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Promoting Crop Diversification and Improved Agricultural Technologies in Tigray Region, Ethiopia

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This Paper: 'Promoting Crop Diversification and Use of Improved Agricultural Technologies (PCDAT) in Tigray Region, Ethiopia' is based on final evaluation of JICA-funded project of Sasakawa Global 2000

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ACRONYMS

ARD	Agriculture and Rural Development
APC	Assistant Project Coordinator
ARCs	Agricultural Research Centers
BoARD	Bureau of Agriculture and Rural Development
BoPED	Bureau of Planning and Economic Development
DAs	Development Agents
EAs	Extension Agents
FLPs	Farmer Learning Platforms
FHHs	Female Headed Households
FTCs	Farmers' Training Centers
GDP	Gross Domestic Product
GTP	Growth and Transformation Plan
HHs	Households
JICA	Japan International Cooperation Agency
JPP	JICA Partnership Program
MELS	Monitoring, Evaluation, Learning and Sharing
MoA	Ministry of Agriculture
NARES	National Agricultural Research and Extension Services
PO	Program Officer
PCDAT	Promoting Crop Diversification and Advanced Technology
PM	Program Manager
PNA	Participatory Needs Assessment
PPP	Public–Private Partnerships
PTPs	Production Test Plots
SAA	Sasakawa Africa Association
SAEDE	Strengthening Agricultural Extension Delivery in Ethiopia
SG2000	Sasakawa Global 2000
SPSS	Statistical Package for Social Sciences
TARI	Tigray Agricultural Research Institute
TDC	Talent Development Consultants
ToR	Terms of Reference
TOPs	Technology Option Plots
WADs	Woman Assisted Demonstrations

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Caveat: All views expressed in this report, commissions and omission are the responsibility of the authors and are neither that of SAA nor SG2000 – Ethiopia.

Executive summary

This evaluation assessed and presented achievements, outcomes, impacts and challenges of a project entitled "Promoting Crop Diversification and Advanced Technologies in Tigray (PCDAT)" which was implemented in some parts of Tigray Region, Ethiopia. PCDAT was a four-year project, July 2011 - July 2015, implemented by the PCDAT project team of Sasakawa Global 2000-Ethiopia based in Mekele in close collaboration with the Tigray Region al Bureau of Agriculture and Rural Development (BoARD) with a financial support from Japan International Cooperation Agency (JICA) under JICA Partnership Program.

The final evaluation was undertaken in March 2015 to examine the successes and challenges of the PCDAT project during its four years project life. The project covered 24 Kebeles in six Woredas in Tigray Region, Ethiopia. The six Woredas were from three of the total six administrative zones of the region- Tsegede and Welkait Woredas in the Western Zone, Tahtay Koraro and Tselemti, in the Northwestern Zone, and Alamata and Raya Azebo Woredas in the Southern Zone of Tigray Region. The project aimed to improve crop productivity and income of smallholder farmers in these Woredas.

The evaluation attempted to measure achievements and outcomes of the PCDAT; assessed processes, strengths and challenges of project implementation; and identified lessons learnt that can be scaled-up in other Woredas. The evaluation was undertaken at three levels; at the Woreda, kebele and farmers' levels. The evaluation started with review of relevant documents, developing three sets of questionnaires, and continued to interviewing partners and stakeholders and conducting selected case studies. Three Woredas were selected for the evaluation, taking one kebele from each to randomly select farmers for the farmer level data.

Results of the evaluation indicated that good partnership was established between implementing organizations – mainly SG 2000, BoARD and Tigray Agricultural Research Institute (TARI) - that led to effective implementation of project activities. SG2000-Ethiopia used a value-chain oriented extension model, which properly followed the chain from crop production to marketing, and benefited from the collaboration with major partners. The project management and coordination enabled PCDAT to effectively implement activities according to plan and contributed for achieving the desired outcomes of the project.

Relevance

Low agricultural productivity, and thus, food insecurity was one of the major problems of target project Woredas. The PCDAT project was designed and implemented considering the above major developmental problems. Needs assessments were conducted to identify and prioritize project activities and suitability of the agro-climatic conditions to grow rice and other crops. Project sites were selected with good accessibility and having sufficient EAs to implement project activities. Considering the development challenges in the project areas and following farmers' needs, the project introduced new crops such as rice, green gram, soya bean and sunflower, and promoted diversifications, along with improved agronomic practice on other local crops such as sorghum, *teff*, sesame, figure millet and wheat. Furthermore, improved

postharvest technologies for rice and the other food crops was promoted and market linkages created to solve marketing problems.

In a nutshell, the project was designed based on felt needs of beneficiary farmers and in line with developmental priorities of the project areas. According to the discussions held with the Woreda level partners in particular, it has been clearly indicated that the project was demand driven from the outset. Additionally, there was joint planning with major partners of the project, particularly woreda and kebele level agricultural offices. Generally, the relevance of the project had sufficiently been maintained in the process of its implementation.

Effectiveness

The PCDAT project improved crop productivity, processing and market access, and all these contributed to increased income of farmers (increased by 24% compared to baseline). Particularly, SG2000 effort in collaboration with Tigray Region BoARD have brought significant changes on coverage, productivity, utilization and marketing of rice. The project introduced and promoted new crops such as rice and green gram along with technologies such as rice millers, multi-crop threshers, seed cleaner and par-boil kit.Farmers were trained on agronomic practices and food preparation and marketing. Effectiveness of the project is further described below per major project components.

