring and evaluation of the project.

The mechanisms to ensure sustainability of program were inbuilt through interventions of famer training and capacity building as well as convergence with existing government schemes. The most crucial development that pinpoints to the self-sustaining capacity of project interventions include the establishment of community-led institutions and the notion of accountability and ownership on the part of participating farmers and other stakeholders. In addition, the cost-sharing approach for demonstration activities and entrepreneurship-based business models has generated significant incentives for the beneficiary farmers to continue their operations as envisaged during the project implementation.

Convergence activities of the project and repeated exposure and interaction of famers and community members with government officials, private players (input suppliers) and project staff has also created a strong pathway for sustainability and adaptability of project interventions. CCAFS has developed detailed post-project convergence plans, by assessing all 75-project villages for climate adaptation and overlaying it with the types of interventions, and finally aligning it to the level of investments required from on-going government programs to climate proof all three districts. These can serve as a valuable tool for communities and policymakers to guide their decisions on future resilience and livelihoods related budgeting. This component of the program is crucial because it has the potential to generate strong spillover effects.

It has laid the foundations for continued uptake and out scaling of climate smart intervention in the three project districts. Furthermore, CCAFS and BAIF will also continue to adapt this unique approach for scalability and sustainability of climate smart technologies in future programs.

Conclusion: The overall objective of the project was to reduce vulnerability to climate risk and improve adoption of climate-smart agriculture. To this end, the project interventions introduced a combination of measures including institutional building, access to advanced technologies and improved farming and livestock management practices to build resilience among the farming operations through CSV approach.

The ‘Climate Smart Village’ project was scaled-up successfully in three distinct agro climatic zones and socio-cultural districts in India, which is reflective of its replicability across diverse geographies. The project made a conscious decision to work in a tribal dominated in Betul to reach a highly vulnerable region not just from a climate risk perspective but also in terms of overall rural development. The project operated in very remote tribal villages where few agencies have worked. Here, the impacts are reflected not just in terms of yields and

income improvements, but also in terms of the significant level of convergence done, collective action undertaken even during challenging times such as COVID-19 linked lockdown and gender outcomes achieved. This validates the appropriate selection of technologies and innovative community mobilization approaches to enhance the resilience of farmers in the most isolated and underdeveloped parts of the country. The project's experience and learnings highlight ample scope to further build on the 'Climate Smart Village' model and expand it in other regions.

The project interventions have empowered farming communities through new knowledge, technology and practices and built a mechanism that has huge potential to scale them out. A unique contribution of the present intervention appears to be the creation of an ecosystem within which farming groups can connect with relevant stakeholders and markets and avail solutions to some of the institutional and regulatory bottlenecks that otherwise hamper productive farming operation. Impacts of community led approaches and convergence initiatives will continue to build the resilience of farmers and farming communities beyond the life of the project.

PROJECT FOOTPRINTS

SCALING CLIMATE SMART VILLAGES

- More than 11,250 farmers benefitted from a suite of 16 climate resilient agricultural technologies and best practices in 75 villages though three portfolios of Super Champion, Champion and CSA.
- Established 4,200 number of demonstration plots covering 627 Ha of agricultural land through 75 farmer-led Climate-Smart Village Committees.
- Overall average yield improvements of 69% with 96% improvements in gross incomes ($819 per hectare) four seasons and key crops (Rice, Wheat, Bajra and Gram) in demo plots.
- Improved average nutrient use efficiency by 140% and 55% reduction in overall CO2 emission per ton of crop production across four seasons and key crops (Rice, Wheat, Bajra and Gram) in demo plots.

BUILDING INSTITUTIONAL MODELS

- Established 13 Custom Hiring Center (CHC) involving 136 women farmers through a business-oriented technology transfer model.
- More than 800 farmers used agricultural machinery over 387 hectares of cropped rea.
- Established 3 Cattle Development Center (CDC) to scale out agricultural machinery and livestock focused interventions at community level benefitting more than 6,200 farmers.
- Converged an amount of approximately INR 393.04 lakhs (approx. $537,478) through multiple government schemes benefitting 12,786 farmers.
- 11,250 farmers got access to ICT based agro-advisory and weather information.

STRENGTHENING STAKEHOLDER CAPACITY

- The project held 444 trainings and 84 farmer field schools (FFS), farmer fair & exposure visits activities.
- Total 3,314 farmers registered to insure key crops under The Pradhan Mantri Fasal Bima Yojana (Prime Minister's Crop Insurance Scheme) as a result of awareness campaigns.
- Trained 18 Community Resource Persons (CRP) who will continue to be a common link among stakeholders beyond project life.

PROMOTING SOUTH-SOUTH COOPERATION

- Conducted two events with 75 stakeholder including representatives from the scientific community, government, NGOs and donor agencies from four major South Asian economies, including India, Nepal, Bangladesh and Bhutan.
- Presented project related results in three global and regional conferences and featured in four high impact publications.

GENDER INTEGRATION

- The project has involved more than 4,500 women farmers across different activities.
- A total of 318 women farmers are engaged in entrepreneurial activities through 182 enterprises as a result of capacity building and institutional development interventions.
- Women participation in training and capacity building activities improved from 17% to 40% during the project period.
- Key outcomes include improvement in agency, leadership and community participation, increased incomes and reduced drudgery.

SUSTAINABILITY

- Community ownership through 13 CHCs, 3 CDCs, 182 enterprises, farmers contributions (up to 25% of technology cost) will continue to benefit at least 11,250 beneficiaries beyond project life.
- Horizontal and vertical linkages including implementation of convergence plans have the potential to reach up to 0.5 million farmers across three districts.

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1

INTRODUCTION

1.Introduction

1.1. Background

In the last few decades, India has made great strides in agriculture and food security. Despite this, the country has one-fifth of the world's hungry people and 40 percent of the world's malnourished children and women. The agricultural sector comprises of 146.45 million farmers, most of them with less than a hectare of land[1]. These small and marginal smallholder farmers in India face unprecedented uncertainties as yields fluctuate and their incomes vary. This has far-reaching consequences on their long-term resilience. There are several reasons for this: small and fragmented land holdings, limited availability and poor quality of farm inputs, un-remunerative farm prices of several commodities and above all the increasing frequency of extreme weather events such as droughts, floods, heatwaves and hailstorms. Three consecutive droughts in 2014, 2015 and 2016, short flood periods, high temperatures and unseasonal heavy rains during the rabi (winter) season in these years resulted in excessive losses in food production at different scales and led to increased agrarian distress. This indicates the urgency of the problem at hand in addressing the increasing climatic risks that India, the fifth most affected country by climate change[2], is faced with.

In India, climate change is set to hit the agricultural sector particularly hard and threaten the livelihood and food security of millions of smallholder and subsistence farmers. Numerous studies show that the productivity of crops, fish and livestock will decline in the absence of adaptation measures. Changes in crop cultivation suitability and associated agriculture biodiversity, lower input-use efficiency, and the prevalence of pests and diseases are some of the major causes of climate change impacts on agriculture. Reducing the risks of climate change and variability to food systems is thus one of the major challenges of the 21st century for eastern India. If the Sustainable Development Goal of ending poverty, achieving food security and promoting sustainable agriculture is to be realized, climate change adaptation and mitigation interventions need to be implemented in earnest. There is, therefore, an urgent need to identify cost-effective, inclusive (with a focus on gender and socially marginalized groups) and evidence-based integrated solutions to enhance the adaptive capacity of vulnerable farming communities.

There are several potential adaptation options to reduce moderate to severe climatic risks in agriculture and allied sectors. In general, adaptation options integrate traditional and innovative technologies, practices and services that are relevant in a location to mitigate climatic risks. Research shows that changes in agronomic practices (e.g. altering inputs and the timing and location of cropping activities), the adoption of new technologies (e.g. improvement in input use efficiency, and conservation of water and energy) and the use of

[1] Source: 2015-16 agriculture census

[2]Eckstein, D., Künzel, V., Schäfer, L. and Winges, M., 2019. Global climate risk index 2020. Germanwatch Available at: https://germanwatch. org/sites/germanwatch. org/files/20-2-01e% 20Global, 20.

relevant and timely information (e.g. climate information based agro-advisories and weather index based insurance) at the farm level can be key components in improving the resilience of agriculture to climate change. Many of these interventions have been successful in increasing production, income and building resilience among farming communities in other areas. These interventions, however, come with varying costs and economic impacts and their implementation requires critical investment decisions on both on-farm capital and for wider agricultural outreach programs.

The Government of India in the 2016 budget announced its commitment to increase efforts to strengthen the rural economy. Several important new schemes have been launched to address the climatic risks to agriculture including; the Pradhan Mantri Sinchai Yojana (Prime Minister Irrigation Program) and the Pradhan Mantri Fasal Bima Yojana (Prime Minister Crop Insurance Program). A National Action Plan on Climate Change (NAPCC) has been in operation since several years and it includes the National Mission for Sustainable Agriculture (NMSA) to promote sustainable agriculture through sub-national planning, convergence, coordination and dissemination of CSA interventions. Most states have also developed their State Action Plan on Climate Change (SAPCC) based on their climate risks and priorities. All climate change adaptation programs and missions related to agriculture and allied sectors reinforce the Rashtriya Krishi Vikash Yojana (National Agriculture Development Scheme) to achieve targeted annual growth rate in agriculture. At national and global scale climate adaptation finance is increasingly becoming available. In India, various NGOs, NABARD, and local government agencies are implementing several programs on climate adaption in agriculture. The corporate sector in India is also using a large amount of its CSR Funds to accelerate this. At the same time funds have become available from agencies such as Green Climate Fund, World Bank, and other international and national donors for weather risk management in agriculture.

Despite the availability of climate finance, several national and state-level schemes, and ample availability of scientific knowledge base about climatic risks and their likely impacts, there is relatively little action that integrates these top-down government schemes, scientific innovations, and stakeholder needs to address the problems of smallholders. Given the nature of impacts of climate change which vary across locations, the effective implementation of adaptation and mitigation options may not be realized in the absence of more integrated approach and well-defined action plans developed at the local level with the engagement of local government bodies and the effective participation of multiple stakeholders and decision makers.

CGIAR's Climate-Smart Village (CSVs) is an innovative multi-stakeholder approach that can bridge this gap by converging adaptation and mitigation schemes/programs at the local level and promoting climate-smart agriculture. This approach incorporates climate-smart technologies, practices, services and processes relevant for local climatic risks management and aligned with current adaptation policies/plans and village development programs.

1.2. About the project

USAID/ India partnered with Climate Change, Agriculture and Food Security (CCAFS), South Asia (CCAFS), for a four-year intervention (October 2016 –September 2020) to scale out climate-resilient agricultural interventions through the Climate Smart Village (CSV) approach. The focus was on a basket of synergistic options, rather than on single technology to improve cropping and livestock development in targeted areas as a means of enhancing resilience to climate variability. CCAFS provides technical leadership and overall guidance to BAIF (an NGO) which was implementing the project on the ground. The project demonstrated a portfolio of climate resilient technologies, practices and services in 75 villages of Uttar Pradesh (Mathura district), Bihar (Nalanda district) and Madhya Pradesh (Betul district).

The key goal of this project was to use global and regional knowledge and skills to build resilient agricultural production system in food insecure and vulnerable areas of the Ingo-Gangetic Plain (IGP) region through the CGIAR's Climate-Smart Village (CSV) approach. Major activities included: i) strategic design of land use options including priority crops, technologies and practices based on agroecological analysis and farmer typologies, ii) promoting climate resilient technologies and maximizing synergies among interventions; iii) providing value-added information services including insurance to farmers; iv) facilitating community partnership for knowledge sharing and implementation of climate resilient technologies and scaling-out through outreach activities like farmers' fairs and videos, and vi) scaling-up through linkages with on-going government schemes and programs.

1.2.1. Objectives

The project had four major objectives:

1. To scale out climate resilient agricultural technologies, practices and services 75 clusters of villages in eastern India (Bihar, Uttar Pradesh, and Madhya Pradesh) to build additional evidence for scaling out climate-smart agriculture;
2. To develop new business and institutional models on the CSV approach involving local organizations, agriculture departments and the private sector (input suppliers, insurance and ICT companies, and agri-business entrepreneurs) to reach scale;
3. To reach scale by strengthening the capacity of Farmers Producers' Organizations (FPOs), local organizations (community-based organizations and NGOs), agencies dealing with CSR Funds, national and international weather adaptation funds, local government involved in adaptation to weather change in implementing CSV approach; and
4. To promote South-South cooperation to enable other developing countries (especially Nepal and Bangladesh) to adopt and learn from lessons in India for reaching scale in their own countries on climate-smart agriculture

1.2.2. Partners

This project was implemented in collaboration with local NGO partner (BAIF), ICT company named IKSL (for weather information, agro-advisory and market linkage), insurance industry (for crop insurance program), input suppliers (for seeds, fertilizers and machines), and national agricultural research systems (knowledge partners).

BAIF Development Research Foundation was selected as a local partner for implementing the CSV program in Mathura (Uttar Pradesh), Nalanda (Bihar) and Betul (Madhya Pradesh). BAIF is a national NGO which is involved in the implementation of development programs in different parts of the country. BAIF played a critical role in scaling up /out of CSV approach by strengthening capacity building of farmers, farmer-producer groups (FPOs), local organizations (community-based organizations and NGOs), private sector, local government agencies and other relevant stakeholders for climate change adaptation in agriculture. BAIF also coordinated with private sector organizations (Agriculture Insurance Companies, Input Suppliers, Agri-business industries and ICT companies) to facilitate their work in the project areas.

1.2.3. Project sites

This Climate-Smart Village (CSV) program implemented in the three states of Bihar, Uttar Pradesh and Madhya Pradesh (Figure 1.1). In these three states, the population density and poverty rates are comparatively higher than in the other states. The majority of poor and food-insecure people are dependent on agriculture as the main source of household income. In these states, any changes in agricultural production can have severe consequences for the livelihoods of millions of people.

Figure 1.1: Project locations

The selection of the project districts was based on a study by the Indian Council of Agricultural Research (ICAR) on the vulnerability of Indian agriculture to climate change

under the National Initiative on Climate Resilient Agriculture (NICRA) project. The study provided a composite vulnerability of agriculture to weather change index included which comprised of sub-indicators representing sensitivity, exposure and adaptive capacity of each district. The composite index of agriculture vulnerability to climate change was divided into five quadrants (very high, high, medium, low and very low) based on the value assigned on all indicators (ICAR 2013). This project selected three districts in three states (Uttar Pradesh, Bihar, and Madhya Pradesh) of India that fell into a high level of vulnerability from these states. Mathura in Uttar Pradesh fell under the very highly vulnerable district. Similarly, Nalanda in Bihar and Betul in Madhya Pradesh were under highly vulnerable districts.

Mathura, Uttar Pradesh

Mathura is located in the western region of Uttar Pradesh, classified as very high vulnerability district. This has a direct bearing on agriculture and the livelihoods of rural people. Rice and Bajra are sown in Kharif season, while wheat, potato and mustard are sown in rabi season. Frequent drought, unusual rains and floods are major climatic risks in the district. Declining water tables and low water use efficiency, multi-nutrient deficiencies and deteriorating soil health and climate change-induced vulnerability also pose major challenges to farmers and rural communities. Impacts of climate change on livestock are in the form of elevated body temperatures, increased respiration rates, decrease in feed intake, low productivity etc. Indirect impacts can be observed in the form of a reduction in grazing land and water availability, the decline in available cattle feed, the emergence of new diseases, etc.

Nalanda, Bihar

Nalanda is located in the north-western region of Bihar, which is very sensitive to climatic change, given the high population density. Rice-wheat is the dominant cropping system in this district. Fruits like Mango, Guava, Lemon, Banana and Papaya are grown along with seasonal vegetables. In terms of climate change and variability, the region faces an increasing risk of drought and flood apart from other hazards like Heatwave, cold wave and frost. The sudden extremities also lead to an increased incidence of pest and diseases. These hazards severely affect agricultural income on an annual basis. Climatic variability directly impacts yields at crop level and also affects soil quality; water resources; brings in pests, diseases and weeds, etc. further aggravating the impact on the cropping system, thereby reducing the yield per hectare of land or per unit of livestock at the farm level.

Betul, Madhya Pradesh

Betul is primarily a tribal district comprising of the Gond and Korku tribes. It is located in the southern region of Madhya Pradesh and is rich in forest and biodiversity. Soybean-rice-wheat is the dominant cropping system in the district. Farmers also cultivate Arhar, Jowar, sugarcane, spices, vegetables, groundnut, sesamum, rapeseed and mustard, linseed and fodder crop in the district. Early season drought, early withdrawal of monsoon, unusual and heavy rains, heatwaves and pest/diseases outbreak are major climatic risks in the districts. The district's socio-economic profile also affects the adaptive capacity of the districts making it more vulnerable to future climate risks. Reducing the risks of climate change and

variability to food systems is thus one of the major challenges for Betul. Hence, it was needed to identify, implement and scale out cost-effective, inclusive (with a focus on gender and socially marginalized groups) and evidence-based integrated solutions to enhance the adaptive capacity of vulnerable farming communities.

1.2.4. Gender and Social Inclusion

Women's involvement in agriculture and their contributions to food security has been widely recognized in India. In the last few decades, women's involvements, access to productive resources and decision-making roles in agriculture and allied sectors have been the focus areas of research and development in the Indian subcontinent. A clear linkage has been shown among social, economic and gender dimensions in agriculture. Women can play a key role in improving agricultural productivity and food security in farming communities. Gender differentiated roles, responsibilities, priorities and access to resources and services at the community and household levels define the gendered inequalities leading to inefficiencies in agricultural production systems. These are further exaggerated by climate related shocks. Building the adaptive capacities of women farmers towards climate risks, therefore, goes hand in hand while developing resilient agricultural systems.

The project has therefore focused on adopting a gender inclusive approach by ensuring active participation of women farmers across different activities. A gender and agriculture related assessment was conducted by CCAFS[3] to identify the districts with a high level of climatic risks as well as high female participation in agriculture. This study highlighted Betul as one of the women in agriculture and climate risks hotspot indicating that the district has a high level of women involvement in the district while also being exposed to high levels of climate risks, compared to other districts in the country. Taking Betul as the focus for gender activities, therefore, the project's aimed to improve access to climate resilient technologies and practices for women farmers, improve women's knowledge through trainings and capacity building exercises, and promote entrepreneurship through institutional initiatives.

1.3. Results Framework

The overall goal of this project is to reduce poverty and food insecurity in the agriculture dependent communities under the changing climate. This goal was to be achieved by increasing resilience in the agriculture production system to changing climate. The increasing resilience in the agriculture production system can improve farm production and income in both good and bad weather conditions during the cropping season.

The target performance indicators of this project included: if i) number of farmers/farm households who have implemented climate resilient agricultural technologies and practices in their farms, ii) number/amount of technologies or management practices under research, under field testing, or made available for transfer as a result of project assistance, iii) number of hectares of land under CSA technology and practice with project assistance, and

[3] Chanana-Nag, N. and Aggarwal, P.K., 2020. Woman in agriculture, and climate risks: hotspots for development. Climatic Change, 158(1), pp.13-27. Available at: https://link.springer.com/article/10.1007/s10584-018-2233-z

iv) number of trainings, workshops, farm visits, farm fairs provided to farmers as well as stakeholders organizations.

The envisioned outcomes of this project were: I) development of climate resilient agricultural systems, ii) improvement in farm production and income, iii) reduction of emission from crop and livestock production, and iv) strengthen gender and social inclusion through capacity building and involved in the project activities.

To achieve these outcomes, all project interventions and resulting outputs can be viewed in the form of a climate resilience framework.

1.3.1. Climate Resilience Framework

Resilience refers to the ability of systems, communities, households or individuals to cope with or mitigate risks as well as recover from adverse events or shocks (FAO 2013). Adaptation plays a key role in building resilience and is directly related to the vulnerability of the system to shocks. From a climate change perspective, building resilience is key to strengthening the agricultural system's capacity to deal with the negative impacts of increasing weather variability and extremities. Building climate resilience of agriculture is also essential to ensure food security while focusing on improving productivity.

Agricultural systems are defined by several social, economic and environmental factors that not just determine the vulnerability of the system but also define the dynamism of resilience that needs to be developed (Béné, Cet al., 2016)[4]. For instance, agriculture in a region comprised of poor farmers, with limited resources and facing severe climate risks may be less resilient to climate change compared to a region with relatively richer, resource endowed farmers facing similar climate risks. This is because the capacity of the community to adapt to climatic risks will be lower in the case of the former and may take longer to develop.

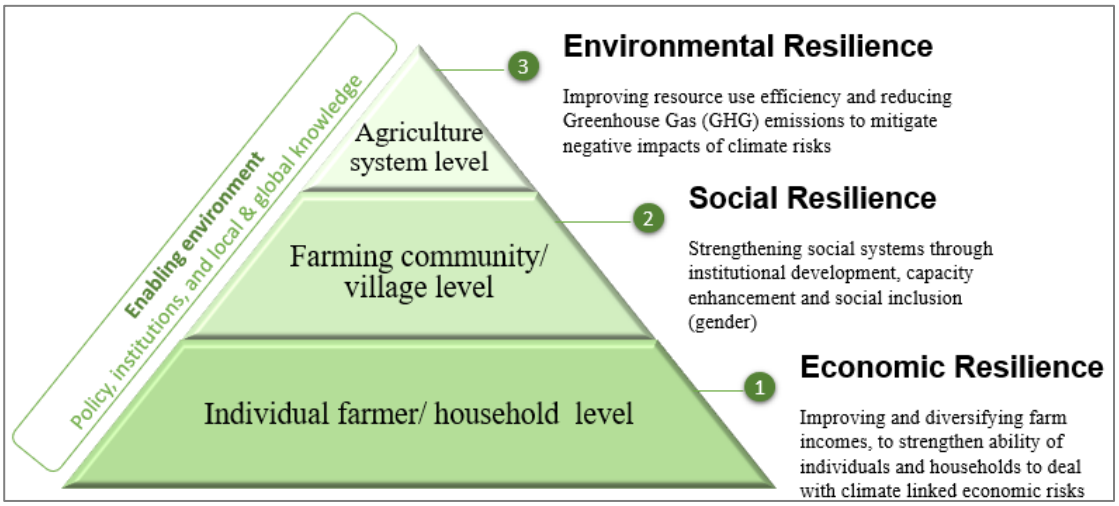

Figure 1.2: Climate Resilience Framework guiding project activities

[4] Béné, C., Al-Hassan, R.M., Amarasinghe, O., Fong, P., Ocran, J., Onumah, E., Ratuniata, R., Van Tuyen, T., McGregor, J.A. and Mills, D.J., 2016. Is resilience socially constructed? Empirical evidence from Fiji, Ghana, Sri Lanka, and Vietnam. Global environmental change, 38, pp.153-170

Figure 1.2 presents a framework that explains climate resilience for agriculture at three different levels, individual/household level, community level and system level. At the household level, resilience is built by enhancing current and future agricultural income in a changing climate by sustaining and improving crop productivity through CSA technologies, practices and services. Improved incomes can prevent the household from extreme poverty levels in times of climate risks and build the capacity of farmers to further invest in climate risk adaptation. Similarly, at the community level, group-based approaches that support collective action and decision making can promote climate risk adaptation at that level, encouraging social resilience. Finally, efforts to mitigate the overall impact of climate risks on agriculture including mitigation related interventions and resource use efficiency can help in building environmental resilience at a sectoral or systems level. Interventions at each of these three different levels can together contribute to the overall capacity of the agriculture sector to cope with climate risks.

The ability of the agricultural system to build resilience is also related to the presence of support systems and mechanisms in the form of policies, institutions and knowledge access. These form the enabling environment present around a system that can impede or accelerate the resilience building process.

The project's intervention and achievements have aimed at building resilience at these levels through a portfolio of interventions:

- Economic resilience: improving yield and household incomes through the implementation of climate-smart technologies, practices and services in the demo plots and gender integration across activities
- Social resilience: building social capital through training and capacity building of farmers, development of farmer-based institutions and strengthening stakeholder relationships (farmer, NGO, public, private) and gender integration across activities
- Environmental/system resilience: improving resource use efficiency and reducing emissions through practices such as INPM, scaling and sustaining adaptation interventions through multiple pathways and gender integration across activities

2

SCALING CLIMATE-SMART VILLAGES IN INDIA

2. Scaling Climate-Smart Villages in India

2.1. The scaling framework

CCAFS adopted the hub and spoke model for CSA technology dissemination of the project at the field level (Figure 2.1). The focus of the model is on the key participants of the process, the farmers. Three types of farmer categories each with a differentiated portfolio of CSA technologies and practices are the key mode of scaling the CSA technologies in the project area. These include Super Champion, Champion and CSA. There are two levels of hubs, the Super Champion and the Champion farmers. The super Champion is the main hub who acts as an influential supporter as well as a promoter of CSA technology for Champion as well as the CSA farmers[1]. The Champion farmers are another level of the hub with whom CSA farmers can be connected. A technology portfolio for the Super Champion farmers includes all possible climate resilient technologies, practices and services to test and evaluate in his/her field, while the Champion farmers are implementing a list of 9 CSA technologies, practices and services. CSA farmers receive a basic portfolio of agro-advisory, capacity building and some activities related to institutions in the CSVs.

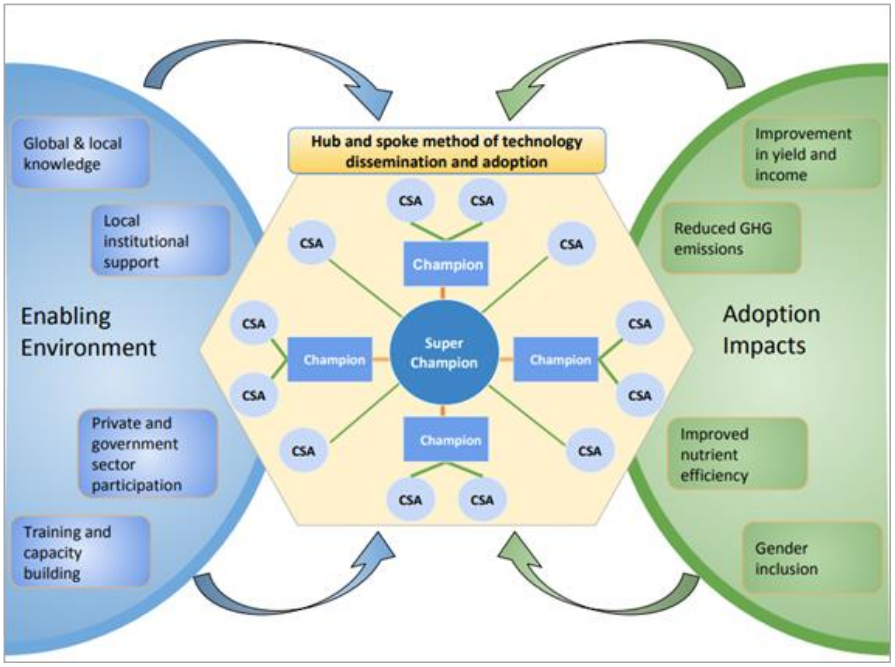

Figure 2.1: A hub and spoke method of technology dissemination and adoption.

Each of the 75 project villages includes one Super Champion, 14 Champion and 135 CSA farmers. These farmers were selected based on their willingness and ability to participate and contribute financially to the process of technology adoption. The hubs are the focus of all technology linked implementation, who as a result also become the testing grounds for learning and adoption of best practices by other farmers.

Several participatory activities such as farmer field visits and farmer fairs facilitate the working of the hub and spoke method. Champion and CSA farmers are regularly taken to the demo fields of Super-Champion farmers to understand the climate smart interventions on the field and the difference in outputs between the demo and regular plots. Similarly,

during farmer fairs, the participants are exposed to the different types of climate smart technologies and practices that the Super Champion and Champions are implementing. They are also shown some of the demo plots to understand the benefits of changing the traditional cropping practices. This ensures the spread of knowledge and the initiation of interactive learning among the farmers.

2.2. Process of implementation

The project was implemented in three districts in three states (Uttar Pradesh, Bihar, and Madhya Pradesh) of India. All three locations varied in terms of their vulnerability to climate risks, as well as their socio-economic characteristics. The project selected 25 villages in each selected district (Nalanda, Mathura, Betul) for the implementation of climate resilient agricultural technologies. Each village represents a cluster of similar villages (5-10) in terms of cropping and livestock production systems and the status of water resources. Secondary data available at block level were used along with suggestions provided by the local stakeholders (farmers groups, KVK) for selection of the villages. Implementation of field activities began from 10 villages in the first year in each district. Field staff conducted a series of meetings with local farmers in each village to provide an overview of project activities, plan to the farmers and to identify their willingness to participate in the implementation of a range of climate resilient technologies, practices and services in their villages. The activities were scaled out to all 75 villages within the second year. Agricultural related CSA interventions were promoted in al districts of Betula and Nalanda and only 10 districts of Mathura. Given higher importance of livestock development in Mathura, 15 villages of the 25 selected in the district were provided with only livestock focused interventions other than agro advisory and capacity building.

The institution of Village Climate Management Committees (VCMC) or "*Gram Jalvayu Prabandh Samiti*" was formed in every village to drive the implementation of CSA interventions at the local level. The members of this institution comprised of the Super Champion and Champion farmers. As a group, they were responsible for ensuring technology access to all kinds of farmers and therefore act as a link between the farmers and the external agencies such as the private sectors and government. The VCMCs acted as a self-governing mechanism by tracking activities and ensuring compliance of all farmers concerning their financial contributions, capacity building and awareness raising related to CSA technologies and practices. Through the VCMC, the project has disseminated the portfolios of climate-smart technologies and practices to all the direct 11,250 farmer beneficiaries. These committees have been formed to ensure equitable access to climate-smart technologies to all farmers, especially marginal farmers, and women. The activities being implemented have been selected based on participatory prioritization processes, field evaluations and farmer discussions (Table 2.1, details in annexure 2).

Table 2.1: Portfolio of technologies for different categories of farmers

Super Champion	Champion farmers	CSA farmers
• Improved seed • Laser Land Levelling • ICT based weather and agro-advisory services • Crop Insurance • Integrated Nutrient Management (based on LCC, Green Seeker) • Alternative Wetting and Drying • Direct Seeded Rice • Minimum Tillage • Fodder Management • Concentrate Feeding for Livestock • Stress Tolerant High Yielding Breeds of Livestock • Area Specific Mineral Mixture for Livestock • Climate smart Housing for Livestock • Biogas • Other equipment through Custom Hiring Centers • Infertility Camps (and other services through CDC)	• Improved Seeds • Laser Land Levelling • ICT based weather and agro-advisory services • Crop Insurance • Integrated Nutrient Management (based on LCC, Green Seeker) • Fodder Management • Concentrate Feeding for Livestock • Stress Tolerant High Yielding Breeds of Livestock • Area Specific Mineral Mixture for Livestock • Other equipment through Custom Hiring Centers • Infertility Camps (and other services through CDC)	• Improved seed • ICT based weather and agro-advisory services • Crop Insurance • Livestock development (De-worming, vaccination and support for 2 cattle per family) • Other equipment through Custom Hiring Centers • Infertility Camps (and other services through CDC)

2.2.1. Demonstration plots

Demonstration plots established on Super Champion and Champion farmers' fields served as the central testing grounds as well as learning platforms for the portfolio of CSA interventions (Figure 2.2). Demonstration and evaluation of climate resilient technologies cover 1,549 acres (627 hectares) of agricultural land through new and improved seed variety of agricultural and fodder crops during the project period (145 acres in Y1, 799 acres in Y2 and 606 acres in Y3). Intervention in the demo plot including seed replacement with improved seeds, seed treatment before sowing, changes in sowing/transplanting methods, integrated and precision nutrients management, and new water management techniques such as system of rice intensification (SRI) helped to improve crop yields in the project areas.

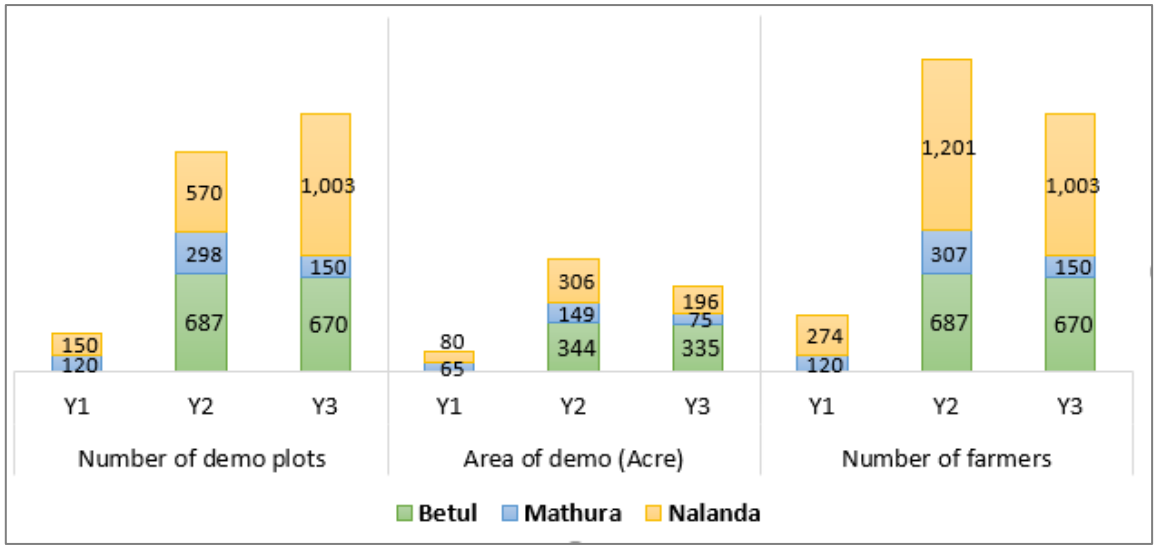

Figure 2.2: Demo plot details

Key cops promoted during the project period include Rice and Bajra during the Kharif (monsoon) season covering 27% and 9% of the demo plot area respectively. Wheat and Gram were the major Rabi (winter) season crops comprising 36% and 12% of the area respectively. Additionally, the project also promoted vegetable cultivation and fodder crops for better livestock health each of which comprised 8% of the cultivated area. These demo plots covered all Super Champion and Champion farmers of the project villages.

A key input in these demonstration plots has been of improved seeds. Majority of the farmers (76%) in the evaluation survey have found this input to be most useful in improving yield and income. Use of these seeds with improved sowing methods has been widely accepted by most farmers and is being increasingly adopted across all project locations.

"Earlier, I was throwing 60-70 Kg of seeds on 1 acre of land randomly over the field. But project staff told us to practice line sowing method for cultivation. Line sowing method helped us reduce wastages as were now planting the appropriate seed quantities and our cost of production declines significantly." - Ms. Savita Kumare (Super Champion Farmer, Betul, Madhya Pradesh)

2.3. Improvements in yield and income

Climate variability and diverse agro-diversities across all three intervention sites necessitated a customized suite of option to build the resilience and adaptive capacity of farmers. Depending on the kind of risk as well as the cropping pattern, the project has promoted climate smart interventions to enable farmers to reduce potential losses from these risks (table 2.2). As a result, farmers have not only been able to prevent expected losses but also achieve an average increase in yield and incomes by 69% and 96% respectively during the project duration. This will enable them to move towards a more economically resilient farming system.

Table 2.2: Type of climate risks and specific strategies to overcome them

District/ Key crops	**Weather variabilities faced by region**		**Key adaptation strategies**	
	Kharif	*Rabi*	*Kharif*	*Rabi*
Betul *Kharif: Rice* *Rabi: Wheat, gram*	Less average rainfall	Cold waves/hailstorms during harvesting months reducing grain weight	Interventions requiring less water such as medium duration rice seed variety, requiring and alternate wetting and drying irrigation	Stress tolerant seed variety, and application of Potash as fertilizer for strengthening the crop
Mathura *Kharif: Bajra* *Rabi: Wheat*	Excess rainfall after sowing damaging the crop due to water logging	Excess rainfall/hailstorm during harvesting	Line sowing and improved seed variety (water logging resistant)	Early harvesting through use of improved short duration variety and agro-advisory
Nalanda *Kharif: Rice* *Rabi: Wheat, gram*	Delayed rains resulted in sowing failure	Increase in average temperature during the grain filling period resulting in lower weight of the seeds	Direct Seeded Rice for farmers with irrigation access and Short duration variety for farmers without irrigation access	Light irrigation application through sprinkler

2.3.1. Kharif season

Rice was the major Kharif crop cultivated in Betul and Nalanda. Bajra was cultivated in Mathura as a major Kharif crop. Figure 2.3. highlights an improvement in average yields and income that is also accompanied by a reduction in the overall variance of the group pointing towards the development of a resilient system. Since project inception, the project interventions have enabled the farmers to increase their yields and incomes every year.

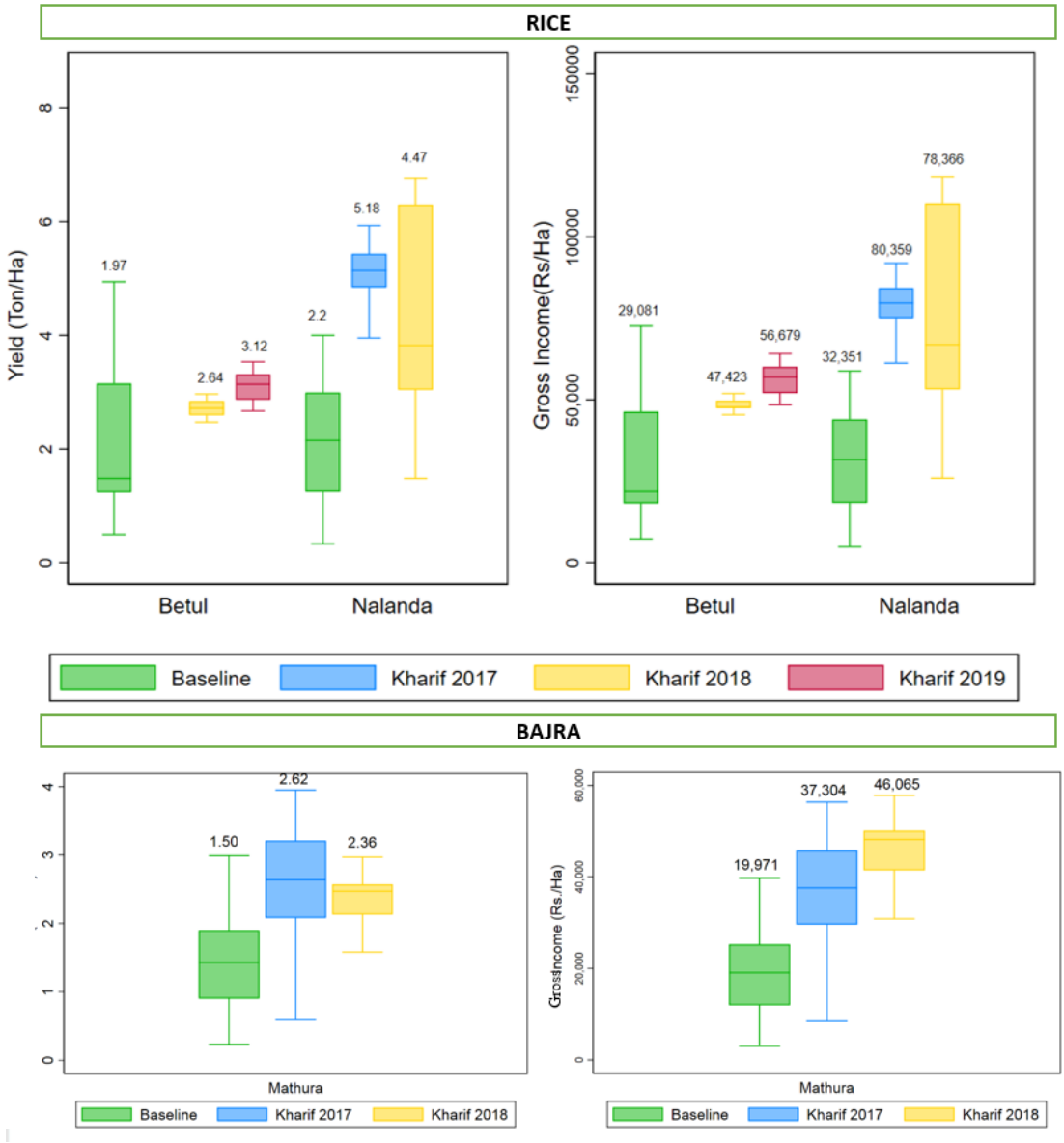

Figure 2.3: Yield and gross income trends of Kharif crops, Rice and Bajra in project districts

Overall average yields have been higher than 87% over baseline with a 115% improvement in income for Rice. For Bajra, yields have improved by an average of 66% along with a 109% improvement in income. On average, farmers have been able to earn a cumulative incremental income of INR 69,382 per hectare from Rice and INR 43,427 per hectare from Bajra in the two Kharif seasons.

2.3.2. Rabi season

Wheat has been the major Rabi crops for the three districts across the years. Figure 2.4 highlights the improvements in yields and income since project inception for Rabi crops of Wheat and Gram. The overall variance of the group is also seen across both crops. Since project inception, the project interventions have enabled the farmers to increase their yields and incomes every year. On average, farmers have been able to earn a cumulative incremental income of INR 60,923 per hectare from wheat and INR 56,033 per hectare from Gram in the last two years. Overall wheat yields have also improved by 52% with a 67%

improvement in incomes. Similarly, for Gram yields have improved by 73% while incomes have improved by 94%.

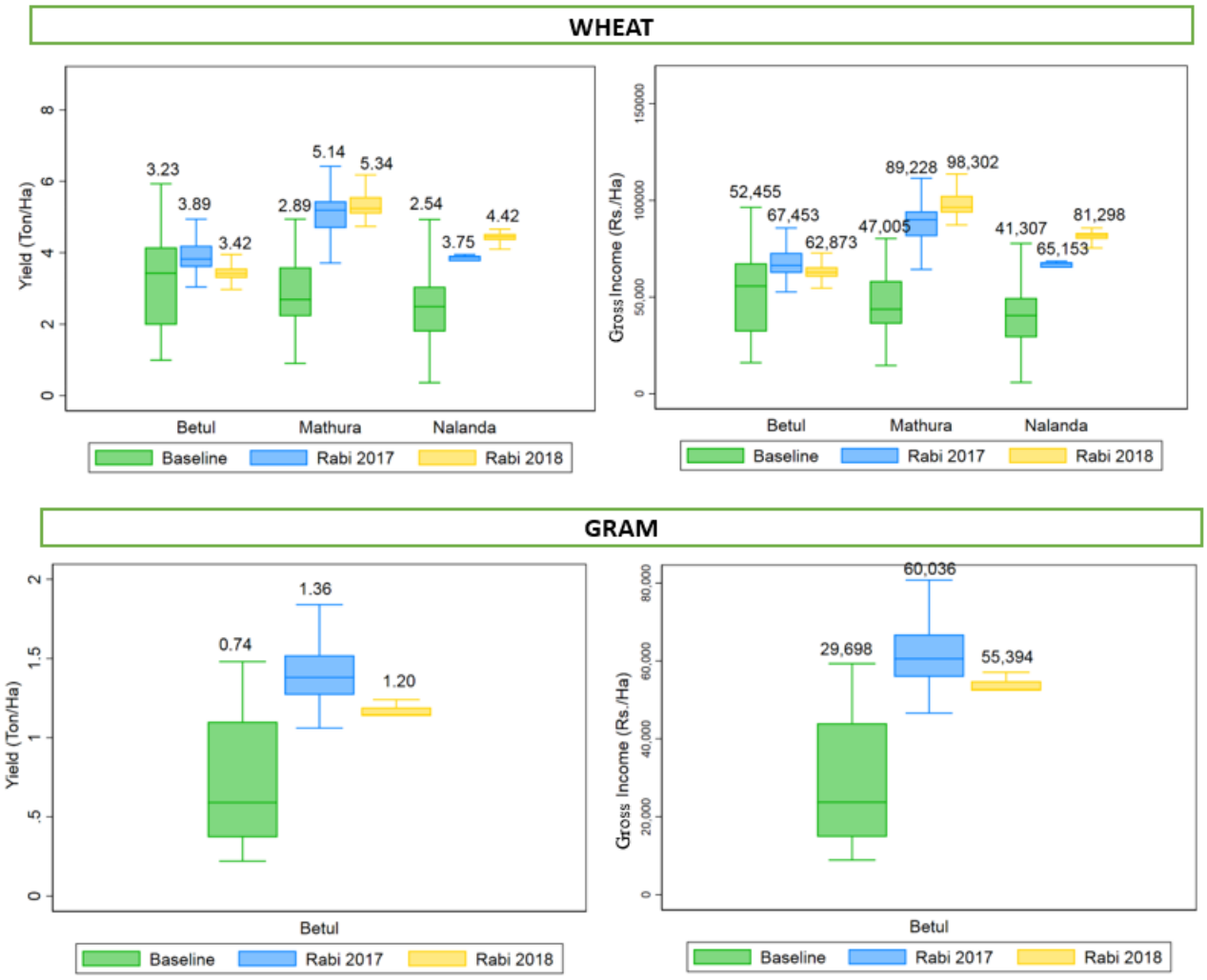

Figure 2.4: Yield and gross income trends of Rabi crops Wheat and Gram in project districts

The improvements in yield and income have been a result of multiple factors including the adoption of adaptation interventions. While the results are convincing, they represent indicators for a limited number of farmers in a given season. There is a need to do further work to understand the replicability and scalability of such interventions.

2.4. Improvement in resource use efficiency

As a result of continuous training, awareness generation and capacity building exercise, farmers in all the three districts have reduced usage of excess amounts of fertilizers and pesticides such as Urea and DAP in all crops. As a result, farmers have saved input costs and also achieved a reduction in nitrogen usage leading to lower emissions. The usefulness of INPM practice has also been agreed upon by the farmers where 38% of endline respondents highlighted the intervention as being useful for improving soil health.

Table 2.3 shows the changes in nitrogen use efficiency across all crops in each district. The efficiency has been calculated by dividing the crop yields (output) with the nitrogen content of fertilizers (input). The significant increase in efficiency is due to two factors: reduction in fertilizer input as well as an increase in yield outputs. Overall there has been an improvement of 140% in nutrient use efficiency during the project period with Rice (196%) and Bajra (182%) showing the most improvement, followed by Wheat (163%) and Gram (17%)

Table 2.3: Changes in nitrogen use efficiency across all crops

Crop	Nitrogen use efficiency (yield output/ nitrogen input)			% improvement over baseline in nitrogen use efficiency per hectare	
	Baseline	Y2/Y3[5]	Y3/Y4[6]	Y2/Y3	Y3/Y4
WHEAT					
Betul	28.26	46.04	97.74	62.9%	245.8%
Mathura	26.95	54.20	139.13	101.1%	416.2%
Nalanda	23.30	14.39	41.85	38.3%	79.7%
RICE					
Betul	16.43	-	21.26	-	29.4%
Nalanda	15.76	53.68	65.66	240.6%	316.6%
GRAM					
Betul	41.39	43.82	52.69	5.9%	27.3%
BAJRA					
Mathura	27.91	54.83	102.62	96.5%	87.2%

2.5. Reduction in Greenhouse Gas (GHG) emission

2.5.1. Reduction in emission through Nutrient Management

Excess usage of inorganic fertilizers such as Urea contributes to the increase in emission of the greenhouse gas. This can be managed through integrated approaches to the management of nitrogen fertilizer such as Integrated Nutrient Management which advocates reduced amounts and more strategically placed inorganic fertilizer. Through our project, we have promoted the reduction in Urea input by replacing some of it with Vermicompost for all crops, which has resulted in reduced usage of Urea as well as lower emissions. Table 2.4 shows that the practice has resulted in an average of 55% reduction in

[5] Includes Y3 for Betul ; Y2 for Nalanda and Mathura

[6] Includes Y3 for Nalanda and Mathura; Y4 for Betul

overall CO_2 emission per ton of crop production over the project duration by reducing the amount of Urea inputs. These have been the maximum for Rice crop showing 70% reduction. Emissions were calculated using the CCAFS MOT tool.[7] These results reflect the reduction from the 1,228 acres of demo plots of the four crops in the three districts.

Table 2.4: Reduction in emission intensity

Crop	Emission intensity – (Kg CO_2 per Kg production)			% change	
	Baseline	Y2/Y3[8]	Y3/Y4[9]	Y2/Y3	Y3/Y4
WHEAT					
Betul	0.37	0.11	0.07	-71.4%	-80.2%
Mathura	0.40	0.10	0.10	-74.9%	-74.2%
Nalanda	0.46	0.23	0.15	-50.5%	-68.2%
RICE					
Betul	3.44	1.19	1.29	-65.4%	-62.5%
Nalanda	3.83	0.64	1.41	-83.2%	-63.2%
GRAM					
Betul	0.81	0.50	0.49	-37.5%	-39.0%
BAJRA					
Mathura	0.44	0.27	0.25	-38.7%	-43.7%

2.5.2. Reduction in emission through Manure Management

The way in which manure from livestock is managed also contributes to GHG emissions. Different manure treatment and storage methods affect how much of these GHGs are produced. Biogas technology can help in reducing methane emissions through the use of surplus cow-dung produced by cattle, as well as a reduction in firewood burning as fuel. Table 2.5 explains the estimated amount of GHG reduction through the use of Biogas in project districts. There are a total of 34 Biogas of 2 cubic meter capacity in the three districts, 6 in Betul, 13 in Nalanda and 15 in Mathura. Firewood burning as a cooking fuel is used only in Betul and hence the calculation is done only for 6 Biogas systems in the district. The emission from fuelwood is based on the following formula by IPCC:

$$\text{Emissions}_{\text{GHG,fuel}} = \text{Fuel Consumption}_{\text{Fuel}} \text{ x Emission Factor}_{\text{GHG,fuel}}$$

Where, Emissions $_{GHG,\ fuel}$ = emissions of a given GHG by type of fuel (kg GHG), Fuel Consumption $_{fuel}$ = amount of fuel combusted (TJ), Emission Factor $_{GHG,\ fuel}$ = default emission factor of a given GHG by type of fuel (kg gas/TJ).

[7] The CCAFS-MOT tool combines several empirical models to estimate GHG emissions from different land use. Available at https://cgspace.cgiar.org/handle/10568/67027

[8] Includes Y3 for Betul ; Y2 for Nalanda and Mathura

[9] Includes Y3 for Nalanda and Mathura; Y4 for Betul

Table 2.5: Estimated reduction in emissions from the usage of Biogas[10]

Estimated GHG reduction from using cow dung	**Details**
Amount of cow dung used per Biogas	25 Kg/Day
Dung produced per animal	10 Kg/Day
Number of animals required to produce dung (1)	2.50
Emissions per animal per year (2)	1.6 tons of CO2 eq.
Yearly emissions by anima per Biogas (3= 1x2)	4.00
Total number of Biogas in project areas (4)	32
Total annual GHG (methane) emission saving from project Biogas (3 x 4)	**128 tons of CO_2 eq.**
Firewood usage before Biogas	1.760 Ton/Yr
Firewood usage after Biogas	0.208 Ton/Yr
Firewood usage reduction	1.552 Ton/Yr
Number of Biogas in Betul district	6
Total firewood saved in Betul (Ton per year) (5)	**9.31** Ton/Yr
Amount of fuel combusted (6)	0.015 TJ/Ton
Emission factor for wood (7)	112 Kg CO2/TJ
Total estimated GHG (CO_2) emission saving from firewood replacement (5x6x7)	**15.6 tons of CO_2**

The overall evaluation results reported largely resound with farmers view on the project's intervention. The endline evaluation positively points to improved resilience of rural livelihoods through enhanced productivity, profitability and resource use efficiency. Broadly, 91% surveyed farmers experienced improved crop and livestock productivity while 89% of farmers also pointed to improved incomes. Overall, the availability and access to food reportedly increased for 85% of respondents.

[10] Sources: ILO. 2014. a) Field survey; b) The economics of biogas. Creating green jobs in the dairy sector in India. Available at https://www.ilo.org/global/topics/green-jobs/publications/WCMS_242911/lang--en/index.htm; 2006 2006 IPCC Guidelines for National Greenhouse Gas Inventories

3

PRIVATE SECTOR SUPPORTING PARTNERS

3. Private sector supporting partners

Private sector partnership forms a strong base for the successful implementation of project interventions. Across the three districts, several private players are supplying the different technologies and services through the NGO partner, ensuring access to new technologies for all farmers. While several players are already a part of the CSV system, others are also willing to join in and help in scaling out climate smart technologies to other villages and provide support to farmers' custom hiring centers. Table 3.1 provides a list of current players as well as players that have been identified by the project team as prospective partners in the coming years

Table 3.1: List of current and potential private players involved in the project

Private sector players	Betul	Nalanda	Mathura
Current	• IFFCO Kisan Sanchar Ltd. (ICT provider) • Urja Biosystems (biogas) • MP Agro (CHC machinery) • Saur Deep Kisan, FPO, Betul (Solar pump)	• IFFCO Kisan Sanchar Ltd. (ICT provider) • Urja Biosystems (biogas) • Kisan Agro, Biharsharif (CHC machinery)	• IFFCO Kisan Sanchar Ltd. (ICT provider) • Urja Biosystems (biogas) • JAI enterprises, (CHC machinery) • Devendra Agriculture works (CHC machinery)
Potential	• Jain irrigation (solar) • Kisan Agro, Patna Bihar • HDFC Agro Bank • Agro Industries and Farmers Federation • Agriculture Insurance Companies		

The project has partnered with IFFCO Kisan Sanchar Ltd (IKSL), an ICT provider, to disseminate weather and climatic information using existing scientific knowledge and farm conditions. This information, sent in the form of voice calls and messages includes inputs related to new agricultural practices, livestock related information, markets and prices, along with real-time weather forecasts. The information is scheduled as per the cropping cycle of the production system and is localized as per farmers' interest and feedback. Apart from the push advisory system, the farmers also have access to a toll-free helpline number to resolve any related query. The project has provided these services to all project farmers throughout the three years of the project.

The usefulness of mobile-based weather and agro-advisory services for farmers is evident through the endline survey where 83 % of respondents reported utilizing the information received on their agricultural plots. Change in sowing dates (43%) and the use of natural pesticides/fertilizers (27.5%) were identified as the most useful information received and applied through the agro advisory services. This also highlights an improvement in the awareness level of farmers about weather and crop related information, which as per the baseline report, was very limited before project interventions.

The member of IFFCO Kisan Sanchar Ltd (IKSL) shared his words on the services provided by them to farmers in the project area;

> *"Farmers receive these advisories through both text and voice messages. They prefer to receive specific advisories on crop sowing, harvesting etc. through voice messages and information such as name of the fertilizers through text messages. Overall, they find the two information channels as complementary to each other*." - Mr. Morup Namgail, IFFCO, Mathura.

4

BUILDING INSTITUTIONAL MODELS

4. Institutional models

To effectively address the challenges of climatic risk faced by the farmers, different institutional approaches were developed. These were in the form of local institutions to support the CSA technology transfer process by keeping all stakeholders connected. These are primarily community-based approaches that support collective action and decision making to promote climate change adaptation. They lay emphases on the strengthening of local level institutions and cadre, play an important role in generating community-level ownership and participation in climate smart village planning and development initiatives. These institutions will continue to support and sustain the project activities beyond the project life.

This section highlights the two institutional models of Custom Hiring centers (CHCs) and Cattle Development Centers (CDCs) along with the supporting mechanisms of private sector and convergence that together help in maintaining the adoption of climate-smart adaptation practices by farmers in the project villages.

4.1. Custom Hiring Center (CHC)

The institution of Custom Hiring Centers (CHC) has been established to facilitate technology transfer to the local community through an institutional and business-oriented approach. Managed by women farmers, these institutions also contribute to gender integration and empowerment in the farm community. Given the small landholdings of farmers combined with a minimal investment capacity for new technologies, the CHC promotes a technology hiring mechanism to overcome affordability barriers. Thereby making CSA technologies available at a rental cost, the CHCs are enabling farmers to overcome the technology access issue, facilitating efficient use of inputs, promoting the use of CSA to farmers in and around their locality, and earning a source of income for its members. There are 13 Custom Hiring Centers established across the three districts and provide 10 key technologies for dissemination among the farmers. Some prominent technologies include rotavator, potato planter, cono weeder, sprinkler pipe, solar pump, seed treatment machine, Paddy harvester/cutter. Knowledge sharing and capacity building sessions followed by participatory discussions with farmers enabled the selection and shortlisting of technologies to be promoted through the centers. These centers also encourage adoption of the technologies by the women members themselves. A total of 136 women farmers are running these centers.

Multiple private sector players are playing an important role in making technologies, practices and services available to farmers through the CHCs. In addition to these, local institutions (VCMCs) support the centers for CSA technology transfer process by keeping all stakeholders connected. The CHCs services have been hired by more than 800 farmers and covered 387 hectares of the area across all the three districts. The centers have managed to gradually expand their presence in the project districts. They have gained momentum in the last two years of the project. For instance, last year farmers using CHC equipment increased

by 69% with a simultaneous increase of 90% in the area covered by the use of the equipment (Figure 4.1). In terms of the equipment driving this increase, it was observed that sprinkler was popular equipment taken on rent by a majority of the customers in both Nalanda and Betul during the Rabi (winter crop) season. Irrigation during the Rabi season has been particularly helpful for farmers in Nalanda as the region faces heat stress during the winter season requiring a light application of water to prevent loss in crop quantity and quality. The use of sprinkler has also been popular for growing vegetables in both districts. In Mathura, on the other hand, tilling machine and solar sprayer have been most hired among the customers.

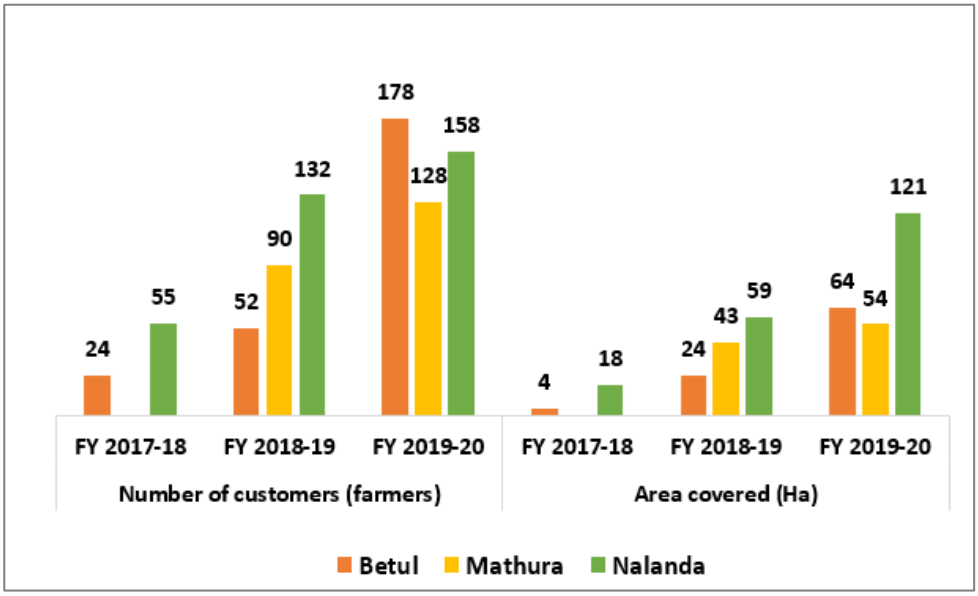

Figure 4.1: Customer base and area coverage by CHCs in the last two years

Total costs of establishing the 13 CHCs comprise majorly of the cost of equipment, amounting to 35.6 lakhs, that are provided for hire. Women CHC members in Mathura and Nalanda contributed 10% of the total cost thus ensuring their share in the ownership of the equipment. Total rental incomes during the project period ranged from INR 26,825 in Betul to INR 59,995 in Mathura and INR 49,080 in Nalanda (Table 4.1). Key revenue generating equipment has been the paddy transplanter, sprinkler and zero-till machine in Nalanda, solar pumps and sprinklers in Betul and rotavator and potato planter in Mathura. In addition to the rental revenues, this model provides significant scope to help rural women build resilience towards external stresses, by enabling them to maximize economic opportunities, reduce farm related drudgery, increase agriculture productivity and household food security.

Table 4.1: Rental income earned by CHCs in Mathura, Nalanda and Betul

Rental Income earned by CHCs	Total rent received for use of technologies (INR)		
	FY17-18	*FY18-19*	*FY19-20*
Betul	2,675	7,860	16,290
Mathura	-	21,725	38,270

Nalanda	4,060	21,020	24,000

These centers are also contributing to improved yields, incomes and nutrition of farmer households as also confirmed by the endline respondents. The most useful benefits from availing the CHC services included improved agricultural production (45%) followed by improved access to various farming equipment at affordable rental cost (27 % farmers).

Sustainability of these institutions can be ensured through convergence with government schemes, increased involvement of the community and improved stakeholder linkages. While there are several pathways to ensure the sustainability of these institutions, the involvement of government funds through the process of convergence is important to ensure cost-effectiveness of these centers. Similarly, investments from private players in the form of CSR (corporate social responsibility) can encourage the expansion of such centers and contribute to building climate-resilient agricultural communities.

In Betul district, the CHC model has been observed as an 'innovative model' as mentioned by the district Additional director of Agriculture in the convergence workshop held by the project in August 2020. The government stakeholders also showed interest in scaling up the model to other parts of the district and to promote similar models for fruit and vegetable cropping systems. Government stakeholders in the other two districts have also suggested linking these CHCs with large market entities as well as Farmer Producer Groups to enable their expansion.

Story from the field: Benefits of CHC membership

Satoka Bai of Chunagosai village, Betul district of Madhya Pradesh has been a member of Custom Hiring Centre since 2018. She owns 2.5 acres of land and used to adopt flood irrigation technique for wheat crop which provided insufficient water during the maturity stage of the crop resulting in yield loss up to 40%.

Picture: Sprinkler in Satoka Bai's field

She then started using the sprinkler set hired from the CHC along with adopting other CSA practices including improved seed varieties, line sowing, optimum utilization of fertilizers, seed treatment practices being promoted under the project. This resulted in 43% improvement in Wheat yield as well as 30-40 % water savings.

4.2. Cattle Development Center (CDC)

Livestock in the study areas is characterized as low yielding cattle having a poor rate of conception, poor quality germplasm, and inadequate animal health care. Further, climate stresses such as drought, heat stress and excess rainfall affect the health and productivity of the animals. The farmers also lacked information and knowledge about better practices that could improve the cattle's overall wellbeing as well as productivity. Therefore, CDC, one each in the three districts have been established to promote improved breeds of cattle, provide better healthcare for the animals and build the capacity of farmers to better manage their livestock to reduce adverse climatic impacts on them. Youth participation is encouraged for managing the activities of the institution and promote the use of CDC interventions to farmers in their villages. These institutions are directly linked with the local research centers to update them about the latest technologies, practices and breeds in the field. These CDCs are providing the following services to the farmers:

- Promotion of improved breed (high yielding and stress-tolerant) of cattle: Sahiwal, Holstein Friesian, Jersey, Gir (cow) and Murrah (Buffalo); and sexed semen through Artificial Insemination Service[11]
- Preventive animal health care: vaccination, mineral mixtures and deworming
- Capacity building training for scientific management of livestock including health and feed management
- Infertility camps

The CDCs have managed to benefit more than 6,200 farmers across the three districts (Table 4.2). Livestock is a major part of Mathura's rural economy and therefore the focus on CDC development has been more there as compared to other districts. While reasonably priced products such as de-worming tablets and mineral mixtures have been popular among most farmers, the intervention of improved breeds through Artificial Insemination (AI) has been accepted and adopted by an increasing number of farmers across the three districts. Two types of AI are provided general and sorted semen. The chances of pregnancy through a general AI are about 50%. However, through sorted semen, the chances of having a female calf are almost 95%. The two, however, differ in terms of cost. The scaling of AI has been a challenging activity for the project, particularly in Betul district. Cultural factors such as the sanctity of the cow prevented farmers to take benefit of these services. Therefore, several awareness and capacity building exercises were organized where farmers were also taken to neighbouring villages to understand the benefits of these services. The preference for this technology was also highlighted in the endline survey where Sorted semen AI and General AI were cited as the most useful livestock related interventions by 34% and 25% of the farmers, respectively.

[11] The breed improvement program is in accordance with the state specific guidelines for breed improvement across project districts.

In addition to AI the project has also promoted goat development to provide an additional income source from livestock. Goat breeds have also been promoted and are being provided with natural services for rearing in Mathura and Betul.

Table 4.2: Details and coverage of services offered by the CDCs during the project period

District name	Service in CDC	Price per service (Rs.)	Unit of price	Number of farmers availing service			Number of animals covered		
				Y2	Y3	Y4	Y2	Y3	Y4
Betul	AI general	100	Per AI	146	393	229	295	422	435
	AI sorted semen	350	Per AI	-	39	94	-	54	118
	Mineral Mixture	120	Per animal/ farmer	36	180	-	100	385	-
	Deworming Tablet	5	Per Bolus	105	203	-	403	647	-
	Infertility Camp	-	-	284	170	34	1,854	478	231
	Vaccination	-	-		194	224	-	695	546
	Sirohi Goat	-	-	-	35	-	-	10	
Mathura	AI general	100	Per AI	700	854	948	1,200	882	1049
	AI Sorted Semen	250	Per AI	120	173	-	150	177	-
	Mineral Mixture	65	Per kg	50	523	25	100	1,046	25
	Deworming Tablet	8	Per Bolus	2,500	486	-	5,000	972	-
	Infertility Camps	-	-	600	695	-	600	862	-
	Barberi goat	-	-	-	14	-	-	13	-
Nalanda	AI general	100	Per AI	250	206	-	220	624	-
	Sorted Semen (cow)	525	Per AI	6	5	-	6	5	-
	Mineral Mixture	47.5 (50% subsidized)	Per animal /kg	413	692	-	331	694	-
	Deworming Tablet	7.15 (50% subsidized)	Per Bolus	1,466	1,374	-	1,173	1,635	-
	Infertility Camp	20	per farmer	546	332	-	332	546	-

The success of the AI intervention can be captured through the success rate of pregnancy and the new calves being born (Table 4.3). A total of 5,541 AIs have been conducted during the project duration with most of them happening during the third year. The average success rate for pregnancy has been 56% with a total of 1,300 new cow/buffalo calves being born, 54% of them being female. These new calves are expected to be more productive and less vulnerable to weather stresses. Additionally, the project has also introduced breeding bucks of goat to develop goatry among households who are dependent on small ruminants for livestock-based livelihoods. A total of 48 farmers benefitted from this intervention and 176 new goat kids were conceived during the project period.

Table 4.3: Details and coverage of Artificial Insemination

AI details							
District		**Total AI**			**Success rate of AI diagnostics (confirmed pregnant)**		
		Y2	Y3	Y4	Y2	Y3	Y4
Betul	General Cow	205	288	249	58%	58%	52%
	General Buffalo	102	202	160	77%	53%	48%
	Sorted AI (Cow/buffalo)	-	54	119	-	86%	49%
Mathura	General (Cow & Buffalo)	1,276	968	1,106	60%	68%	57%
	Sorted AI (Cow)	-	193	-	-	73%	-
Nalanda	Cow	224	251	-	45%	47%	-
	Buffalo	58	81	-	28%	44%	-
	Sorted AI	6	5	-	-		-
Total		1,865	2,042	1,634	54%	61%	52%
Calves born							
District	AI type	Male			Female		
		Y2	Y3	Y4	Y2	Y3	Y4
Betul	General Cow	5	53	45	3	42	46
	General Buffalo	1	32	23	0	36	20
	Sorted AI (Cow/buffalo)			0			19
	Goat natural service			91			85
Mathura	General (Cow & Buffalo)	30	201	245	32	136	185
	Sorted AI (Cow)	-	2		-	44	
Nalanda	General Cow	3	34		2	37	
	General Buffalo	0	12		0	12	
Total		39	334	404	37	307	355

To address the issue of reduced availability of green fodder for livestock, the project also promoted different types of fodder cultivation. BAIF Hybrid Napier 10 was promoted while Makkhan grass was introduced as part of the seasonal fodder system. Additionally, Azola mother culture units were also established in the farmer's field and nutri-feed was also promoted. The farmers are seeing benefits of cultivating these two types of grasses and better feed through improved animal health and productivity especially in Mathura. A total of 352 farmers benefited from Napier cultivation while 148 benefitted from Azola across the three districts. Makkhan Grass and Nutri-feed were promoted only in Mathura benefitting 300 and 246 farmers respectively.

The achievement of the intended benefits of livestock interventions was visible during the endline evaluation where benefits such as improved milk and improved livestock nutrition were highlighted by 92% of the respondents.

5

STRENGTHENING STAKEHOLDER CAPACITY

5. Strengthening stakeholder capacity

Capacity building and strengthening have been a key component of the project activities. It has played a crucial role to build resilience at the societal level by adopting multiple approaches. The objective of the training and capacity building exercises was twofold, to inform and train farmer about new CSA technologies, practices and services, and to connect them with government and private sector stakeholders to enable scalability and sustainability of the project interventions. To do this, therefore, the capacity building activities were done for three types of stakeholder groups, i.e. farmer level, field staff and local institutions, and government and private players.

The initial project years focused on developing farmer capacity (through regular trainings and interactions) while gradually also involving community members (including farmers other than Super Champion and Champion in the project villages) to understand and adopt project interventions. The approaches, therefore, included training sessions including video trainings, farmer field days and farmers' fairs. Towards the final year of the project, activities focused on exposure visits to agricultural universities, and interaction meetings with government and private stakeholders to strengthen the relationships of farmers with these stakeholders.

5.1. Farmers

5.1.1. Trainings

Farmers were the key stakeholder of the project. To develop resilience among the farmers required consistent efforts to train and build their capacity. The project held trainings on different thematic subjects before, during and post cropping seasons. By considering the requirements of farmers, the trainings were based on the following thematic areas:

- *Climate smart Agricultural practices and technologies:* These included training on improved seed, seed treatment, nursery preparations, and seed production for next season. To improve the agronomical practices trainings on systematic rice intensification (SRI), direct seeded rice (DSR), broad bed furrow (BBF), line sowing practice through seed drill were also provided to the farmers. Trainings on water management including irrigation management practices like use and importance of micro irrigation system like drip and sprinkler, land levelling practices were also imparted.
- *Livestock Management*: These involved information and training on scientific management of Livestock feed and health including information on perennial fodder cultivations using BNH10 variety, azola cultivation, nutrifeed, Makkhan grass, climate resilient housing for cattle, improved breeding through Artificial Insemination (AI), sorted semen technology in AI, use of deworming medicine, mineral mixture and vaccination.

- *Integrated Nutrient and Pest Management*: these involves trainings on biopesticides preparations like *jeevaamrit, neemastra, and brahmastra*, vermicomposting, soil sample testing, understanding soil health card and application of fertilizers based on recommended dose.
- *Other themes*: These included other areas such as awareness campaigns and trainings on crop and livestock insurance, weather information, agro advisory, usage of multiple farming equipment's, trainings for CHC members on CHC operation and management as well as with farmers on CHC awareness, information on government schemes and process of convergence.

A total of 444 such trainings were organized during the project period, with 53% of them focusing on crop related to the theme of 'Climate smart agricultural practices and technologies' mostly in Betul and Nalanda (Figure 5.1). Most of the livestock management trainings were in Mathura, given the project's focus on the sector in the district. While a majority of the participants were males, women farmers participation can be seen gradually increasing during the project period, from 17% of total participants in Year 2 to 40% in year 4 (Figure 5.2). This trend is visible in all districts including Mathura and Nalanda where women from beneficiary households have also attended these sessions.

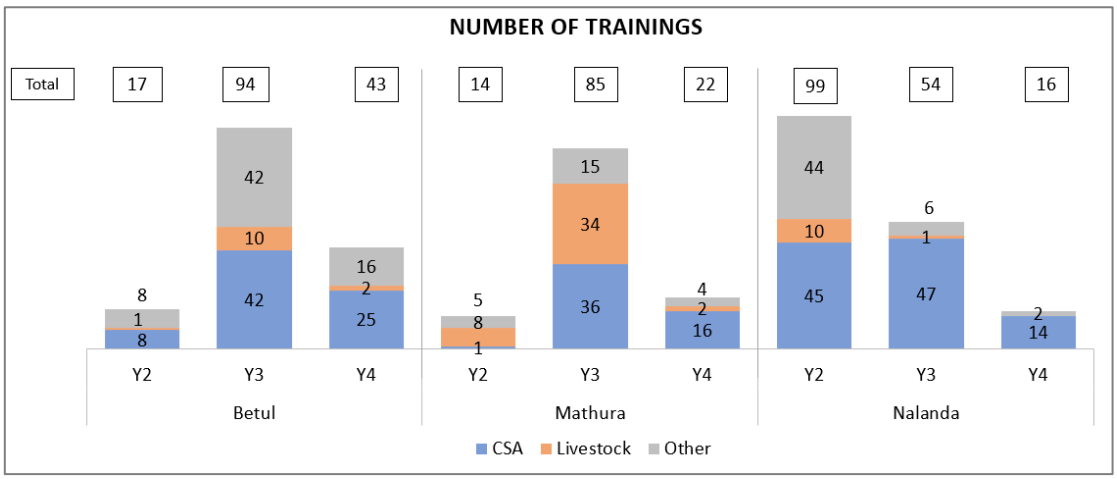

Figure 5.1: Training numbers by themes across the three project areas during the project period

The benefits of these trainings were highlighted by most endline respondents. As much as 90% of the respondents in each farmer category confirmed attending trainings organized by the project. These farmers also reported significant changes in agricultural practices such as a change in sowing method (62%) and optimizing pesticide or fertilizer use (9%).

Additionally, as a result of multiple insurance related awareness camps and training, the project managed to enrol 3,314 farmers in the Pradhan Mantri Fasal Bima Yojana (Prime Minister's Crop Insurance Scheme) for key crops including Rice, Wheat, Gram, Soybean and maize (1,715 in Nalanda, 849 in Mathura and 750 in Betul).

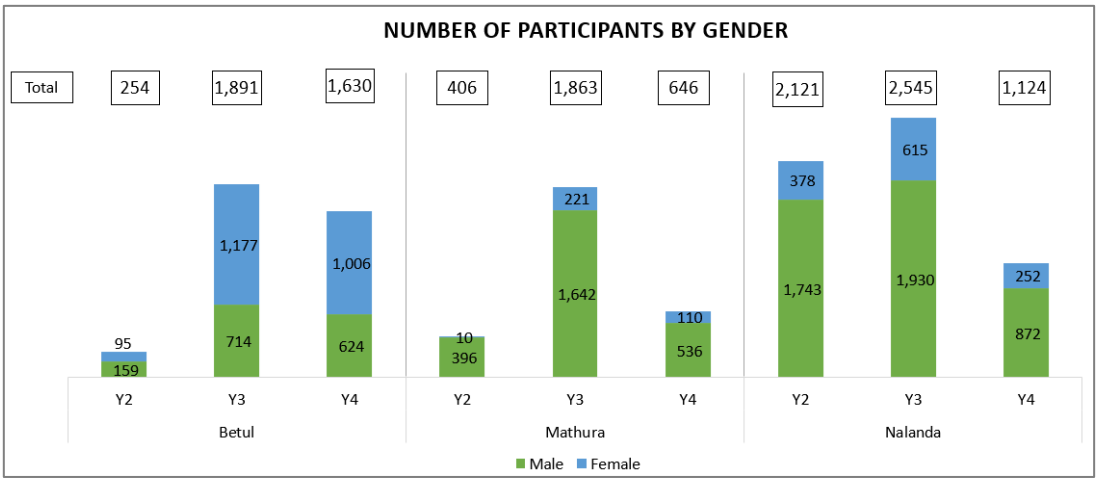

Figure 5.2: Training participants by gender across the three project areas during the project period

5.1.2. Capacity building

Apart from regular trainings related to adaptation implementation, farmers were exposed to field visits or visits to the local university to gain additional practical knowledge related to both existing practices as well as new practices (exposure visits). Champion, CSA and non-beneficiary farmers were regularly taken to the demo fields of Super-Champion farmers to understand the climate smart interventions on the field and the difference in outputs between the demo and regular plots (Farmer field days). Additionally, farmer fairs were also organized to involve a large number of farmers and highlight the adaptation benefits to non-project farmers. All these events served as a cross-learning platform for farmers and enabled scaling out of the technologies and practices to neighbouring areas. Table 5.1 highlights the number of such events in the three districts. A total of 84 such events have taken place during the project period, cumulatively covering 4,452 farmers, out of which 19% were females, and at least half of which have been other farmers (other than direct beneficiaries). Majority of these events have been in the form of Farmer Field days

Table 5.1: number of farmers' field days, exposure visits and fairs conducted

District	Number of events			Total male farmers			Total female farmers		
	Y2	***Y3***	***Y4***	***Y2***	***Y3***	***Y4***	***Y2***	***Y3***	***Y4***
Betul	2	7	14	25	261	116	15	75	475
Mathura	14	20	2	286	545	23	6	42	10
Nalanda	4	9	12	150	365	370	18	92	118
Total	20	36	28	461	1,171	509	39	209	603

Picture: (Left) Farmers in Nalanda visit to Bhagalpur agricultural university to attend a farmer fair (2019); (right)Farmers from Mathura visit a farmer fair in GP Pant agricultural university (2019)

5.2. Implementing Staff

To support communities for the adoption of CSA technologies with training and capacity building, the project staff was also trained on various aspects through technical experts and resource agencies. In the initial phase of the project, scientists from BISA-CIMMYT provided trainings on selection and implementation of CSA technologies, practices and services to the staff of local partner (BAIF) and farmers. These trainings covered technology specific implementation method, data collection, monitoring and evaluation of CSA interventions in the CSVs. For the establishment of the local institute like Custom Hiring Centers (CHCs), the project team were trained on the concept of CHC, selection of SHG for CHC operation, development of business plan for CHC, selection of farming equipment's, rent finalization for CHC equipment's, operation and management modalities etc. The field team were also trained on the preparation of Participatory Village Development Plan (PVDP) which helped for the preparation of village level plan of project villages. In addition to the implementing staff, the project has also trained 18 community resource persons (CRP) working across project locations (10 in Betul, 5 in Nalanda and 3 in Mathura). The CRPs undergo training and participate in exposure visits along with farmers, enabling them access to information, skills and resources that are essential to support communities beyond the project life. They will continue to act as a useful resource for farmers and serve as an important link between the farming community and other public and private stakeholders.

Story from the field: Coping during crisis

Building social resilience at community level through capacity building and training of the village-based institutions and farmers and linking them to government officials and market stakeholders has proven to be useful during the COVID-19 pandemic.

With markets closed, reduced labor access, and lack of transportation to move produce, the rural areas were faced with multiple challenges during the final project months of April, May and June. However, the knowledge gained, institutions formed, and linkages developed enabled farmers to better respond to these challenges.

During these months, collective action by beneficiary farmers and SHGs mentored by the project supported the sale of produce for farmers in Betul while project staff assisted farmers in gaining access to seeds and markets. Similarly, in Mathura, the village community was able to absorb the excess milk amongst themselves as markets were closed while some farmers continued to benefit from convergence activities that had been initiated before the lockdown. In Nalanda, CHC members were able to help farmers gain access to machinery in the absence of labor due to lockdown. These examples highlight the self-sufficiency of the farming communities to be able to cope with a crisis situation as a result of the capacity built and institutions set up by the project.

"During the lockdown, I was unable to sell freshly harvested tomatoes from my field. I then contacted the district officials of the Agriculture Department, from the list provided by the project team. The officials were very supportive and informed us that we can sell our harvest at designated areas from sunrise till 10:00 am. The project team has given us the confidence to talk to the government officials" - Sangeeta Rajesh, Farmer, Betul, Madhya Pradesh

6

CONVERGENCE THROUGH GOVERNMENT PROGRAMS

6. Convergence Through Government Programs

There are multiple policies and programs implemented by the Government of India to address climate risks mitigation and management in India. While implementation of these schemes is majorly lead by the State governments, the central government also provides support for schemes such as Rashtriya Krishi Vikas Yojana (National Scheme for Agriculture Development), the National Mission on Sustainable Agriculture (NMSA), Pradhan Mantri Fasal Bima Yojana (Prime Minister's Crop Insurance Scheme), Pradhan Mantri Krishi Sinchai Yojana (National Scheme on Farm Irrigation) among others to advance agricultural growth and rural development. The State Departments of Agriculture, Horticulture, Forestry, and Animal Husbandry support farmers and their communities through numerous programs including those related to climate-resilient seed production and distribution, Soil Health Cards, monitoring of pests and diseases, farm machinery and equipment, production of high-quality vegetable nurseries and fodder plants.

All these schemes and programmes are often implemented in silos by the respective sectoral departments of the government. However, through the Climate-Smart Village approach in Betul, it has been shown that to build climate resilience of the agricultural system, it is required that several schemes and programmes linked to the community's adaptation needs are implemented in an integrated manner. This necessitates community mobilization and awareness generation among the community about the existing schemes and programmes that they can benefit from.

Certain challenges need to be overcome to successfully implement an integrated approach. These challenges include the following:

- Farmers are unaware of the details, requirements, and process to avail such policies
- There is a lack of a comprehensive need assessment of the farming community that is linked to their existing activities and that can help them to adapt to future climate risks
- There is a lack of a forum to bring together farmer's needs, plan their requirements and communicate the same to the policy implementers

Adaptation to climate change cannot happen effectively in isolation. Multiple stakeholders need to join hands together. The local government stakeholders play an important role in enabling farmers in adapting to and mitigating the climate change effects. The project has tried to address these challenges by facilitating the convergence of the central and state-sponsored schemes to implement adaptation interventions in the Climate-Smart Villages.

The initiative of convergence has been undertaken to bring together funds, institutions and human resources of various schemes and programmes of the government (central, state, gram panchayat) to sustainably scale out climate smart agriculture (CSA) approach in the

three states of India (Figure 6.1). The initiative tries to converge government schemes at Panchayati Raj Institution (PRI)[12] level to formulate a Climate-Smart Village (CSV), with Gram-Sabha[13] being the participatory planning unit. A convergence of these schemes provides an integrated and holistic action plan to actualize the CSA approach, at a practical level. The funds acquired under various schemes along with the technical support and guidance of respective departments provides the necessary fillip to implement, augment and scale-up Climate-Smart Villages (CSVs). Convergence takes place in three forms:

- **Institutions:** It requires institutional support and coordination at various levels including state line departments, Panchayati raj institutions, farmer organizations and other agencies including implementing partners.
- **Funds**: It converges financial resources from different stakeholder, farmers, gram panchayat and state/central government schemes required to implement adaptation interventions at the farmer/village level
- **Human resources**: It involves the cooperation of different stakeholders at the village, gram panchayat and government levels along with representatives from extension services and educational institutions

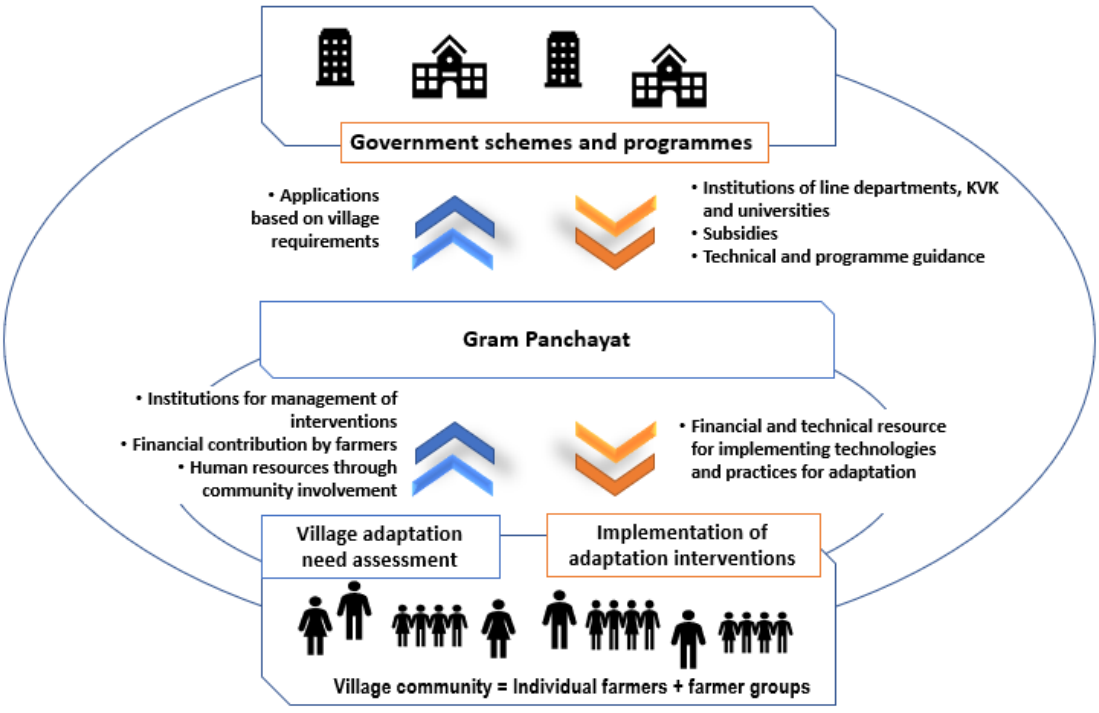

Figure 6.1: The convergence process bringing together human, financial and technical resources from different levels for implementing adaptation interventions at the village level

[12] Panchayati Raj Institution (PRI) is the oldest system of local government in the Indian subcontinent was introduced by the 73 Amendment of the Constitution of India. The Constitution envisages that Panchayats will function as institutions of local government and prepare plans and implement schemes 'for economic development and social justice'. The Panchayati Raj Institution (PRI) consists of three levels: 1. Gram Panchayat at the village level, 2. Block Panchayat or Panchayat Samiti at the intermediate level and 3. Zilla Panchayat at the district level. (Source: Annual report 2019-20, Ministry of Panchayati Raj, Govt. of India)

[13] The Gram Sabha is the grass root level democratic institution in each Village Panchayat. A vibrant Gram Sabha is essential for the effective functioning of Village Panchayats by promoting transparency and accountability in administration, enhancing public participation in the planning and implementation of schemes and in the choice of beneficiaries, and paving the way for social audit. (Source: Rural Development and Panchayat Raj Department, State)

The project strategized to engage with Gram Sabhas and PRIs to facilitate participatory planning and convergence, for usage of these funds for scaling up CSA. Through continuous interactions and capacity building session with the village community, the project field team established a strong rapport with the respective PRIs and the community.

Convergence related interventions in the project can be broadly divided into three phases (Figure 6.2).

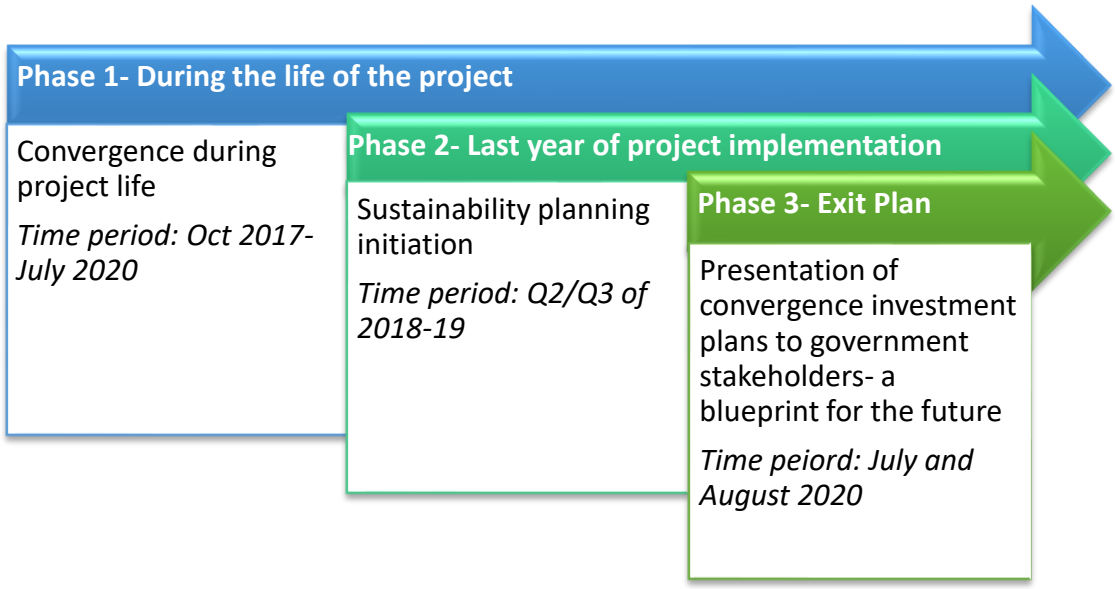

Figure 6.2: Phases of convergence initiative

6.1. Phase 1: Convergence during the life of the project

The process of convergence provides a common platform for community and local government institutions to discuss, ideate, plan and implement programs. Though, the momentum for the formation and smooth functioning of such platforms has been provided by a third party (in this case a development organization). Third party's involvement has also been instrumental in creating common understanding amongst the stakeholders. It has provided the handholding support to the community members to approach the government officials and access the government funds provided under various schemes.

6.1.1. Process

The project took the following steps to initiate convergence:

1) <u>Formation of community-based organizations</u>

   As an initiation to participatory planning, the project formed a community-based group's titled Village Climate Management Committee (VCMC). This group was firstly capacitated, to understand the issue of climate change, and the impact it might have on their lives and livelihoods. With the help of the members of the group, participatory need assessment of the community was conducted. The groups also play a key role in monitoring all activities as well as maintaining all assets created as a result of convergence.

2) Developing Participatory Village Development Plans (PVDP) at the beginning of the program

A participatory village development planning process was undertaken in each of the 75 villages. In each of the villages, a detailed participatory exercise was undertaken with men and women farmers for assessing the socio-economic and resource status to identify developmental needs concerning the prevailing climate risks. Using different types of participatory tools (natural resource mapping, food security calendar, gender issues, etc.), the process encourages involvement from all villagers to plan and prioritize areas of intervention. This process results in village/cluster development plans with agreed commitments for cost, effort and contributions of different stakeholders. The next stage is to share these plans with the Gram Panchayat for consideration and action.

3) Capacity building of community leaders

In the initial phase of the program, getting the support of the elected members of the panchayat and panchayat secretary, was a challenge. Also, meeting the quorum of the Gram Sabha was also seeming difficult. As an intervention strategy to facilitate community participation, BAIF started their meetings with the local leaders of the community, who were imparted awareness and knowledge on the aspects of climate change and its impact on agriculture, CSA approach and the role of community and local government bodies can play in scaling it. The knowledge imparted to the local leaders trickled to other sections of the community, facilitating the participation of a large section of the Gram-Sabha in the planning and implementation phase. Active involvement of the community also provided the necessary fillip to Janpad, to timely respond to the applications of the community and panchayats.

4) Preparation of Gram Panchayat Development Plan (GPDP)

With the participation of the community, a Gram Panchayat Resource Map and a Gram Panchayat Development Plan (GPDP) was prepared in consultation with Panchayat Secretary. This GPDP was then presented to the Gram Sabha for their inputs and approval.

5) Applications to government line departments

Once GPDP was passed in Gram Sabha, applications were submitted to respective government line departments at block level to request for funds and resources. From the block level, the applications go to the district level where they need to be approved by the District Planning Committee. Once approved by the DCP, it was implemented on the field. There was continuous follow up by the community representatives to ensure smooth processing of application as well as timely release of funds.

6) Implementation of development plan at the village level

The convergence happened at the panchayat level, which used the funds received from different departments to ensure implementation of the plan to meet the objectives of building resilience through climate change adaptation. Government support can be provided through different institutions including government line

departments (for application), KVKs (for technology access) and universities (for trainings).

The project has been successful in working extensively with state government line departments by way of joint field visits to partaking in coordination meetings convened by the government. And doing so has enabled the project access funds through several national flagship programs like the National Mission for Sustainable Agriculture, Kapil Dhara Yojna and Mahatma Gandhi National Rural Employment Guarantee Scheme (MNREGS). The project has managed to converge an amount of approximately Rs.3.93 crores (approx. USD 535,478[14]) through multiple schemes across the three districts during Oct 2017- July 2020 (Figure 6.3). Most of the convergence has happened in Betul district (77% of the total amount), followed by Mathura (18%) and Nalanda (5%). About 12,786 households, including 96% of the total project direct beneficiaries have benefitted by convergence in both agriculture and livestock-related activities during this period. Of these, a total of 2,022 households are indirect project beneficiaries[15]. As can be seen from Figure 5.3, an average of 93.6% of the funds has come from the government (total INR 3.67 crores) while the farming community has also contributed an average of 6.4% of the total amount (approx. INR 25.05 lakhs).

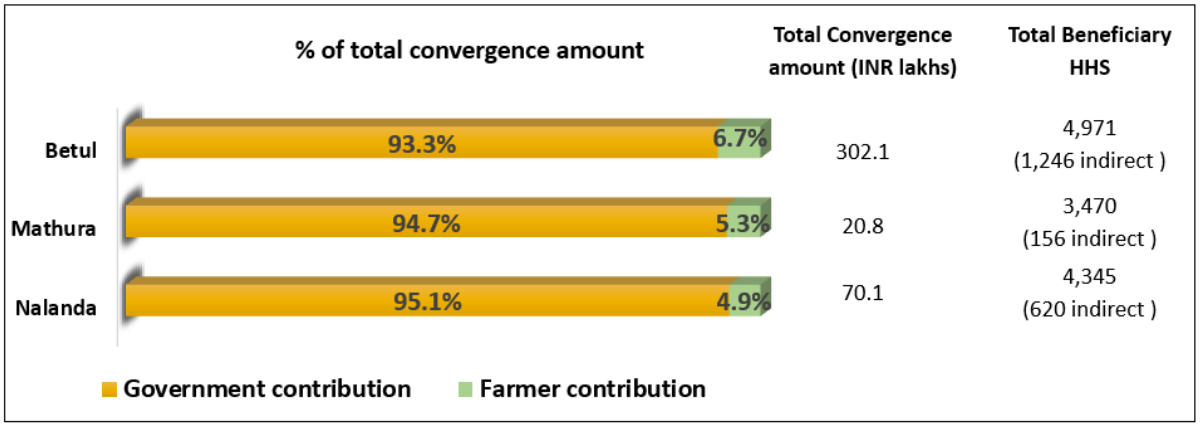

Figure 6.3: Convergence summary during the project period (2017-2020)

The convergence efforts have attempted to scale out a wide portfolio of adaptation interventions including those related to seed, water, nutrient, knowledge and energy. Water-Smart interventions (67% of total project convergence amount) have been the most investment intensive interventions converging funds from the central government's flagship MNREGA scheme. Knowledge-smart interventions (17%) followed by Seed-Smart interventions (12%) and have also been widely converged through government schemes such as Rashtriya Krishi Vikas Yojana, and Soil Health Card Scheme from the agricultural departments.

[14] ER : 1USD=73.4INR as on 10th September, 2020

15 Indirect project beneficiaries are those who were not directly benefited from the project interventions but have been benefited through convergence by participating in the process at the gram Sabha level

Majority of the convergence activities took place during 2017-2019 in Betul district while in the other two districts the convergence initiative gained momentum towards the end of the project (Figure 6.4). Water-Smart interventions such as building of ponds, check dams, wells, etc. have been the most investment intensive activity in Betul district followed by seed smart activity (new seed variety including vegetables). In Mathura, convergence activities were initiated with livestock related intervention (Energy/Carbon smart) which took place in year two and three. However, majority of the convergence amount in the district was attributed to economic support through the 'Pradhan Mantri Kisan Samman Nidhi Yojana' scheme (Knowledge Smart). Water-smart interventions in Mathura were mostly related to micro-irrigation schemes for sprinkler-based irrigation. Improved seed including those of vegetables has been the most converged activity in Nalanda followed by farmer trainings. In terms of coverage of households through convergence, however, the trends were different. Seed-smart interventions covered almost all farmers in Betul followed by nutrient smart interventions. Similarly, livestock interventions covered all 3,725 farmers in Mathura compared to only 991 households covered through Knowledge-Smart intervention.

As a unique outcome of convergence activities of the program; the project staff in Mathura has created a WhatsApp group comprised of cluster in-charge, project officer, central in-charge, government officials and project farmers for information sharing on agro and climate-based advisories. Such groups will provide information to farmers on agricultural practices, new farm technologies and government schemes on an ongoing basis. However, such an initiative is limited to farmers who have smartphones. Even with limited WhatsApp groups, through a participatory approach, there is a potential to disseminate the information to a larger group of relevant stakeholders. The potential for scalability benefits also cannot be ignored in the context of the current program as the program activities are prone to generating several positive externalities with respect to advisory services, institutions, farm training activities etc. for the entire area covered in the study.

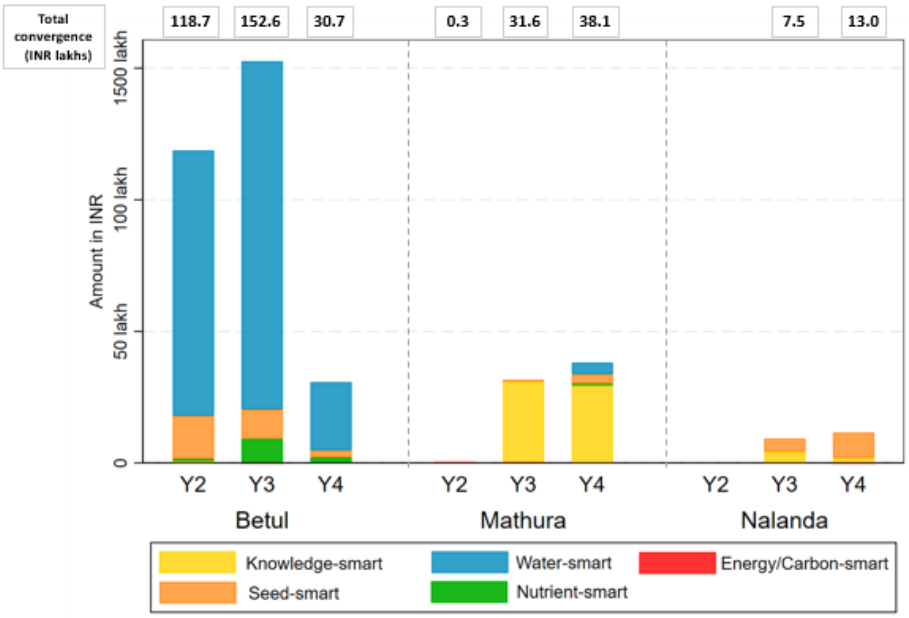

Figure 6.4: Convergence amount by types of adaptation interventions, year and state during the project period

Overall, efforts to establish convergence across all the three districts were corroborated through the endline survey as well where 93% of the respondents agreed to be beneficiaries of this initiative, while 63% also mentioned that they would be able to reach out to government officials themselves highlighting the capacity-building effects of the project interventions.

6.1.2. Water-smart interventions through convergence

Betul district has a high level of drought probability and faces climate risk of delayed monsoons during the Kharif season as well as less overall rainfall during Rabi season. Lack of water, as well as irrigation facilities, limit the regions crop production and productivity. Understanding the importance of efficient water usage, the project focused on developing water-smart interventions in the district this year. Water structures such as wells, farm ponds and check dams were constructed as detailed in Table 6.1. This intervention has benefitted 301 households by adding 143 new structures/equipments and expand the irrigated area by 182.4 hectares. Majority of the structures were financed through convergence.

Picture: (Right) Well-deepening beneficiary; (Left) Group well being constructed as a result of convergence

Table 6.1: Details of water-smart interventions in Betul

	Beneficiaries	**Number of units**	**Total area irrigated (Ha)**
Wells	80	68	44.5
Well deepening	138	138 (existing)	101.2
Farm ponds	43	43	8.1
Check dams	16	8	8.0
Micro-irrigation	24	24	20.6
Total	301	143 (new)	182.4

This was a participatory exercise involving regular discussions with farmers, water user groups, government officials as well as the local governing body (panchayat committee). Discussions with the Village Climate Management Committees (VCMCs) helped in identifying farmers based on well availability, crops grown and groundwater levels. Group wells were identified based on groundwater recharge zones. All plans for developing structures including wells, ponds, check dams, as well as the use of micro-irrigation systems such as drip irrigation, were discussed with the gram panchayat to explore options for convergence.

Story from the field: Fruits of convergence

Suresh Prasad, a farmer from Chandi Village, Nalanda District of Bihar, has been growing onions over the past many years. Though, limited production never allowed him to have a comfortable life, where he could provide quality education to his children

Picture: Suresh Prasad with his Onion harvest

As part of the project, a new variety of onion seeds were provided to him. The seeds were provided in collaboration with the National Horticultural Research and Development Foundation led program, under the convergence initiative. Besides technical guidance and support was provided. In 2018, Mr Suresh Prasad received 2 kg of onion seeds for 0.5 acres. Using these, he produced 70 quintals of onion in 0.5 acres. Which in-turn led to an income of INR 1,05,000.

6.2. Phase 2: Planning for the continuation of convergence in the last year of project implementation

As part of the sustainability efforts, the project team developed a blueprint of climate resilience plans for all 75 villages in Madhya Pradesh, Uttar Pradesh and Bihar. A detailed participatory exercise was undertaken with men and women farmers for assessing the socio-economic and resource status to identify developmental needs in relation to the prevailing climate risks. The identified needs were associated with different forms of climate resilience (Economic, Social and Environmental16). Thereafter, government schemes and departments were identified for addressing some of these key needs and requirements of the village through the process of convergence. The output was summarized by highlighting major areas of development and potential interventions that can be planned and scaled through convergence.

These plans outline areas of future intervention to make communities' climate-resilient and where possible create greater convergence with on-going national flagship programs to cope with climate variability and extreme weather events.

6.2.1. Process

The project undertook another Participatory Village Development Planning (PVDP) in Q2-Q3 of the year 2018-19 that enabled the identification of local-level challenges and needs that are essential to developing a robust and resilient agricultural system to enable farming communities to adapt to the increasing climate risk in the district. A detailed participatory exercise was undertaken with men and women farmers for assessing the socio-economic and resource status to identify developmental needs relate to the prevailing climate risks. Participatory Rural Appraisal activities were undertaken with a group of 10-12 farmers in each village over 2-3 days in the final phase of the project. These activities highlighted the key challenges and needs of the farmers within the prevailing climate risks. The identified needs were mapped with different forms of climate resilience (Economic, Social and Environmental). Thereafter, government schemes and departments were identified for addressing some of these key needs and requirements of the village through the process of convergence. The output was summarized by highlighting major areas of development and potential interventions that can be planned and scaled through convergence. Tables below (6.2-6.4) show the summary of the *Village Climate Resilience Plans* for 25 villages of Betul, Nalanda and Mathura district.

[16] Economic resilience: involves interventions that enable enhancing current and future agricultural income in a changing climate by sustaining and improving crop productivity through CSA technologies, practices and services; Social resilience: involves interventions that promote group-based approaches that support collective action and decision making can promote climate risk adaptation; Environmental resilience: involves interventions that enable efforts to mitigate overall impact of climate risks on agriculture including mitigation related interventions and resource use efficiency

Table 6.2: Summary of climate-resilient village development plans for the 25 project villages in Betul

Contributing to: Economic resilience Social resilience Environmental resilience		
DETAILS	***POTENTIAL ADAPTATION INTERVENTIONS***	***POTENTIAL SCHEMES/AGENCIES FOR CONVERGENCE***
1. High dependence on climate-vulnerable agriculture for livelihood		
• Members from about 30-66% of the households migrate for work for almost 30– 100 days in a year. • Most of the families dependent on rainfed agriculture on their own or leased land • Lack of utilization of forest products • Absence of livestock and forest-based livelihood despite potential • Insufficient employment through government schemes such as MGNREGA	• Improved agriculture training for climate-resilient interventions focusing on improving water availability and irrigation. Example promotion of improved and drought tolerant seed varieties, • Promotion and interventions focusing on improving vegetable cultivation. • Conserving the forest through collection of forest products such as wood for fuel, Mahua and Tendupatta, Chironji, Amla, Bhiriya, Lediya, Jamun, Bamboo for livelihood. • Promotion of livestock-based livelihood including cows, buffaloes, poultry, goat and pig husbandry, as well as fodder development • Skill training like masonry work, carpentry work, bamboo craft, tailoring	*Schemes:* • Tribal Area Sub Plan • National Rural Livelihood Mission *Agencies:* • Agricultural department • National Skill Development Corp • Animal husbandry Department • Gram panchayat, Zila panchayat, Janpad panchayat • National Rural Livelihood Mission
2. High gender gap in agriculture		
• Women comprise the majority of the agricultural workforce • Lower access to technology, weather and market information, and ability to take decisions on their own for women as compared to men	• Promotion of SHG based approaches such as custom Hiring Centers to provide access to machinery specifically to women farmers • Compulsory involvement of women members in trainings and capacity building efforts to improve their knowledge and awareness	*Schemes:* • Tribal Area Sub Plan • Agri-Clinics & Agri-Business Centers • Mass Media Support to Agricultural Extension *Agencies:* • Agricultural department • National Skill Development Corp • Gram panchayat, Zila panchayat, Janpad panchayat

3. High susceptibility to soil erosion, worsened by excess rainfall 		
Heavy rainfall, sloping terrain and light and murum soil make the village prone to frequent soil erosion. Factors enhancing erosion include: • Department of soil as low as 2 feet in some areas of the village and 10 feet in agriculture land. • Formation of Nalas or gullies • Less vegetation on sloping land • Absence of bunds in farmland to prevent fertile soil from erosion	Water-Smart interventions such as: • Area treatment like Soil bunds, Gully plugs, Nala plug, Check dams and stop dam construction and repair • Land levelling, farming on slopes with bunds • Plantation of trees (including WADI) and grass/fodder on slopes and bunds	*Schemes:* • MGNREGA • Tribal Area Sub Plan • NRLM *Agencies:* • Agriculture department • Horticulture department • Gram panchayat, Zila panchayat, Janpad panchayat
4. Lack of water for agricultural and drinking purposes 		
• Water table drops by 24-39 meters from monsoon to summer • Thin soil and sloping terrain enhance water run-off • Lack of enough water structures such as check dams and stop dams to conserve runoff • Insufficient hand-pumps for domestic use and absence of water supply schemes	• Watershed development program with ridge to valley approach, area treatment and the drainage line treatment consisting of reservoirs on the ridge, check-dams and nala pugs. • Creating large ponds/reservoirs for water harvesting and percolation • Recharging wells and bore well with rainwater • Promotion of the efficient irrigation system like micro-irrigation	*Schemes:* • Madhya Pradesh fund • MGNREGA • Tribal Area Sub Plan *Agencies:* • Irrigation department • Central groundwater board • Agriculture department • Horticulture department • Krishi Vigyan Kendra • Gram panchayat, Zila panchayat, Janpad panchayat
5. Under-developed animal husbandry sector 		
• Heatwaves affect animal health and productivity, impacting potential improvements in animal husbandry. • Scarcity of good quality fodder and drinking water throughout the year • Low acceptance of breed improvement methods due to lack of awareness	• Establishment of Cattle Development Centers (CDC) to promote better livestock management • Promotion of breed-smart interventions including Artificial Insemination • Promotion and establishment of climate-resilient house for cattle because safe of cattle to heatwaves. • Promotion of breed improvement	*Schemes:* • Tribal Area Sub Plan • Madhya Pradesh fund *Agencies:* • Animal husbandry Department • Private and Public Milk cooperatives • Gram panchayat, Zila

• Absence of animal health centers	through buck of SEROHI breed intervention. • Health camp for Artificial Insemination and other services. • Intervention for fodder development • Market connections through cooperatives and collection centers	panchayat, Janpad panchayat
6. Poor social development indicators		
• Health issues due to open defecation, open water near home, inadequate household water facilities and overall lack of awareness about health and hygiene • High prevalence of malnutrition among children • Lack of awareness about health and hygiene	• Effective implementation of schemes such as Swachh Bharat Abhiyan • Promotion of Vermicompost to utilize wet waste from cow dung and other household waste • Awareness camps based on health and nutrition • Promotion of vegetable cultivation • Educational interventions including improving the quality of teachers, literacy awareness among parents and computer education • Building the capacity of and empowering women-led groups to monitor the progress of social indicators	*Schemes:* • Tribal Area Sub Plan • MGNREGA • Swachh Bharat Abhiyan *Agencies:* • Education Department • Health Department

Table 6.3: Summary of climate-resilient village development plans for the 25 project villages in Nalanda

Contributing to: **Economic resilience** **Social resilience** **Environmental resilience**		
DETAILS	***POTENTIAL ADAPTATION INTERVENTIONS***	***POTENTIAL SCHEMES/AGENCIES FOR CONVERGENCE***
1. High dependence on climate-vulnerable agriculture for livelihood		
• Lack of awareness and use of improved agricultural practices • Some of the households are also involved in other diversified livelihood activities such as running local shops, daily wage labor, and auto driving. • Insufficient employment through government schemes such as MGNREGA	• Promotion of climate-resilient interventions including improved seed varieties • Promotion of Custom Hiring Centers to provide access to machinery • Promotion of livestock-based livelihood including cows, buffaloes, poultry, goat and pig husbandry, as well as fodder	*Schemes:* • Mukhya Mantri Yojana, Harit Kranti Krishi Unnati Yojana, Tanavrodhi Yojana • National Rural Livelihood Mission • Bihar Rural Livelihood Promotion Society • Agri-Clinics & Agri-Business Centers

(youth unemployment)	development • Skill training like computer course, enterprise start-up, plumber training for youth	*Agencies:* • Krishi Vigyan Kendra • Agricultural department • National Skill Development Corp • Animal husbandry Department • Gram panchayat, Zila panchayat, Janpad panchayat
2. Depleting soil health due to excessive use of chemicals		
• Excessive use of chemical intensive fertilizers and pesticides • Lack of awareness about optimum usage of fertilizers and pesticides	• Promotion of Integrated Nutrient and Pest Management Practices • Vermicomposting • Soil Health check • Use of green seeker and soil health cards	*Schemes:* • Soil Health Card Scheme • Jaivik Krishi Yojana *Agencies:* • Agriculture department • Gram panchayat, Zila panchayat, Janpad panchayat
3. Poor livestock development		
• Less availability of alternate green fodder throughout the year. • Low yielding livestock breed • Limited access to milk markets resulting in a lower return on milk sales	• Establishment of Cattle Development Centers (CDC) to promote better livestock management • Promotion of breed-smart interventions including Artificial Insemination	*Schemes:* • National Artificial Insemination Programme • Loan for dairy farming yojana *Agencies:* • Animal husbandry Department • Private and Public Milk cooperatives • Gram panchayat, Zila panchayat, Janpad panchayat
***4.* Limited water availability and delayed monsoon**		
• There is an increasing occurrence of pre-monsoon drought • Delayed monsoon often leads to shortening of sowing time for Rabi crop (due to delayed harvesting of Rice) • Declining groundwater levels • No large-scale irrigation facilities available • Insufficient hand-pumps for domestic use	• Promotion of water-saving technology Direct-Seeded Rice, System of Rice Intensification (SRI) and Alternate Wetting and Drying (AWD) • Promotion of Zero tillage practice to complete Rabi sowing on time • Construction of domestic water infrastructure • Watershed development program with ridge to valley approach, consisting of reservoirs on the ridge, check-dams and nala plugs.	*Schemes:* • National Rural Livelihood Mission • MGNREGA • Jal Jeewan Hariyali Yojana *Agencies:* • Irrigation department • Agriculture department

	• Creating of large ponds/reservoirs for water harvesting and percolation	
5. Poor social development indicators		
• Non-availability of health facilities • Lack of awareness regarding social security schemes	• Construction of health infrastructure • Awareness generation of government schemes • Building the capacity of and empowering women-led groups to monitor the progress of social indicators	*Agencies:* • Health Department

Table 6.4: Summary of climate-resilient village development plans for the 25 project villages in Mathura

Contributing to: resilience Economic resilience Social resilience Environmental		
DETAILS	***POTENTIAL ADAPTATION INTERVENTIONS***	***POTENTIAL SCHEMES/AGENCIES FOR CONVERGENCE***
1. High dependence on climate-vulnerable agriculture for livelihood		
• High dependence on rain fed agriculture. • Lack of awareness regarding subsidized seeds and government schemes related to agriculture. • Absence of knowledge of low-cost technologies for the agriculture management • Absence of livelihood for youth despite greater potential. • Insufficient employment through government schemes such as MGNREGA	• Improved agriculture training for climate-resilient interventions focusing on improving water availability and irrigation. • Awareness through village meeting regarding govt schemes for farming and seed availability. • Promotion and interventions focusing on improving vegetable cultivation. • Promotion of livestock-based livelihood including cows, buffaloes, poultry, goat and pig husbandry, as well as fodder development • Skill training like masonry work, carpentry work, bamboo craft, tailoring for youth	*Schemes:* • MGNREGA • Pradhan Mantri Kaushal Vikas Yojana (PMKVY) *Agencies:* • Agricultural department • Financial Literacy center • Animal husbandry Department • Gram panchayat, Zila panchayat, Janpad panchayat • Rural Self Employment training Institute by lead bank. • Pradhan Mantri Kaushal Kendra
2. Water scarcity as well as high salinity for irrigation and drinking purpose.		
• The water table is deep and the water in most areas is	• Efficient use of water for irrigation	*Schemes:*

saline, both for drinking and agriculture purpose. • The soil has become alkaline due to excess application of fertilizer without knowing the actual need. • Lack of any big structure such as pond, lake for water storage. • Intermittent flow of canal water (only three months a year)	• Promotion of micro irrigation such as drip and sprinkler. • Adequate application of fertilizers after soil and water sampling (Integrated nutrient management). • Groundwater recharging structures construction and rooftop rainwater harvesting.	• MGNREGA • Soil Health Card Scheme • Micro Irrigation yojana *Agencies:* • Irrigation department • Central groundwater board • Agriculture department • Krishi Vigyan Kendra • Gram panchayat, Zila panchayat, Janpad panchayat
3. Unavailability of Fodder for livestock and adverse effect of saline water on livestock health and fodder production.		
• Saline water consumption affects animal health and productivity, impacting potential improvements in animal husbandry. • Scarcity of good quality green fodder and drinking water throughout the year. • Unavailability of pastureland and the problem of free grazing • Absence of animal health centers. • Lack of cattle milk collection facility/centers • Lack of awareness regarding government Schemes	• Establishment of Cattle Development Centers (CDC) to promote better livestock management • Health camp for Artificial Insemination and other services. • Intervention for fodder development such as Hybrid Napier, Makkhan Grass etc. • Market connections through cooperatives and collection centers.	*Schemes:* • Uttar Pradesh Gau gram scheme • National Artificial Insemination Programme • Loan for dairy farming yojana *Agencies:* • Animal husbandry Department. • Private and Public Milk cooperatives • Gram panchayat, Zila panchayat, Janpad panchayat
4. Poor social development indicators		
• Health issues due to open defecation, lack of proper drainage on either side of road consequently open water near home, inadequate household water facilities, lack of awareness about health and hygiene • High prevalence of malnutrition among children	• Installation of a toilet in each house as a part of Swachh Bharat Mission. • Promotion of Vermicompost to utilize wet waste from cow dung and other household waste • Awareness camps based on health and nutrition • Solar street lights can be installed.	*Schemes:* • MGNREGA • Swachh Bharat Abhiyan *Agencies:* • Health Department • Agriculture Department

6.3. Phase 3- presentation of future climate-smart investment plans at the time of exit

To enable achievement of the climate-resilient development pathways, highlighted by the village level climate resilience plans developed in phase 2, a detailed district convergence plan document was shared with key government stakeholders highlighting investment required, convergence potential, interventions to implement and government schemes that can be leveraged for convergence to achieve the targeted interventions in the next 1-2 years after project closure.

The project has proposed a financial plan for convergence of approximately INR 6.1 crore for the 75 project villages (Table 6.5). Out of this, 5.7 crores (93%) can be utilized from existing government schemes and programmes. It is anticipated that the below plan can be implemented within 1-2 years in the project villages. The plan also highlights a gap of 7% (INR 41.6 lakhs) between the total amount required and the support available from the government. This indicates a potential for collaborative efforts between the government departments and private agencies, NGOs and development funds to partake in this activity (by way of co-financing and replicating existing plan) and further strengthen as well as scale out the convergence process in and beyond these villages.

Table 6.5: Summary of the convergence action plan for the 75 project villages in the three districts

State	Total investment required	Leverage from government schemes and programmes	Co-finance (Farmers/ development sector organizations /private agencies)
Betul	₹ 2,13,22,500	₹ 1,88,80,000	₹ 24,42,500
Mathura	₹ 1,25,64,500	₹ 1,09,69,225	₹ 15,95,275
Nalanda	₹ 2,69,64,080	₹ 2,68,45,088	₹ 1,18,992
Total	₹ 6,08,51,080	₹ 5,66,94,313	₹ 41,56,767

Mapping district level climate requirements with investment levels and overlaying it with on-going government schemes gives a very clear pathway for potential investors. The district-level convergence plan is a blueprint for potential investors from the public and private sector to take decisions around the kinds of climate-smart interventions that are required at the district level and the associated costs for funding such interventions.

These plans were presented in three district level workshops to seek feedback from these government stakeholders on the process of convergence and to encourage them to

participate in this activity in the near future. These were organized as online meetings with the relevant officials during July and August 2020.

These plans received positive feedback from the stakeholders. Mathura stakeholders emphasized on the need to expand project interventions by focusing on backwards regions of the district, through collaborations with KVKs and other agencies for training and knowledge dissemination, by the promotion of custom Hiring Centers and linking them with the market. The need to scale out interventions through farmer groups and Farmer Producer Organizations (FPO) was also emphasized upon by Nalanda government officials. They also showed their interest in continuing interaction with farmers, especially for improved seeds for vegetables and livestock related interventions. Betul government stakeholders also expressed their willingness to continue providing support to project farmers in the form of trainings, especially for women farmers, as well as livestock development related interventions. The institution of CHC was highlighted as an innovative model and it's potential to be scaled out in other parts of the district to help farmers access agricultural technology. The feedback received is indicative of positive action to implement these plans and the project, therefore, is hopeful of them being achieved in the coming one to two years.

Across all these stages, the implementing agency (BAIF) played a key role in the facilitation of meetings, and capacity building of village community, community organizations (VCMV, CHC, farmer groups), gram panchayat members, government line departments, and community resource person. Liaising with the government departments in the initial stages was also a key activity for the agency.

The process of convergence aims at sustainability of current adaptation interventions by trying to achieve several positive developmental outputs. These interventions, however, come with varying costs and economic impacts and their implementation requires a more integrated approach and well-defined action plans developed at the local level with the engagement of local government bodies. The process of convergence, therefore, provides a common platform for community and local government institutions to discuss, ideate, plan and implement adaptation programs to build and strengthen community resilience to climate risks.

6.4. Encouraging participation

Private and government stakeholders were regularly asked to visit project demo sites, participate in farmer fairs and stakeholder workshops organized by the project as well as be involved in interactions with farmers through trainings.

- Different forum like *Kisan mela (Farmer fairs)* also involved government officials, where farmers exchanged their learning from the project and possible ways to do the convergence through the government schemes. Interactions of government and private players with farmers were also organized during visits by CCAFS senior project staff during the project.

> *"Attending meetings and trainings and interaction with KVKs and block officials has helped me to build a repo with them. Now we know whom to contact for getting agricultural related information or any issues related to availing benefits of a schemes" – VCMC member (village Hathkauli, Mathura, Uttar Pradesh)*

- In order to make the convergence initiative sustainable, the project organized stakeholders workshops (Kisan Sangosti) in all three districts in 2019 involving members of Village Level Climate Management Committees (VCMCs) and Custom Hiring Centers (CHC) established under the project, along with district and block level government officials (line department officials, NABARD representatives, scientists from KVK and Universities). The objective was to facilitate an independent process of convergence by encouraging village community members to take a lead in the process. The workshop focused on interactions between government officials and farmers. While the farmers shared their experiences of the project related to the adoption of CSA practices and technologies, the government officials shared future opportunities to upscale Climate smart Agriculture activity through government programs in respective locations.
- Scientists and staff of Krishi Vigyan Kendra, in particular, were encouraged to be involved in trainings of farmers for different thematic areas.

Picture: (Left) Government official visit to farmer Azola plot in Nalanda; (Right) Visit by government official to Betul Rampurmal cluster to observe project interventions

7

PROMOTING SOUTH-SOUTH COLLABORATION

7. Promoting South-South Cooperation

As part of the project, one of the objectives was to promote South-South cooperation to enable cross-border learning with other developing countries, especially Nepal and Bangladesh, on climate smart interventions that can be replicated at scale in their respective countries. With CCAFS leading the 'Climate smart Village' approach in several South Asian countries, it regularly identifies and showcases best practices/ innovations to stakeholders in the region. This objective was therefore achieved through a series of field visits, workshops and knowledge exchange programs, to give stakeholders a practical approach for implementing resilience related strategies. Two key approaches were adopted, including planned interactions with key stakeholders of South Asian countries and communication of project results to global audiences through and conferences as well as publications.

7.1. Stakeholder interaction

This component comprised four major steps as explained below;

7.1.1. Knowledge exchange program for Nepalese delegates

The South-South learning was initiated with a workshop attended by 15 government delegates from Nepal. The two-days' workshop held on 1-2 October 2018 aimed to promote knowledge sharing among different stakeholders and learning from field-based experiences between the two countries.

The first day of the workshop included a brief introduction about the need and objective of the workshop, followed by an overview of CCAFS's work in South Asia and how CCAFS can work with the Nepal government to help tackle climate stress in agriculture. Representatives from two states of Nepal, namely Gandaki and Province 5, then spoke about their plans to initiate programmes to promote climate-smart agriculture in their respective districts. Presentations by CCAFS scientists explained how best to design, implement and prioritize the investments announced by the governments focusing on three key areas; closing the yield gap, knowledge and technology transfer and developing linkages with the market and the private sector. Examples from the project sites were also shown to explain the process and expected outcomes. Participants visited Mathura (Uttar Pradesh), where participants witnessed the portfolio of interventions being implemented by the project. They interacted with the members of the all-women Custom Hiring Centre (CHC) who explained how the CHC model works to transfer technologies to farmers. Interactions with the Village Climate Management Committee (VCMC) members also highlighted the role of local farmer organizations in leading and managing multiple climate-smart interventions. A visit to the *Bajra* crop field and fodder field exposed the participants to the practices of line sowing, nutrient management, fodder management, insurance and agro-advisory which are helping farmers in improving crop yields and incomes.

The participants appreciated the guidance and knowledge shared by all stakeholders and expressed their keen interest in continuing to strengthen their relationship with CCAFS and its and local implementing partners in India. Details about the visit were shared in a CCAFS South Asia newsletter article[17]. The visit was able to promote a healthy dialogue for CSV related learnings between the participants and provide a better understanding of ongoing adaptation interventions in India through the USAID project site in Mathura. Based on a short feedback during the evaluation, the participants highlighted interest in interventions such as ICT based agro-advisory and insurance for implementation and scaling in Nepal.

7.1.2. South-South Session in Global Conference

A CCAFS South Asia regional meeting titled *"Strengthening Climate-Resilient Agricultural Systems in South Asia"* was organized in Bali- Indonesia from 6th to 7th October 2019. The meeting aspired to build as well as further strengthen the already existing institutional partnership. As the second step, of stakeholder interaction, during this meeting a 'South-South cooperation (SSC)' learnings session was organized wherein the project interventions were presented along with an insightful discussion among over 60 participants including representatives from the scientific community, government, NGOs and donor agencies from four major South Asian economies, including India, Nepal, Bangladesh and Bhutan. The session provided a platform for cross-country learnings and potential strategies for scaling out climate-smart interventions in the region. It focused on exploring the possibilities of cooperation among different organizations working in the Global South. The session was chaired by Simrat Labana from USAID-India and co-chaired by Suryanarayan Bhaskar from ICAR-India.

Key areas discussed during the session included knowledge exchange on research, and technology demonstrations on CSA technologies and practices on a common platform such as SAARC (South Asian Association for Regional Cooperation); sharing CSA success stories as well as learnings from projects with different stakeholders on a common platform; initiating cross-regional projects through collaborations with agricultural universities and governments; and exploring the potential for cross-country technology transfer, capacity building and knowledge sharing.

Overall, the session participants emphasized the need to understand geopolitical, socio-economic and spatial opportunities of each region as different areas have their possibilities. The need to involve other countries of the Global South in the discussion was also highlighted as an action point. The participants were particularly interested in several Indian project-related innovations such as commercialization of small-scale mechanization through Custom Hiring Centers, eco-system required to promote Artificial Insemination for livestock improvement, use of climate-resilient seeds, engagement with tribal communities, and convergence activities.

[17] Link: https://ccafs.cgiar.org/publications/csalp-south-asia-quarterly-newsletter-vol19#.Xi-9aWgzaUk

The evaluation of this workshop through a feedback survey highlighted that discussion on knowledge exchange on research, and technology demonstration on CSA technologies were found to be most useful by the participants who were also willing to pursue this in the near future. Additionally, all respondents agreed on the usefulness of the interactions arranged and also confirmed their willingness to participate in such forums in future.

7.1.3. Activities affected due to COVID-19

Two more activities were planned by the project as part of the South-South stakeholder interactions. However, the project was unable to complete them due to the ongoing COVID-19 pandemic and resultant lockdown and travel restrictions. These included an exchange visit for 20 Indian project stakeholders, including NGO partner and farmers, from India to Nepal in March 2020 and inviting participants from South Asian countries of Nepal, and Bangladesh for the final project workshop.

7.2. Communication to Global Audiences

7.2.1. Presentations in global and regional conferences

During the project period, the project team from CCAFS as well as BAIF have made several presentations to external scientific audiences, NGOs as well as the private sector (Table 7.1). These presentations have helped in igniting interest about project interventions especially those related to the institutions of Custom Hiring Centers and the overall approach to involve women across activities in Betul district. The livestock-based intervention of Artificial Insemination has also generated some interest. Below are some key workshops and conferences where project related results were presented:

Table 7.1: List of presentations

Theme of presentation	Workshop/Conference details
Gender integration through institutional approach in CSVs	'The 5th Global Science Conference on Climate-Smart Agriculture', October 2019, Indonesia
Project results related to resilience framework	'Strengthening Climate-Resilient Agricultural Systems in South Asia', CCAFS Regional Workshop, October 2019, Indonesia
Best practices of project in Betul district	Regional workshop, February 2020, ICIMOD, Nepal

7.2.2. Representation in international and regional publications

Besides, several newsletter articles have been produced highlighting project activities and circulated amongst CCAFS partner organizations in South Asia. These include scientific community members, NGOs, Private sector players and government representatives from countries including India, Nepal, Bangladesh and Sri Lanka among others. Additionally, the project site of Betul has been represented as a case study in multiple international publications. These have also helped in showcasing the project activities to neighbouring countries and encourage further discussions on scaling CSA interventions.

Some high impact publications include the following:

- CARE publication titled 'Gender Transformative Adaptation From Good Practice to Better Policy', 2019. Available online at https://reliefweb.int/report/world/gender-transformative-adaptation-good-practice-better-policy
- Huyer S, Gumucio T, Tavenner K, Acosta M, Chanana N, et al. (2020) From vulnerability to agency: gender equality in climate adaptation and mitigation. In R Pyburn & A Van Eerdewijk (Eds.), Advancing gender equality through agricultural and environmental research: past, present and future. IFPRI, Washington, DC
- Sophia Huyer and Tatiana Gumucio. Going Back to The Well: Women, Agency, and Climate Adaptation. World J Agri & Soil Sci. 5(3): 2020. WJASS.MS.ID.000611. DOI: 10.33552/WJASS.2020.05.000611.
- Arun Khatri-Chhetri and Nitya Chanana, 2019, Empowering Women Farmers for Climate Change Adaptation, Agriculture World Magazine, April edition

Overall, project related innovations like commercialization of small-scale mechanization through Custom Hiring Centers, eco-system required to promote Artificial Insemination for livestock improvement, engagement with tribal communities (especially women farmers), and convergence activities have generated interest among the participants of these activities. The project team is hopeful that its efforts will promote a better understanding of its approach and learnings to its participants of the South-South cooperation activity and encourage them to adopt similar interventions for scaling out Climate-Smart interventions in their respective regions.

8

GENDER INTEGRATION

8. Integrating gender in climate change adaptation

8.1. Approaches Adopted for Gender Integration

Gender inclusion and empowerment forms an intricate part of the project's overarching goal of building the resilience of farmer communities. All three districts are characterized by different social structure and therefore women's role in agriculture, as well as their level of participation in interventions differs across the three project districts. Throughout all stages of project implementation, conscious efforts have been taken to include women as not just beneficiaries but also as active participants across the key stages of the project. The project has adopted a systematic approach to integrating gender across the key stages of adaptation.

The project was implemented in three clusters differing in socio-economic and cultural contexts. While striving to get women participation in implementing climate-smart agriculture (CSA) approach, variation was observed in the kinds of efforts required to facilitate their engagement. The main reason for the same was the differences in a socio-cultural context. For instance, Betul district in Madhya Pradesh is predominantly tribal. Women have relatively more freedom and their engagement in agricultural operations is also traditionally high. The district also has several established self-help groups which provide a potential base for encouraging women-led activities. Additionally, a gender and climate risk-related assessment identified the district as a hotspot having a larger proportion of women laborer's and cultivators in agriculture, while facing higher climate risk of drought, compared to other districts in the state. This was therefore the reason why the project decided to focus on this district for gender-based activities. Nalanda district in Bihar is characterized by a higher proportion of small and medium landholder farmers. While women are traditionally engaged in agriculture, the highly male-dominated social norms do not promote women's agency in both domestic as well as agricultural matters. Mathura district in Uttar Pradesh has been the most challenging cluster in terms of women participation in project activities as the rural women still practice purdah (a religious and social practice of female seclusion from public observation through concealing clothing in front of senior members of the family and outsiders). Women practicing purdah also refrain from speaking to outsiders, which proved to be a key challenge in in involving them in the project activities. High level of mechanization in recent years, further limited the role of women in the agricultural workforce.

Given this context, this section highlights key activities that were undertaken to promote gender inclusion in the project and the resulting outcomes that were achieved as a result.

8.1.1. Baseline Assessment

Gender integration in the baseline assessment primarily involves understanding the prevailing gender dynamics at both the household as well as the village community level.

The baseline survey conducted at the beginning of the project with 1,1250 farmers across the three districts also included questions related to gendered decision making in agriculture and livestock. It highlighted that the majority of agricultural decision making in the project areas was done by only male (61% households) as compared to only females (3% households), except for Betul. In Betul, with most of the farmers belonging to tribal communities, women enjoyed relatively higher levels of freedom when it came to decision making in the families, with 68% of households citing joint decision making. In Mathura and Nalanda, on the other hand, 77% of households agreed that male household heads made decisions on agriculture related activities. In both areas, women's participation in decision making on agriculture related activities was very low (below 8%). A similar pattern of decision making was observed for livestock production related decision making in the project areas. In the tribal communities of Betul district, both male and female farmers were involved in the decision-making process. In the other two areas, women's participation in decision making on livestock related activities was very low (below 10%). A similar pattern of decision making was observed for livestock production related decision making in the project areas. In the tribal communities of Betul district, both male and female farmers were involved in the decision-making process (76%). In the other two areas, women's participation in decision making on livestock related activities was very low (below 10%).

A separate survey was conducted to see the average labor contribution of men and women farmers in agriculture. It was found that active participation of women in agricultural activities in Betul district, where women contribute almost the same number of labor days as men in the cultivation process of all the crops. In Nalanda, women are involved more in Rice cultivation whereas in Mathura it is livestock that accounts for their maximum labor inputs. Women farmers' major labor contribution goes into transplanting, weeding and harvesting of Rice which takes up 60-70% of their total labor days in Rice crop cultivation. They also contribute more labor to value addition of crops. In Nalanda, most of these tasks are performed by hired female labor, while the women in the family supervise them. In Mathura, in term of livestock activities such as preparing the feed and curing the animal's women contribute around 50% of their daily time.

8.1.2. Adaptation Design

Women's participation and role in agricultural activities and decision-making process was considered as a basis for technology intervention design. The adaptation design focused on identification and prioritization of gender friendly climate-smart agricultural technologies, practices and services.

In Betul cluster, women actively participated in all the project activities including those which are considered more male centric. Key activities where women have actively participated are summarized in Table 8.1.

Table 8.1: List of key activities in which women participated

S. No	Key activities	Betul	Mathura	Nalanda
1.a	Institutions: Village Climate Management Committees			
1.b	Institutions: Custom Hiring Centers			
2	Promotion of CSA technologies			
3	Trainings			
4	Entrepreneurship			

The VCMCs have been formed in every village to drive the implementation of CSA interventions at the local level. In Betul district, all VCMCs are comprised of and led by women farmers. The institution of Custom Hiring Centers (CHC) has been established to facilitate technology transfer to the local community through an institutional and business-oriented approach. Managed by women farmers, these institutions also contribute to gender integration and empowerment in the farm community. Through these activities, the project has managed to involve more than 4,500 women farmers, majorly from Betul.

Women in project areas have shown high acceptance of specific CSA technologies and they have directly adopted them on their family farms. Special emphasis was given to promote these technologies and practices including Climate smart Housing for Livestock, Sprinkler irrigation, Integrated Nutrient and Pest Management (INPM), Biogas, and kitchen gardens/ vegetable cultivation.

All women super champion and champion farmers were trained in various thematic areas such as seed treatment, nutrient application, cropping practices, and water use efficiency improving technologies. Additionally, women farmers across the project locations were given sessions on the use of a recommended dose of chemical fertilizers, the inclusion of farmyard manures (organic) and preparation of organic pesticide/insecticides through several knowledge sharing sessions. Women farmers were also trained on entrepreneurship and business management to help them run the institutions of Custom Hiring Centers more efficiently. Several formats were used to provide knowledge to women and expose them to new and different techniques, practices and technologies in agriculture

(especially in Betul). These included meetings with technical experts, practical demonstrations, experience sharing and exposure visits

The promotion of activities such as capacity building in INPM, vegetable cultivation and provision of improved seeds has helped women, farmers, to take up entrepreneurial activities including the sale of vegetables, seeds as well as fodder in some cases open (Table 8.2). The institution of Custom Hiring Centers is also recognized as an activity that promotes a sense of business and entrepreneurship among the members. A total of 318 women farmers are engaged in entrepreneurial activities through 182 enterprises (mix of group and individual membership-based) and earning additional income for themselves as well as their households through project promoted activities. Women farmers from Betul comprise 55% of the total and are mostly involved in the sale of vegetables as well as seeds.

Story from the field: Multiple benefits of a single technology

Sumanti Bai, a Super Champion farmer from Betul district, Madhya Pradesh is a happy beneficiary of biogas, She says

Picture: Sumanti Bai with her Biogas plant

"As a climate-smart super-champion, I have installed a bio-gas plant behind my house and have greatly benefitted from it. I just need to use the excess cow dung as input and I get natural fertilizer and clean cooking gas as a result. Also, the smokeless cookstove has reduced my cooking time by 50%. Earlier my husband and I used to go to collect firewood and had to travel 8-10 kilometres every 2-3 days. It was difficult to procure firewood most of the times as we also had to bribe the forest officials to let us pass through. We also spent a lot of money to get fertilizer though it did not seem to have much impact on the yield. Now, I don't have to do all that. I also sell surplus vermicompost at times and earn money from that."

Table 8.2: Number of women farmers involved in entrepreneurship

	Betul	**Nalanda**	**Mathura**
Total number of micro enterprises	***117***	***61***	***4***
CHC (group)	5	42	4
Sale of organic pesticide/fertilizer (group)	2	3	-
sale of Napier fodder	5	3	-

vegetable cultivation and sale (individual in Betul/Group in Nalanda)	70	2	-
sale of seeds (individual)	35	11	-
Total number of women engaged in micro enterprises[18]	***175***	***92***	***51***
CHC (group)	41	44	51
Sale of organic pesticide/fertilizer	24	10	-
sale of Napier fodder	5	3	-
vegetable cultivation and sale	70	24	-
sale of seeds	35	11	-

8.2. Key Outcomes

Project intervention have enabled empowerment of women farmers through women-led groups, primarily in the form of increased access to climate and market information, community participation and group-based agency. Listed below are project related achievements that highlight some of the key indicators of women empowerment:

8.2.1. Improvements in agency, leadership and community participation

The participation of women farmers as part of VCMCs, CHCs as well as capacity building activities has enabled increased recognition and leadership in the community, access to knowledge and information, as well as improved participation in household decision making. They have facilitated support of the local Gram Panchayats in promoting climate-smart technologies in the village. This has also improved the representation of women in decision making and their engagement with the local government bodies which was very nominal earlier. Women farmers have increasingly shown interest in learning new skills and gaining knowledge. This has been evident through the increased participation of women farmers from 17% in Year 2 to 40% in Year 4 during the trainings conducted. The increasing participation of women has also been seen in Mathura (2% in Year 2 to 17% in Year 4) and Nalanda (18% in Year 2 to 22% in Year 4) as result of constant communication with men and women farmers about the importance of gender inclusion in agriculture.

[18] *Some members are part of both CHC as well as other type of enterprises

"Through this project, I along with my other CHC members got an opportunity to visit ATMA, Pantnagar where we were given training on mushroom cultivation. They also provided us with good quality seeds of mushroom. The training helped me and my CHC members to improve our production practices and increased in income from mushroom cultivation. Apart from this, we were also provided with a paddy trans-planter which helped us in efficient use of resources by saving labor cost and water " - **Dharmsheela, CHC Leader, Nalanda**

8.2.2. Improvement in incomes

Members of the CHCs are providing equipment on rent to other farmers and this is enabling a regular flow of income for the group. This is not only helping them to earn an income but also enabling them to build their decision-making capacity. Total rental incomes during the project period ranged from INR 26,825 in Betul to INR 59,995 in Mathura and INR 49,080 in Nalanda. Besides the income from the CHC, the regular trainings provided as part of the INPM practice is helping them to replace costly chemical-based inputs such as urea with organic and natural substitutes.

Entrepreneurship activities such as selling biopesticide products like Nimastra, Dasparni, Bijamrit in have helped women groups in Betul earn an average of Rs. 800 to 1200 per month which is being used as a capital investment for the business they have started on a small scale. Some of the women have kept their income as savings with themselves. In Betul and Nalanda, women were also able to sell surplus vegetables produced by them from the kitchen garden activity. This also added to their economic independence and stability. The average income earned in a season by a women farmer through this activity is INR 8,000-10,000.

Story from the field: A vegetable entrepreneur

With the technical help and guidance of the project team, Sulanta Brajlal, a women farmer of Betul district- Madhya Pradesh started vegetable cultivation on 0.5 acres of land behind her house. Sulanta Brajlal started growing bitter-guar and chillies in her vegetable garden via employing the acquired knowledge of sustainable farming. This reduced her dependence on the market to purchase vegetables, instead after getting her fill for the household purpose she started selling surplus vegetables in the farmers market, which in-turn led to a saving of INR 12,200. This amount was much higher than the earnings she received by cultivating maize on the same piece of land (INR 2,500).

Picture: Sulanta Brajlal with her harvested vegetables

8.2.3. Drudgery reduction

Interventions such as direct-seeded rice, bio-gas and solar pumps not only involve women's participation but also help in reducing their labor hours while enabling GHG emission reduction. Direct seeded rice (DSR) is a practice that eliminates the activity of transplanting rice, a labor-intensive activity which is mostly carried out by women. Similarly, a total of four 1HP portable solar pumps are being promoted through the CHC model in Betul. The solar pump is not only an emission smart technology but is also a tool to reduce the labor burden of women farmers. These pumps, apart from being used for irrigation of crops such as vegetables, are also being used to pump out water for domestic purposes from the village wells. Women now need to use less energy to draw water from the wells and are also able to complete the water task in a lesser amount of time. Biogas plants also have a labor reducing potential apart from reducing GHG emissions. The used of Biogas for cooking eliminates the need for firewood collection as fuel and reduces the time taken to make cow dung cakes.

8.2.4. Health Nutrition and Sanitation

Women farmers in Betul have also actively sought participation in activities related to health, nutrition and sanitation, conducted by other local agencies in their villages. For instance, women in two villages of Betul are also involved in programs such as the Water, Sanitation and Hygiene (WASH) program through which they are benefitting from access to assets and facilities such as smokeless *chulhas*, bathrooms and toilets. By participating in multiple initiatives, therefore, women are being exposed to a wide portfolio of agricultural as well as domestic interventions, thereby improving their overall life and wellbeing. Additionally, women in Betul and Nalanda have also been enthusiastic about taking up organic farming, and vegetable cultivation. These activities also help in improving family nutrition through a more diverse and healthy diet.

These outcomes are also affirmed through the endline survey where more than 85% of the respondents in Mathura and Betul highlighted a positive impact on women empowerment as a result of project interventions. These were mostly in the form of improved community participation (58%), improved confidence (13%) and increased access to new technologies and practices (11%).

The present project has displayed that integrated participatory approach of empowering women farmers via varied activities and technologies can significantly improve the condition of women farmers. Activities such as focused training, use of gender-inclusive technologies, institutional mechanisms, and promoting entrepreneurship among others are some of the major activities which have displayed an encouraging impact on the life of women farmers. They have not just made them economically independent, but have also assisted them in claiming their space, respect and vagility in the society. The results have also highlighted that all outcomes are context specific and are subjected to change based on the location in which they are applied. Socio-economic and cultural characteristics of a community largely influence the efforts required as well as the results expected for gender related interventions.

Nevertheless, replicating these efforts would offer immense scope for empowering women farmers across the country. Introducing centre and state-sponsored agricultural schemes which become the guiding book for facilitating the integration of women farmers in their programs. Various mechanism such as providing extra subsidy to women farmers, organizing women farmers' centered training at KVK, introducing/ subsidizing gender inclusive equipment and technologies can be some of the institutional changes which can be introduced in the system.

9

SCALABILITY AND SUSTAINABILITY

9. Scalability and Sustainability Pathways

Sustainability and scalability of the project have been one of the most important indices while ideating the project. Factors supporting both horizontal and vertical scaling of the project were incorporated into the project design stage itself. The project has ensured the engagement of all the relevant stakeholders to establish a sense of ownership amongst local stakeholders, especially farmers. This instilled their active engagement throughout the implementation phase as well as facilitated participatory monitoring and evaluation of the project.

The project adopted a multi-dimensional approach to ensure scalability and sustainability of project interventions to enhance the resilience of farmers and communities in the project districts of Mathura, Betul and Nalanda. This was implemented through a project life-cycle approach, commencing right from its inception to the development of a post-project roadmap for continued investments in climate-smart technologies beyond the life of the project (Figure 9.1). A combination of activities comprising of training and capacity building, technology demonstrations, cost-sharing by farmers for adoption of technologies, mentoring community-led institutions and micro-enterprise, outreach, and convergence with government programs has laid the foundations for continued uptake and out scaling of climate-smart intervention in all three project districts. CCAFS and BAIF will also continue to adopt this unique approach for scalability and sustainability of climate-smart technologies in future programs.

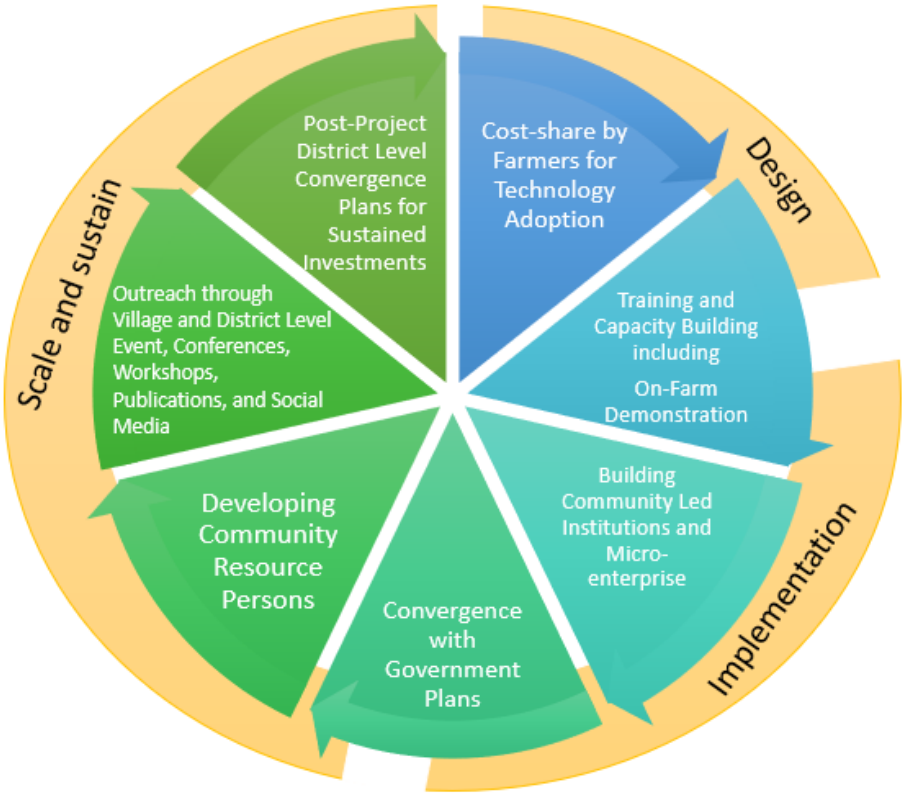

Figure 9.1: Project Lifecycle approach for scaling and sustainability pathways

In the past four years, the project has endeavoured to build the capacity of farmers and communities through various approaches to make project activities self-sustaining. The report explains these approaches through two key sections:

9.1. The CSV project model:

This section explains the approach that has been adopted by the project since its inception for promoting technology dissemination and adoption. The importance of the model is highlighted through its key components that make the project design sustainable

9.1.1. Hub and Spoke Model:

The project adopted the hub and spoke model for implementation which involves farmers as a key participant of the process. There are two levels of hubs, the Super Champion and the Champion farmers. The Super Champion is the main hub who acts as an influential supporter as well as a promoter of Climate-Smart Agriculture (CSA) technology for Champion as well as the CSA farmers. The Champion farmers are another level of the hub with whom CSA farmers can be connected. The Super Champion farmers implemented a portfolio of 15 CSA technologies related to agriculture and livestock, while the Champion farmers implemented a list of 9 CSA technologies, practices and services. The project ensured that all selected Super Champion and Champion farmers contribute a share of the technology portfolio cost that was implemented in their fields. Farmers contributed up to 25% of technology cost in their fields or households, which includes demonstration plots, installation of biogas plants, azola ponds, etc.

Several participatory activities such as farmer field visits and farmer fairs facilitated the working of the hub and spoke method. Private and government sector partnership forms a key role in providing the CSA technologies, services and related practical knowledge. Across the three districts, several private players are supplying the different technologies and services through the NGO partner, ensuring access to new technologies for all farmers on a cost-sharing basis. For instance, IFFCO Kisan Sanchar Limited provided ICT based weather, agro-advisory and market information in the villages through voice messages and SMSs to the farmers at a subsidized rate. Similarly, farmers were linked with the government's agriculture insurance scheme to help them mitigate climate impacts on crops. Similarly, institutional mechanism developed to scale-out project's interventions including the Custom Hiring Centers and Cattle Development centers provided services to farmers on a cost-sharing basis. The convergence approach has also been undertaken keeping in mind the sustainability of the project by encouraging farmers to invest in adaptation interventions while benefitting from government incentives on the interventions.

Deriving from the hub and spoke model of CSA implementation, the next section highlights resources and activities which will help sustain project interventions beyond the life of the project. Implementation of the model in a participatory manner, promoting partnerships with stakeholders beyond the farming community, and disseminating technical knowledge across platforms, are essential pathways to ensure sustainable results of the model.

9.2. Sustainability and scalability pathways:

Based on the learnings derived from the project model, this section highlights different approaches that have already been adopted as well as activities that can be continued in the future to ensure the sustainability of the project interventions beyond its life. It emphasises on both assets that have already been created in the form of knowledge, institutions and technical resources) as well as potential opportunities in the form of partnerships with agencies across the value chain is also emphasized. traditional cropping practices. This ensures the spread of knowledge and the initiation of interactive learning among the farmers.

9.2.1. Strengthening Community Ownership

Learning's from the project highlight the willingness of farmers to contribute resources to the model if it is designed as per their suitability and needs. The project has therefore ensured to work in partnership with the farming community to encourage their active involvement for successful implementation of the model itself. This will help in benefitting the 11,250 project beneficiaries beyond the life of the project.

9.2.2. Institutions

The project has promoted community-based institutions such as Cattle Development Centre and Custom Hiring Centers. In the past three years, there has been an increase in the uptake of services from these two community-centric institutions, and the project team anticipates continued usage of services from them beyond the life of the project.

- Improvements in livestock development through the Cattle Development Centers are expected to continue to benefit the farmers beyond the life of the project. These services are available not just for the enrolled farmers in the project but also for all community members. Moreover, these services can now be offered through the BAIF Sustainability Model (BSM), which ensures that the AI Technicians (a village youth) earn money through the services he/ she offers, thereby ensuring sustainable climate-smart livestock intervention. Improvements in livestock development will continue to benefit the farmers beyond the life of the project.
- Similarly, the Custom Hiring Center model has made farm machinery accessible to villagers residing in project districts. The equipment is available on rent to the entire community. These community-based institutions promote a 'business model' to seed the concept of self-reliance and entrepreneurship in rural communities. Managed by women farmers, these institutions are also contributing to gender integration and empowerment in the farm community.

In addition to these, project interventions such as vegetable cultivation, improved seeds and Napier grass cultivation has encouraged farmers who start small enterprises and earn additional income. For instance, in Betul, two groups, each comprising of 15-16 women, are selling the biopesticide products in surrounding villages and 37 women farmers are involved in vegetable cultivation and selling them in the market. These enterprises will therefore also

ensure continued interest in the adoption of these project interventions by the farmers and enable strengthening off their adaptive capacity to deal with climate risks in agriculture.

9.2.3. Community Contribution

As another step towards ensuring community participation and ownership, from the very beginning, the project has ensured that all selected Super Champion and Champion farmers also contribute a share of the portfolio cost that is being implemented on their fields. Farmers have been contributing up to 25% of technology cost in their fields or households, which includes demonstration plots, installation of biogas plants, azola ponds, etc. They have also availed services of CDC by paying up to 70% of the cost of service.

Based on the project's internal field-based monitoring, most farmers have continued to adopt improved practices during the final year of the project without project input support. For instance, 467 farmers in Nalanda adopted the Direct-Seeded Rice during Kharif 2019 while at least 500 farmers have continued to adopt improved seed and line sowing in Mathura. Enterprises formed in Betul continue to run even during the pandemic situation. Additionally, the project has managed to indirectly benefit more than 8,000 farmers majorly through interventions such as CHCs, CDC, convergence and farmer fairs.

9.2.4. Capacity Building

Throughout the project duration, farmers have been engaged in regular trainings in different formats. Apart from regular training related to adaptation implementation, farmers are also exposed to field visits or visits to the local university to gain additional practical knowledge related to both existing as well as new practices. Additionally, farmer fairs have also been organized to involve a large number of farmers and highlight the adaptation benefits to non-project farmers. Some of the women farmers trained on Integrated Nutrient Management are also increasingly taking part in teaching other women farmers. A few of them are also engaged in their businesses of selling the products. All these serve as a cross-learning platform for farmers and are enabling scaling out of the technologies and practices to neighbouring areas. The project has specifically focused on enhancing the capacity of Super champions and Community Resource Persons, who as part of the hub and spoke method, in turn, would impart awareness and knowledge to other members of the community.

9.3. Developing Partnership

This pathway emphasis the development of partnerships to scale-out project interventions in the existing project areas (horizontal) as well as with organizations across value chains to scale out through policy and other development sector players to other geographic locations (vertical).

9.3.1. Horizontal

The projects convergence initiative aims to ensure continuity of interventions within project areas by providing a platform to farmers to benefit from multiple government incentives and therefore continue to have access to the project-initiated interventions. For instance,

the participatory approach adopted to ensure smooth facilitation of the convergence process promotes collective planning and implementation among different stakeholders in the village community to enable improved management of activities and work output. Similarly, certain interventions such as those related to water management result in the creation of durable assets which continue to benefit the community for a long time. These structures also create economic opportunities when converged with schemes such as MNREGA.

To ensure the continuation of the convergence process for scaling out CSA intervention in the project districts, the project developed a three-step approach: First, development of village-level climate resilience plans for each of the 75 villages, second, sharing of these plans along with a district-level convergence plan with key district government stakeholders (highlighting investment required, convergence potential, interventions to implement and government schemes that can be leveraged for convergence to achieve the targeted interventions in the next 1-2 years after project closure), and third, conducting a district-level workshop with these stakeholders to seek feedback and to encourage them to participate in this activity in the near future.

The convergence plans suggest a total convergence of approximately INR 6.1 crore for the 75 project villages across 3 districts. Out of this, 5.7 crores (93%) can be utilized from existing government schemes and programmes. It is anticipated that the plans can be implemented within 1-2 years in the project villages. The plan also highlights a gap of 7% (INR 41.6 lakhs) between the total amount required and the support available from the government. This indicates a potential for collaborative efforts between the government departments and private agencies, NGOs and development funds to partake in this activity (by way of co-financing and replicating existing plan) and further strengthen as well as scale out the convergence process in and beyond these villages.

Schemes across several departments at district levels play an important complementary role in promoting climate change adaptation intervention at the village level. Mainstreaming adaptation into planning implementation of these can, therefore, provide a means to scale up local adaptation actions at the district level. It will provide a platform to support and channelize public and private-sector investments. It will also help adaptation to be aligned with existing long-term national, sub-regional development plans and thereby provide direct gains to the vulnerable communities. These plans therefore also highlight the potential of scaling these plans at the district level. By implementing these plans at the district level, the project promoted adaptation interventions have the potential to reach 3,247 villages covering at least 4,87,050 households (Table 9.1).

Table 9.1: Details of convergence plan for the sustainability of project interventions at the district level

District	Total investment required (INR crores)	Leverage from government schemes and Programmes (INR crores)	Potential number of villages covered	Potential number of households covered[19]
Betul	111.5	97.3	1,289	1,93,350
Mathura	43.9	38.3	874	1,31,100
Nalanda	116.9	116.4	1,084	1,62,600
Total	272.3	252	3,247	4,87,050

These plans have received positive feedback from the government stakeholders when shared during the district level convergence workshop. Mathura stakeholders emphasized on the need to expand project interventions by focusing on backwards regions of the district, through collaborations with KVKs and other agencies for training and knowledge dissemination, by promotion of custom Hiring Centers and linking them with the market. The need to scale out interventions through farmer groups and Farmer Producer Organizations (FPO) was also emphasized upon by Nalanda government officials. They also showed their interest in continuing interaction with farmers, especially for improved seeds for vegetables and livestock-related interventions. Betul government stakeholders also expressed their willingness to continue providing support to project farmers in the form of trainings, especially for women farmers, as well as livestock development related interventions. The institution of CHC was highlighted as an innovative model and it's potential to be scaled out in other parts of the district to help farmers access agricultural technology. The Feedback received during these convergence workshops appeared positive across the three districts and the project, therefore, is hopeful of these convergence plans being implemented in the coming one to two years.

9.3.2. Vertical

When scaling up vertically, we aim to ensure that the CSV practices are integrated into various schemes and programs of government and non-government agencies at the district and/or state level. These may include organizations such as NABARD, KVKs, Agricultural Universities and locally relevant NGOs/ CSR agencies. These linkages have been emphasized during be convergence workshops conducted in all the three districts and therefore show potential for promoting the project interventions beyond the project areas. There are

[19] Assuming 150 households covered per village as that is the number for which the plan has been made in the project villages

several potential opportunities for our implanting agency (BAIF) to pursue collaboration with these organizations including the following:

- NABARD: Act as a resource agency for NABARD's Centre for Climate Change and develop training modules based on our learnings and models to integrate our approach as part of their trainings.
- KVK's and Agricultural Universities: Organize visits for the organization staff to inform them about different adaptation options that can be disseminated in their regions.
- CSR agencies and other NGO: Providing technical assistance for evidence generation, impact evaluation, program monitoring, policy advocacy and capacity building for corporate houses and other non-government agencies.
- Government agencies: Engagement with government officials in the ministry of agriculture, extension department, KVK/ATMA to update communities on government programs and technological advancements related to climate change adaptation.

9.4. Promoting Outreach

This pathway highlights current communication efforts that aim to reach out to a larger audience for sharing best practices, information, and success stories from the project. It also involves integrating learnings from the project into agricultural programmes and projects of the implementing NGO partner BAIF.

9.4.1. Training and Technical Support

The processes, experiences and learnings of the implementing agency need to be captured for effective dissemination. These may be in the form of short videos of the intervention or modules for training cadre and farmers. Three types of formats may be used by the implementing agency (BAIF) to facilitate knowledge sharing with other development sector players:

a. Climate-Smart Village' concept appreciation programs: Specialized programs for sensitizing participants about the relevance of adopting holistic approaches to address climate change impacts, and application of the same across different project settings.
b. Programme based trainings: Trainings to facilitate the integration of adaptation interventions across different programmes or projects of BAIF using different formats such as orientation programs, specialized thematic trainings/ workshops, facilitation visits, and need-based trainings.
c. Planned Exposure Visits for the district-level functionaries and farmers: Exposure visits for farmers and/or government officials will be planned to introduce them to the CSV model. The exposure visit will be designed as a 'walk through' informing the participants about the different interventions, helping them understand key inter-linkages between different activities and how available resources can be used to implement a similar programme in their area.

9.4.2. Communication

The project has developed numerous digital outreach and communication materials for external audiences such as a project webpage, articles, info-notes and blogs on CCAFS website and publications which were re-printed / hosted on other websites. Other than that, the project site of Betul has been represented as a case study in multiple high impact international publications. These have also helped in showcasing the project activities to neighbouring countries and encourage further discussions on scaling CSA interventions.

Additionally, during the project period, the project team from CCAFS as well as BAIF have made several presentations to external scientific audiences, NGOs as well as the private sector. These presentations have helped in igniting interest about project interventions especially those related to the institutions of Custom Hiring Centers and the overall approach to involve women across activities in Betul district.

Several communication materials in the form of boards and messages on walls are also present in the villages and will continue to inform farmers about the project's intervention and benefits while also providing them with information. Examples of such communication can be seen in the below pictures.

Picture: (Left): Board highlighting the number of beneficiaries and key project interventions in one of the villages in Chandi block in Nalanda district; (right) Wall of Cattle Development Center in Betul district highlighting the services provided by the center

The development of partnerships to scale-out project interventions as well as with organizations across value chains to scale out through policy and other development sector players to other geographic locations have demonstrated adoption rate of climate smart technologies beyond project households. Though, it will be important to understand the accessibility and affordability two of the most important factors which impact the scalability and sustainability of intervention, even when the demand has been generated. Awareness and knowledge generation coupled with easy access and policy support point towards a strong enabling environment for both horizontal and vertical scaling of the intervention.

Story from the field: Accolades from the government

Picture: Mr. Narendra Prasad being presented with the award from the agricultural minister of Bihar state

Mr. Narendra Prasad is a Super Champion Farmer from Chandi block in Nalanda district. He has been actively involved in project activities since project inception. He participated in training and awareness programs and implemented a portfolio of interventions including improved seed variety, INPM, System of Rice Intensification, Biogas etc. Through these interventions, he has been able to achieve high yield growths (for instance, his paddy yields grew by 76% with more than 100% improvement in gross incomes for Kharif 2018-19). He also managed to get a bumper onion yield after adopting improved seed variety, use of bio-fertilizers and pesticides and other package of practices for the crop.

The news of his success spread across the village as well as surrounding areas and he was chosen to be awarded the Innovative Farmer Award (Abhinav Kisan) from Honorable Mr. Prem Kumar, Agriculture Minister, Bihar state Govt.

His success has been an inspiration for many other farmers, and he is also actively involved in mobilizing community members to adapt to climate resilient technologies promoted under the project.

10

MONITORING AND EVALUATION

10. Monitoring and Evaluation

10.1.Monitoring

Several monitoring activities were carried out on regular basis and CSA impact indicators were measured on seasonal basis through the different stages of the project implementation.

10.1.1. Implementing partner field staff visit

The partner NGO carried out frequent monitoring of the project implementation to verify the quality and performance of the project. The project field staff visited the project area daily whereas the state head of the NGO visited the project area quarterly. Besides, the NGO executive members accompanied by project officials visited and monitored project sites on regular basis. The partner NGO has their Monitoring and Vigilance cell which used to monitor and evaluate the project on the yearly basis and suggested for the improvement and make the aware the project staff for any delay or technical gap in the project implementation.

10.1.2. Review meetings

The project review meetings were held at a different periodic interval. The project review meetings were held monthly at the project location where the project manager and the thematic experts of BAIF reviewed the progress of the project and suggested and guided the field staff for the implementation. The quarterly review meetings were held in the presence of CCAFS project team, BAIF seniors and project field team which helped and resolved the queries of the project and ensured the project progress as per the plan. From the meetings and discussion, the project has made several strategic decisions including additional capacity building to strengthen woman participation, adoption of sorted semen technology and convergence of the project activities with existing government scheme which started with Betul, Madhya Pradesh and later scaled up at remaining two districts i.e. Mathura (Uttar Pradesh) and Nalanda (Bihar).

10.1.3. Report submissions

The project has regularly submitted quarterly and yearly progress reports to update USAID on the field activities and progress. Besides, the project has also prepared 11 case studies and six supplementary reports to highlight the project's key achievements across major thematic areas. These include reports on; Convergence, gender integration, sustainability and scalability pathways, business model and implementation guidelines. The reports showcase the various facets of project interventions for internal and external stakeholders These approaches and implementation pathways can be used by diverse institutions to develop Climate-Smart Villages and climate resilient programs.

10.1.4. CCAFS and USAID Field visits

CCAFS staff like the project manager and field coordinator carried out monitoring visit every month to the project locations. Additionally, the technical experts from the CCAFS visited

the project locations and guided the field team. Besides the planned monitoring and review activities by project team and CCAFS team, project's dignitaries from USAID India have also made several monitoring visits to project sites. It was notable that the visits have encouraged the farmers, partners and the other stakeholders of the project.

10.1.5. Midline Surveys

The midline survey was conducted to provide an information base against which to monitor and assess progress and effectiveness after the activities were completed in the project. The survey provided data that helped to assess project outputs, contribution to project outcomes and impacts. The specific objectives of the midline survey were; to serve as the second measure of all main program indicators as per the Performance Indicator, to highlight the project achievements since inception against the indicator targets described in the Indicators of Performance, to gather data that can inform project implementer regarding the areas that are on track or those that need further attention to achieve project outcomes. The midline surveys were conducted in all three project districts, Mathura (Uttar Pradesh), Nalanda (Bihar) and Betul (Madhya Pradesh) to capture the results of the activities in both the Kharif (2018) and Rabi (2019) seasons. In each district, 25 villages are part of the project. In each of these villages, data was collected from the Super-Champion and Champion farmers on their use of CSA technologies and practices and the resulting improvements in yields, income, resilience and the mitigation was calculated against the baseline.

10.1.6. Remote Monitoring during COVID 19:

Since, March 25th, 2020, with the announcement of nation-wide lockdown, routine operations in India were closed. With no access to labor for harvesting, vehicles for transportation and food markets for selling the produce, many small farmers faced difficulty to trade their produce in the market. During the project duration, several interventions were implemented to enhance the adaptive capacities of the farmers against climate risks. Capacity strengthening of the village-based institutions and farmers through capacity building and training and linking them to government officials and market stakeholders were a key activity in this regard. This has in turn supported farmers to better respond to the Covid-19 induced lockdown in India. The project team provided telephonic guidance and support to farmers during the lockdown period. CCAFS and BAIF remotely monitored the situation on the ground to understand how farmers / SHGs were organizing themselves to be better engaged with the markets- selling farm produce (milk, vegetables, grains, bio-fertilizers or bio-pesticides, seeds, fodder, etc.), collective purchase of seeds, and any other adaptation strategies at the farm gate while highlighting any COVID-19 related intervention that was advocated by the project team which is being adopted by farmers and communication or notification of the government shared by the project team with beneficiaries or communities during the lockdown.

10.1.7. Highlights of project de-briefing

Given the COVID-19 scenario, the closeout workshop was replaced with an online briefing by the project team to USAID on 29th September 2020 from 15:00-17:00. Project representatives from CIMMYT/BISA, CCAFS and BAIF presented the project's key achievements, learnings and scaling plan to the USAID team. Additionally, a government representative from the Agricultural Department of battle also spoke about the convergence experience. The workshop ended with a brief discussion between the participants on the scalability of the technology portfolio approach adopted by the project. The project was highly appreciated by USAID specifically for its comprehensive and detailed documentation, communication to the larger global audience on various platforms as well as the robust approach adopted, and success achieved for its convergence initiative.

10.2. Endline Survey

The project had planned for an end line survey to evaluate project outcomes. However, the Covid-19 scenario in the country, made it impractical to implement the ground-based survey. As an alternative, the team explored the option of a mobile-based survey. However, a pre-testing of the questionnaire using this method highlighted multiple challenges (such as limited time with farmers as they are busy with sowing season, network connectivity issues etc.). As the final attempt, therefore, it was decided to have a survey with a reduced scope. The phone-based end-line survey, therefore, focused on farmer experience on different aspects of the project using a short (and less time consuming) questionnaire. Additionally, it also included some feedback from key stakeholders involved. The survey was conducted with 195 project farmers capturing experiences across all categories (71 Super Champion, 79 Champion and 45 CSA). Most of the results were in line with what the project has been reporting. The intended spillover effects were also highlighted across the control groups indicates the likelihood of the program outcomes to persist in the near future. Key highlights of the endline survey are as below:

- 76% of farmers cited improved seed, short-duration varieties or stress-tolerant varieties as the primary most useful crop-based interventions adopted in the past three years. The second and third most useful intervention was Integrated INPM cited by 34% and 30% of the respondents, respectively. For livestock-based interventions, improved cattle breeds through sorted semen and AI (34%) and General AI (25%) was cited as the most useful interventions by farmers. Benefits of livestock interventions were through increased yields (92%) of milk from improved cattle breeds (General Artificial Insemination), improved livestock income (13%) and improved cattle nutrition (13%) as the second most useful outcome and improved livestock nutrition (92%) from Azola and Napier cultivations as the third most important outcome.
- As much as 90% of the respondents in each farmer category confirmed attending trainings conducted by the project. Post-training, significant changes in agricultural practices included change in sowing method (62%) and optimizing pesticide or fertilizer use (9%).

- A high percentage of respondents in Nalanda (97%) and Betul (95%) districts availed the benefits from CHC services. Due to higher attention of the program on livestock management in Mathura, the spread of these interventions remained limited to 26% in the district. The most useful benefits from availing the CHC services included improved agricultural production (45%) followed by improved access to various farming equipment at affordable rental cost as reported by 27 % farmers. Further, 41% women participants in the survey also reported increased participation in community activities and 25% cited improved confidence as an important outcome from their participation in overall project activities.
- A resounding 83 % of farmers reported using weather and other advisory services facilitated through the project. Change in sowing dates (43%) and use of natural pesticides/fertilizers (27.5%) was identified as the most useful impact from the advisory services
- In Nalanda and Betul a positive outlook on women empowerment was perceived by 89% and 86% farmers, respectively while only a handful of participants (29%) regarded the same in Mathura. Increased community participation (58%), improved confidence (13%) and access to new technologies and practices (11%) are identified as the most important impacts of project activities for women beneficiaries. These results reflect the project's level of efforts in the three districts (focus on gender in Betul and Nalanda) as well as the impacts reported in annual reports.
- A key activity that appeared to be very successful was that of convergence. Convergence benefits were reported by 93% of respondents. As much as 63% of respondents also cited that they would be able to reach out to government officials by themselves highlighting the capacity building effects of the project interventions
- The CSV interventions were aimed to enhanced productivity, profitability and resource use efficiency. To this end, the increase in overall crop and livestock productivity was confirmed by 87% of surveyed farmers, while increased income benefits from crop and livestock were reported by 89% of farmers. Availability and access to food reportedly increased for 85% of respondents.
- For the South-South Cooperation objective, a feedback survey documenting the perception of the participating stakeholders confirms that the components of livestock management, institutional building and ICT based weather and agro advisory services have generated the most interest among the participating nations and thus should be focused in more extensively in future interventions. Such interactions should also continue in future to be able to further explore collaborative possibilities, as also agreed upon by the respondents.
- The most crucial development that pinpoints the self-sustaining capacity of project interventions includes the establishment of institutions such as CDCs, CHCs and VCMCs and the notion of accountability and ownership on the part of participating farmers and other stakeholders. In addition, the cost-sharing approach for demonstration activities and entrepreneurship-based business models has generated significant incentives for the beneficiary farmers to continue their operations as envisaged during the project implementation. Convergence activities

of the project and repeated exposure and interaction of farmers/VCMCs members with government officials, private players (input suppliers) and project staff have also created a strong pathway for sustainability and adaptability of project interventions. This component of the program is crucial because it has the potential to generate strong spillover effects.

The report highlighted that overall sustainability and scalability of project interventions will be tested in the next two years as it is anticipated that farmers, Self-Help Groups and the Community Resource Persons continue to use technologies promoted by the project. The evolution and management of community-based institutions over the next two-three years could also provide interesting insights on the uptake of CSA technologies and the viability of Custom Hiring Centers and Cattle Development Centers.

The aspect of affordability of the most popular interventions was also pointed as it was felt that interventions in future may require continued support from the government or other agencies, especially for smallholder farmers. Also, given the constraints of a phone-based survey to capture quantitative estimation of impacts with the baseline figures (average income improvement of 96% and productivity improvements of 69% as reported by CCAFS in Quarterly Progress Reports and Annual Reports), the difficulty to ascertain the extent of the improved yields and incomes for the beneficiary farmers was also mentioned. Additionally, the report pointed to the importance of sustained activities to ensure that the transitions introduced during the project keep up their pace to meet the new challenges of climate change that will emerge over time.

Overall, the project was termed as an extremely important intervention that has addressed to a great extent and laid a framework to sustain these activities in future. It was noted that a literature review of quarterly reports and annual reports point to very impressive gains in yields and incomes of farmers, which was substantiated by farmers through the phone-based survey. Feedback from farmers and stakeholders has been very positive, which is indicative of successful implementation of project interventions not just in terms of improvements in yields and incomes, but also the overall strengthening of the eco-system through technical knowledge and community mobilization. This to a large extent has been made possible through a coordinated approach between a scientific organization like CCAFS and community led NGO like BAIF. It was advised that USAID commission an in-depth evaluation of the project to ascertain the impact of CSA interventions across project sites to capture the impact of this intervention, as and when possible in future. Impacts of community led approaches and convergence initiatives will make for a very interesting study on out-scaling technologies and amplifying impacts through stakeholders in the eco-system.

10.3.M&E indicators

The following tables highlight the progress and achievements during the project period based on the indicators.

Output indicators

Output indicators		Y2 (2017-18)			Y3 (2018-19)			Y4 (2019-20)			Total project	
		Target	Achieved (dis-aggregated by crop)	Achieved average	Target	Achieved (dis-aggregated by crop)	Achieved average	Target	Achieved (dis-aggregated by crop)	Achieved average	Achieved (dis-aggregated by crop)	Achieved average
Improvement in Yield Average change in yield (tons per hectare of crop land)												
	Rice	10%	136%	86%	15%	68%	61%	25%	57.8%	58%	87%	69%
	Wheat		49%			55%					52%	
	Bajra		74%			57%					66%	
	Gram		84%			61%					73%	
Improvement in Income Average change in income (Rs per hectare of crop land)	Rice	10%	148%	99%	15%	101%	98%	25%	94.9%	95%	115%	96%
	Wheat		59%			75%					67%	
	Bajra		87%			131%					109%	
	Gram		102%			87%					94%	
Improvement in Nutrient use efficiency Average change in, nutrient use efficiencies	Rice	15%	241%	106%	25%	172%	179%	50%	175%	175%	196%	140%
	Wheat		80%			247%					163%	
	Bajra		96%			268%					182%	
	Gram		6%			27%					17%	
Reduction in Emission intensity Average change in emission intensity (CO2 /ton of food production)	Rice	-10%	-83%	-56%	-20%	-64%	-55%	-25%	-63%	-63%	-70%	-55%
	Wheat		-66%			-74%					-70%	
	Bajra		-39%			-44%					-41%	
	Gram		-37%			-39%					-38%	

Notes:

- Y2 (2017-18)- results of demo plots established in Kharif 2017 (Nalanda and Mathura) and Rabi 2017 (all three districts)

- Y3 (2018-19)- results of demo plots established in Kharif 2018 and Rabi 2018 (all three districts)
- Y4 (2019-20)- results of demo plots established in Kharif 2019 (only Betul)
- Target and achieved is measured from baseline for both years

Input indicators

Input indicator	Y1 (2016-17)			Y2 (2017-18)			Y3 (2018-19)			Y4 (2019-20)		
Number of farmers/farm households who have implemented CSA technology and practices	*Super-champion*	*Champion*	*CSA*	*Super-champion*	*Champion*	*CSA*	*Super-champion*	*Champion*	*CSA*	*Super-champion*	*Champion*	*CSA*
	30	420	4,020	75	1,050	10,125	75	1,050	10,125	25	350	3,375
Number/amount of technologies or management practices under research, under field testing, or made available for transfer as a result of project assistance	*Super-champion*	*Champion*	*CSA*	*Super-champion*	*Champion*	*CSA*	*Super-champion*	*Champion*	*CSA*	*Super-champion*	*Champion*	*CSA*
	13	9	4	16	11	5	16	11	5	16	11	5
Number of acres of land under CSA technology and practice with project assistance	*Super-champion*	*Champion*	*CSA*	*Super-champion*	*Champion*	*CSA*	*Super-champion*	*Champion*	*CSA*	*Super-champion*	*Champion*	*CSA*
	30	186	2,010	205	1,305	1,431	205	1,305	1,431	68	435	477
Number of trainings, workshops, farm visits, farm fairs provided to farmers as well as stakeholders organizations	30 trainings on 10 themes			A total of 130 trainings and 20 farmer fairs during the year involving a total of 4,781 farmers			A total of 233 trainings and 36 farmer fairs during the year involving a total of 7,640 farmers			A total of 81 trainings and 28 farmer fairs during the year involving a total of 4,512 farmers		
Number of farmers or farm households have access to weather based agro-advisory, market information and agriculture insurance	3,725			11,250			11,250			3,750 (only in Betul)		

11

KEY LEARNINGS AND WAY FORWARD

11. Key learnings and Way Forward

11.1.Key learnings

The project has come up with many insights which helped the organization, community and the other stakeholders of the project to improve their skill and knowledge about the climate change and enhance their adaptive capacity to tackle the climatic risk.

- **CCAFS-BAIF partnership**: The project achievements reflect the success of an innovative partnership between an international scientific organization (CCAFS) and an implementing NGO agency (BAIF). Each partner contributed their unique set of technical and field knowledge, to mobilize and bring together various stakeholders including several government line departments across the three districts. The symbiotic relationship observed between the two organizations during the project is a lesson for the larger development community. It highlights how scientifically proven interventions can be effectively scaled out at the field level, while at the same time highlighting how local ground-based insights and impacts can also be communicated to the larger global audiences.
- **Participatory identification and design of climate resilient interventions:** The project used a participatory approach for designing the project implementation plan to ensure that stakeholders and communities develop partnerships for the long-run and that primary stakeholders (farmers) have the opportunity to provide feedback on areas for improvement. All project villages in the selected districts, promising CSA technologies, implementation methods were finalized in consultation with farmers and their groups, local government organizations and implementing partners. These kinds of participatory approaches, promote learning, program improvement, and sustainability. This project learned that majority of the farmers are keen to contribute to project monitoring and evaluation if allowed to do so in ways that suit their farming activities. As implementers, therefore, the project team needs to come in with an open mind and be prepared to listen to what the primary stakeholders have to contribute. We also need to work in partnership with community stakeholders to set expectations and brainstorm actionable steps for successful implementation of the CSV approach itself as well as the recommendations arising out of it.
- **Single vs combination of technologies/practices:** Understanding the importance of going beyond a single technology implementation model, the project designed portfolios of climate resilient technologies in the farmers' field to enhance farm production/income, improve input use efficiency and reduce greenhouse gas emissions from the agricultural activities. After the implementation of a portfolio of technology, the results show that the combination of technologies/practices can significantly improve crop yield and income and the majority of farmers are willing to implement a portfolio of technologies. Several practices and technologies were found to be complementary and enabling enhancement of results such as the use of improved seed with the seed treatment enhanced the growth and yield of the crop and reduced the soil

born disease. The endline results, however, point to the fact that the portfolio of technologies need not be a long list as seen for the Super-Champions. Implementation of few technologies including improved seed, nutrient management and agro advisory, as adopted by CSA farmers, can also be effective to enhance agricultural productivity and incomes.

- **Gender and social inclusion:** The project has displayed that integrated participatory approach of empowering women farmers via varied activities and technologies can significantly improve the condition of women farmers. Activities such as focused training, use of gender-inclusive technologies, institutional mechanisms, and promoting entrepreneurship among others are some of the major activities which have displayed an encouraging impact on the life of women farmers. They have not just made them economically independent, but have also assisted them in claiming their space, respect and visibility in the society. Replicating these efforts would offer immense scope for empowering women farmers. However, the socio-economic context plays a key role in the degree of success of such interventions. That has been a key reason for the low participation of women farmers in project activities in Mathura as well as their low technology adoption. The social norms dictating the participation of women and their role in agriculture have limited the project's role in achieving gender integration. However, further work is required to promote transformative approaches that can potentially help in overcoming the socio-cultural barriers and enable better gender integration across adaptation interventions in the district.
- **Promoting Artificial Insemination for developing resilience in the livestock sector:** To boost cattle productivity, the project has promoted Artificial Insemination (AI) across districts through Cattle Development Centers. Two types of AI are available, general and sorted semen. The chances of pregnancy through a general AI are about 50% whereas 95% in sorted semen. The two however, differ in terms of cost. General AI is being provided in all districts and accepted by the farmer over the sorted semen despite its advantages, especially in Nalanda and Betul. The key reasons for non-adoption has been lack of awareness and trust in technology. However, rigorous capacity building and awareness exercises have resulted in the commencement of adoption. The progress has been slow due to the time taken for trust building among the implementing agency and villagers, especially since the technology is new to them as well as expensive. The importance of the implementing partner's presence in the project area before project commencement has therefore been a key learning.
- **The tribal district experience:** Working in a tribal district such as Betul has been a different experience in comparison to the other two districts which are dominated by a non-tribal population. The first, and an important, step is to understand the socio-cultural settings of the tribal community before starting any intervention. This makes it necessary to work with the overall village community and give field level support continuously. Gaining trust is harder in case of a tribal population. Group based approaches are more acceptable with these communities as they operate in groups culturally as well (for instance celebrating festivals together as a community instead of individually). In terms of capacity building, exposure visits as a medium of extension is

more successful as they find it easier to adopt a strategy after seeing the results on the field instead of hearing about it during trainings. Tribal women are more active compared to women from non-tribal communities and it is relatively easier to involve them in gender focused activities. Interventions related to natural resource management (including biogas) are more acceptable, given their stronger bond with nature. All these factors were considered and incorporated while implementing the project in Betul district.

- **Lessons in institutional capacity building: '**Seeing is believing' likewise creating awareness through videos and evidence of technological adoption can enable faster mobilization of farmers for institutional formation. Showing them what other farmers are doing and what can technology help them achieve helps in convincing them better. Also, providing economic incentives related to improved incomes works as an effective incentive to adopt a group approach. For instance, women farmers took more interest in the CHC model as it provided them with an additional income source, as compared to their conventional SHGs that were formed for income saving purposes.
- **Challenges in working with the public or private sector:** It is difficult to convince the private sector to participate as their business-oriented objectives make them reluctant to enter the villages at a small scale. Similarly, with the government, it is challenging to first establish a relationship with them. A lot of continuous engagement needs to be done to convince them to participate in any capacity for the project beneficiaries. Most of the time to attract the government and private sector for the particular technology, it is important to demonstrate it at the farmer field successfully for stakeholders to be able to accept and start investing in it.
- **Convergence is key to building Climate resilience:** Schemes across several departments at district levels play an important complementary role in promoting climate change adaptation intervention at the village level. Mainstreaming adaptation into planning implementation of these can, therefore, provide a means to scale up local adaptation actions at the district level. CCAFS has developed detailed post-project convergence plans, by assessing all 75-project villages for climate adaptation and overlaying it with the types of interventions and finally aligning it to the level of investments required from on-going government programs to climate proof all three districts. These can serve as a valuable tool for communities and policymakers to guide their decisions on future resilience and livelihoods related budgeting. These post-projects converge plans should become standardized components of future resilience projects. CCAFS and BAIF are now well positioned to orient /train other government institutions as well as donor and implementing agencies on this innovative concept of developing post-project convergence plans to build resilience in the eco-system.

11.2. Way forward

Based on these learnings as well as the project team's experience over the last four years, several potential pathways can be explored to promote the project's interventions across different regions, to ensure sustainability and resiliency of the food systems towards climate risks.

The first such pathway explores the potential for public-private partnerships for scaling adaptation interventions. Opportunities to scale up public-private collaboration on building climate-resilient agriculture production systems are largely unexplored. However, benefits through public and private stakeholder relationships for farmers established during the project period highlight immense potential to further explore this nexus of stakeholders. Design of innovative investment mechanisms for CSV approach can help to leverage both public and private capital including the funds available through "Corporate Social Responsibility (CSR)" initiatives and various government schemes. This bundling of a wide range of climate investments options can also provide a more holistic and comprehensive solution to climate change impacts on agriculture, focusing not just on technology provision but also on building knowledge and skill to ensure sustainability.

A second pathway emerges from the convergence initiative which has highlighted that despite the availability of several government schemes and programmes, their utilization is still very limited. Several funds and schemes of agencies such as NABARD provide immense potential to focus on developing interventions aimed at improving the climate resilience of the agricultural systems in India. However, lack of understanding and awareness among the relevant stakeholders about targeting interventions in specific regions based on the local requirements limits the efficient utilization of these funds. Effective capacity building efforts therefore can play a key role in bridging this gap and ensuring effective convergence of funds from different government organizations. International development agencies, donor organizations and NGOs can be a key intermediary here to ensure that adequate capacity is built across research, implementation and policy stakeholders to collectively utilize the synergies offered by the public funds.

The third pathway promotes replication of the Climate-Smart Village concept through the resilience approach. The resilience framework, as highlighted by the project, has immense scope of being replicated and expanded under varied regional and socio-economic contexts. There is a need to focus on the inter-relationships and dependencies of different stakeholders across the three levels. Focusing on only one is not sufficient and therefore efforts need to ensure that benefits have positive spillovers across all three levels. While economic resilience if often the target for most interventions, it can be further enhanced through the development of social resilience, which, at the same time, can also augment environmental resilience. Future interventions, therefore, should focus on context-specific issues defined by not just the changing climate conditions but also the prevalent socio-economic and cultural systems. For this building and strengthening local level institutions can play a key role, as learnt from the project's experience during the COVID-19 related lockdown.

To summarize, the project's experience and learnings highlight ample scope to further build on the project's achievement and expand the same across other regions. The report highlights several pathways to scale out as well as sustain the current levels of project's progress made in the three districts. To ensure the security of farmer's livelihoods against climate variability, it suggests the building of resilience at different levels through a portfolio of complementary interventions. A holistic and comprehensive framework driving implementation, therefore, empowers the development of climate-resilient farming systems.

ANNEXURE

Annexures

1. Media Coverage, Communications And Dissemination

Media coverage

The article published in the local newspaper and local news channel

1. The article on organic farming and farmer workshop held in the project published in the local newspaper of Nalanda district dated 25th December 2017

2.News covering ICT based agro advisory workshop given by IKSL for Rabi crops in Nalanda in December 2017 & January 2018

जलवायु परिवर्तन एवं ग्रामीण परियोजना पर प्रशिक्षण श

3. News covering thematic trainings on Rabi package of practices conducted at Nalanda College of Horticulture in December 2017

मंथन कार्यशाला | जलवायु स्मार्ट गांव व सरकारी योजनाओं के आपसी समन्वय पर दिया गया जोर

बेहतर पैदावार के लिए कृषि वैज्ञानिकों के सुझाव को जमीन पर उतारने का प्रयास करें

जलवायु परिवर्तन से किसानी पर पड़ रहा विपरीत प्रभाव : डीडीसी

4. News cover by Nalanda newspaper about the meeting conducted with farmers and government officials in Nalanda in July 2018. This was held during USAID's visit to the project sites in the district

मथुरा

Resilient Agricultural Practices, Technologies and Services in Mathura, Uttar Pradesh

जलवायु स्मार्ट गाँव और सरकारी योजना के बीच में समन्वय हेतु एक दिवसीय किसान गोष्ठी

रिपोर्ट – सुनील भारद्वाज

देश

मथुरा

रिपोर्ट – सुनील भारद्वाज

देश

भर्ती कराया गया। गोकुल के रमण रेती आश्रम में आयो

5. The farmers meeting during Mathura field visit was covered by a local news channel

Communications and Dissemination Activities

Project webpage on CCAFS website

- A project page has been developed on the CCAFS website describing the key objectives, activities, outputs, and other related information about the project. The page can be accessed at https://ccafs.cgiar.org/scaling-out-climate-smart-village-program-vulnerable-areas-indo-gangetic-plains-india#.XY30IPkzaUk

Videos

The project video is available on YouTube as well as the project page. The links for both are as below:

- https://www.youtube.com/watch?v=Nxf97q0vF7I
- https://ccafs.cgiar.org/scaling-out-climate-smart-village-program-vulnerable-areas-indo-gangetic-plains-india#h3_3

The project was also featured in two videos made by CCAFS global team on *World Environment Day (June 5). These were shared on social media (YouTube and Twitter) as below*

- Theme-Convergence:https://www.youtube.com/watch?v=klv4cKcqxZo&feature=emb_logo
- Theme - Custom Hiring Centers (CHC): https://www.youtube.com/watch?time_continue=7&v=vjQA-khoaEM&feature=emb_logo

Publications on CCAFS website

- Khatri-Chhetri A, Pande K, Pant A, Sahin S. 2017. Scaling up resilient agricultural practices, technologies and services in the vulnerable areas of India. New Delhi, India. CGIAR Research Program on Climate Change, Agriculture and Food Security (South Asia). Available at: https://cgspace.cgiar.org/rest/bitstreams/144766/retrieve https://ccafs.cgiar.org/publications/scaling-resilient-agricultural-practices-technologies-and-services-vulnerable-areas#.W5eaqPkzaUl
- InfoNote on gender: Nitya Chanana, Arun Khatri-Chhetri, Kunal Pande and Rajashree Joshi, Integrating Gender into the Climate-Smart Village Approach of Scaling out Adaptation Options in Agriculture, Aug 2018

https://ccafs.cgiar.org/publications/integrating-gender-climate-smart-village-approach-scaling-out-adaptation-options#.W5eZLfkzaUk

Blogs on CCAFS website

- Sakshi Saini (CCAFS), Rajashree Joshi (BAIF) & Nitya Chanana (CCAFS), How CSV farmers are adapting to COVID-19 induced lockdown in India, May 2020, https://ccafs.cgiar.org/news/how-csv-farmers-are-adapting-covid-19-induced-lockdown-india#.X1ZOGHkzaUk
- Anil H. Pimpale, Sakshi Saini and Nitya Chanana (CCAFS South Asia), Reducing climate change induced water stress through the Convergence Initiative, December 2019, https://ccafs.cgiar.org/research-highlight/reducing-climate-change-induced-water-stress-through-convergence-initiative#.X1ZN3XkzaUk
- Nitya Chanana and Arun Khatri-Chhetri (CCAFS South Asia), Meeting farmers in Indian Climate-Smart Villages, Apr 2019 https://ccafs.cgiar.org/news/meeting-farmers-indian-climate-smart-villages
- Shehnab Sahin, Tending to the crying earth and the weeping shores, June 2018 https://ccafs.cgiar.org/blog/tending-crying-earth-and-weeping-shores#.W5eQe-gzY2w
- Shalika Vyas and Arun Khatri-Chhetri, Impacts of Climate-Smart Villages: A non-zero sum game, Apr 2018 https://ccafs.cgiar.org/blog/impacts-climate-smart-villages-non-zero-sum-game#.W5eQUegzY2w
- Shehnab Sahin. Oct, 2017. Women-led climate-smart village in India, all set to blaze a trial. Available at: https://ccafs.cgiar.org/blog/women-led-climate-smart-village-india-all-set-blaze-trail#.WfMcvmiCy70
- Shehnab Sahin, From trauma to triumph, Oct 2017, https://ccafs.cgiar.org/blog/trauma-triumph#.W5ePmugzY2w

CCAFS South Asia Newsletter Articles

- Arun Khatri-Chhetri and Nitya Chanana (CCAFS South Asia), Setting the stage for south-south learning, Dec 2018, https://ccafs.cgiar.org/publications/csalp-south-asia-quarterly-newsletter-vol19#.XD8T6TAzaUk
- Mansi Nagpal and Arun Khatri-Chhetri, Improving farmers' access to climate-smart agricultural technologies, Apr 2018, https://ccafs.cgiar.org/publications/csalp-south-asia-quarterly-newsletter-vol17#.W5eXHvkzaUk
- Nitya Chanana, Arun Khatri-Chhetri and Kunal Pandey, Of journeys to the field, Apr 2018, https://ccafs.cgiar.org/publications/csalp-south-asia-quarterly-newsletter-vol17#.W5eXHvkzaUk
- Arun Khatri-Chhetri, Kunal Pandey (CCAFS South Asia) and Rajashree Joshi (BAIF), A stitch in time saves nine, Jan 2018, https://ccafs.cgiar.org/publications/csalp-south-asia-quarterly-newsletter-vol16#.W5eYnfkzaUl
- Nitya Chanana, Arun Khatri-Chhetri, Shehnab Sahin and Rajashree Joshi (BAIF), Women farmers call the tune in Betul, Madhya Pradesh, Jan 2018, https://ccafs.cgiar.org/publications/csalp-south-asia-quarterly-newsletter-vol16#.W5eYnfkzaUl

- Nitya Chanana, Arun Khatri-Chhetri, Kunal Pandey (CCAFS) and Rajashree Joshi (BAIF), Flowering growth through seeds of inclusion, Jan 2018, https://ccafs.cgiar.org/publications/csalp-south-asia-quarterly-newsletter-vol19#.XD8T6TAzaUk

Magazine Articles

- High Impact Publication: National Geographic Padmaparna Ghosh, Climate-smart villages: the future of farming. June 2018. https://cgspace.cgiar.org/rest/bitstreams/154665/retrieve
- Arun Khatri-Chhetri and Nitya Chanana and (CCAFS South Asia), Empowering women farmers for climate change adaptation, Apr 2019, Agriculture World Magazine https://www.researchgate.net/publication/333395261_Empowering_women_farmers_for_climate_change_adaptation

External Publicity

- Publication titled 'Integrating Gender into the Climate-Smart Village Approach of Scaling out Adaptation Options in Agriculture' featured on ReliefWeb (a humanitarian information source on global crises and disasters provided by the UN Office for the Coordination of Humanitarian Affairs) https://reliefweb.int/report/india/integrating-gender-climate-smart-village-approach-scaling-out-adaptation-options

Other communication material hosted on other site

1. Empowering Women Farmers for Climate Change Adaptation (article in Agriculture World magazine): https://www.researchgate.net/publication/333395261_Empowering_women_farmers_for_climate_change_adaptation
2. Platforms for women result in higher levels of participation. In Gender Transformative Adaptation From Good Practice to Better Policy (Published by CARE): https://reliefweb.int/sites/reliefweb.int/files/resources/CARE_Gender-Transformative-Adaptation_2019.pdf

2. Portfolio by farmer category and expected impact

State	District	Super Champion Farmers	Champion Farmers	CSA Farmers
Bihar	Nalanda	25	350	3350
Uttar Pradesh	Mathura	25	350	3350
Madhya Pradesh	Betul	25	350	3350
Total		75	1050	10050

Technology

Technology	Which Type of Farmer? [i]	Crop/Livestock	Potential Impact[ii]	Gender & Social Inclusion[iii]
Alternative Wetting and Drying (AWD)		Rice		
Conservation furrow, Line sowing, Raised bed		Pulses, Soybean, Maize, Pearl Millet		
Crop insurance		Rice, Soybean, Pulses		
Direct Seeded Rice (DSR)		Rice		
ICT based climate information and agro-advisory services		Agriculture systems		
Improved seeds (drought/heat/disease resistant)		Major crops		
Integrated Nutrient Management (based on LCC, Green Seeker)		Major crops		
Integrated Pest Management (IPM)		Major crops		
Laser land levelling		Rice, Wheat		
Minimum tillage (zero-tillage)		Wheat, Maize, Soybean		
Rain water and irrigation management		Agriculture systems		
Solar pump		Agriculture systems		
Crop diversification		Agriculture systems		
Agroforestry, Fodder management		Livestock		
Bio-gas		Livestock		
Weather-smart housing for livestock		Livestock		
Concentrate feeding for livestock		Livestock		
Mineral mixture for livestock		Livestock		
Stress tolerant high yielding breeds of livestock		Livestock		

Productivity *Resilience* *Emission mitigation* *Helpful for Female Farmers* *Helpful for Small Holdings*

3. Environmental Mitigation And Monitoring

This Environmental Mitigation and Monitoring Plan (EMMP) describes how this project will meet the requirements of the program Initial Environmental Evaluation (IEE) and the conditions established therein, complying with USAID environmental regulations (Regulation 216 and ADS 204). The threshold determinations for this project are the following:

- Activities that are Categorically Excluded are those for which no environmental impacts are expected. The IEE establishes Categorical Exclusions for technical assistance, training, community mobilization and prioritization, risk assessments, gap and opportunity analyses, scaling up climate adaptation policies, practices, infrastructure standards and norms, and land use planning, as well as other capacity building, analysis, studies, academic or research workshops or meetings, and document and information transfers.
- However, if any topic associated with Categorically Excluded activities affects the environment, the activity would include information on how to minimize and/or mitigate environmental impacts, or the activity would be classified as having environmental risk.
- There are some activities that have very low impact on the environment but where the inclusion of mitigation measures can prevent significant impacts. Construction of water harvesting structures, use of fossil fuel in agricultural operation and other small infrastructure construction fall in this category. List of technologies that are going to implement in the farmers' field are presented in the table below

Activities	**Major Negative Environmental Impacts**	**Mitigation Measures**	**Monitoring & Reporting Activity**	**Monitoring Indicator Responsible party & Timing**	**Person responsible for implementing mitigation & Timing**
Participatory field demos of CSV interventions including distribution of adapted seeds, water management, simple precision sensors, ICT	Expansion of cultivated land, use of chemical fertilizers, pesticides and energy intensive technologies leading to increased GHG	No expansion of cultivated land, use of low carbon technology and energy efficient machines. Promotion of organic fertilizers	Review of CSA technology implementation guidelines, field visit, provision of training to the stakeholders	Inventory and records of input use and agriculture activities. Local partners Cropping season	Implementing partners, field coordinator

support on insurance, agro-advisories and market information together with insurance	emissions	and integrated insect and pest management technologies			
Strengthening the capacity of farmers producers' groups (FPOs), local organizations (community-based organizations and NGOs)	Emission from travel and waste of training materials	Avoid or reduce number of travels. Not waste of training materials	Review of training activities and reports	Number of travels, amount of training materials Local partners Quarterly	Implementing partners, field coordinator
South-south learning: strengthening the capacity of FPOs, NGOs, and local government agencies of Nepal and Bangladesh	Emission from travel and waste of training materials	Avoid or reduce number of travels. Not waste of training materials	Review of training activities and reports	Number of travels, amount of training materials Local partners Quarterly	Implementing partners, field coordinator

4. Key project staff

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The project team would also like to acknowledge the role of Dr Arun Khatri-Chhetri as Project Manager till September 2019, Ms Shehnab Sahin as Communications Specialist till 2018 and Mr Kunal Pande as Field Coordinator till 2019.

About the Project:

USAID/ India has partnered with The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), South Asia, for a four-year intervention (October 2016 – September 2020) to scale out weather-resilient agricultural interventions through the Climate Smart Village (CSV) approach. The focus was on a basket of synergistic options, rather than on single technology to improve cropping and livestock development in targeted areas as a means of enhancing resilience to climate variability. Scaling through local institutions and convergence with government programmes has been a key strategy to promote resilience building at a larger scale. CCAFS provided technical leadership and overall guidance to BAIF (an NGO) which was implementing the project on the ground. The project demonstrated a portfolio of weather resilient technologies, practices and services in 75 villages of Uttar Pradesh (Mathura district), Bihar (Nalanda district) and Madhya Pradesh (Betul district).

About CCAFS: The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), led by the Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT), brings together some of the world's best researchers in agricultural science, development research, climate science and Earth system science, to identify and address the most important interactions, synergies and tradeoffs between climate change, agriculture and food security. www.ccafs.cgiar.org.

About BAIF: The BAIF Development Research Foundation is an award-winning charitable organisation based in Urali Kanchan near Pune in Maharashtra, India, that pioneers agricultural development. It was founded in 1967 by Manibhai Desai as the Bharatiya Agro Industries Foundation.

About USAID: The United States Agency for International Development is an independent agency of the United States federal government that is primarily responsible for administering civilian foreign aid and development assistance.

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