Crop Productivity Enhancement: One of the major successes of the PCDAT project was introducing new crops to the project sites. In line with its major objective, the project introduced and promoted four new crops such as rice, green gram, soya been and sunflower to 24 project Kebeles as alternative to traditionally produced existing crops. This has contributed to a change in cropping pattern and crop diversification in the projects sites, particularly through the promotion of rice and improved agronomic practices.

The evaluation showed improved skills and knowledge of extension agents and farmers in crop production. A total 13,631 farmers were trained during the past four years of the project. Almost all (98%) interviewed farmers indicated that the training sessions and continuous advices from the project and EAs have helped them to improve their farming knowledge and skills on crop production.

Crop production and productivity in the project sites has showed significant change compared to the baseline situation (2010/11). Productivity of major crops increased, on average, by about 32% and reached 2.0 ton/ha in 2014/15 (end of project) as compared the baseline when it was on average only 1.5 ton/ha. The main reasons for the change in productivity of these crops in order of importance were the use of improved technologies, adequate amount of rainfall, and attractive market prices which motivated farmers to produce more.

Use of improved technologies, including application of fertilizer with appropriate agronomic practices, has improved. SG2000 promoted use fertilizers along with improved agronomic practices using a well-managed demonstration plots. Hence, over 90% of sampled farmers reported the use DAP and Urea at least on one plot.

Postharvest and agro-processing: Awareness and skills of farmers on improved postharvest handling techniques showed a significant change compared to the situation before the PCDAT

project. The project introduced and promoted rice mills, multi-crop threshers, seed cleaner and par-boil kit. Sampled farmers reported that they received different trainings on postharvest handling, storage managements, utilization of rice mills and multi-crop thresher. A total of 4,549 farmers were trained on the use of improved postharvest handling, achieving over 100% of the project target.

The promotion of PHAP technologies created huge demand from farmers, private entrepreneurs and government partners. Tigray Bureau of Agriculture purchased six additional rice mills to provide service to farmers in the Region. One private investor and one Monastery also purchased rice mills after observing service provision of the SG2000 promoted machines. In total 6,628 farmers obtained the services of the PHAP technologies.

Despite the successes, the PHAP machines did not process (thresh or polish) enough quantity of crops as compared to their capacity and potential. Particularly use of the threshers was very low due to mainly poor repair and maintenance service. The rice mills were also processing low amount of rice compared to their potential. The main reason was lack of proper management of the machines.

Marketing and market access: The project contributed to improved marketing and market access in the project sites through providing training to 462 extension agents and 3,638 farmers, and establishing and strengthening 18 groups engaged in production and marketing. Majority of interviewed households indicated that major positive changes have been observed in the areas of market access, price of output, quality of products and income levels. The project also attempted to link farmers to potential markets, but still some additional support is required in this aspect. Market linkages were created for major crops (clearly observed for rice) in the project areas, particularly in Tsegede Woreda, and huge quantity of rice was sold to areas around Woreta town. Nevertheless, efforts in facilitating marketing particularly for rice faced some challenges due to low demand of the crop during the time of this evaluation.

Change in income and livelihood: Annual income of households in the project sites has increased by about 24% compared to the baseline level. The increment is even above the project target (20%). The increase in production of major crops such as sorghum, rice and millet, and high product price contributed for this change. This evaluation, based on selected cases, found that after the project, some households have managed to save some money and diversify their livelihood. Project farmers, benefiting from their good harvest and its sale, have bought goats for the purpose of fattening and built assets and created wealth. Some reported change in the quality of their houses and household utensils as a result of income generated from their production and marketing.

Efficiency

The project was efficient in planning and on timely implementation of the planned activities. It was important that the project office was hosted at the Tigray BoARD in Mekele and all staff except for the project manager were from the region who are well acquainted with the agro-ecology, culture and language of the target areas. Although it was the first time for SG2000 Ethiopia to establish such satellite type office, it greatly contributed to smooth information

sharing and collaboration among the team and the Bureau. Particularly, planned activities in the areas of training were undertaken at different levels in close collaboration with Regional, Woreda and kebele level project participants. There was also a periodic monitoring and evaluation of the project which facilitated achievement of the intended outputs and outcomes. Key informants indicated that the process of implementation of the project was up to the expected level. The project started immediately, fulfilling all the necessary preconditions, such as allocating required budget and office space, and recruiting required personnel. Flow of project inputs such as finance, equipment, agricultural inputs and others, was efficient, according to discussions held with partners and implementing staff. Planned activities of the project were accomplished with in the allocated budget and time frame. Furthermore, implementations of activities utilized efficient collaboration with the primary implementing partners.

Sustainability

The project has been on sustainable path as evident in the major indicators including the demand created among farmers for the new crops and technologies, improved local capacity in service provision and scaling up efforts of the government.

The project has introduced new crops and promoted improved varieties of existing crops. Good level of demand was created among farmers both in terms of acceptance of the new crops for consumption as well as in using the improved technologies. Improved agricultural technologies (including postharvest machines) were also promoted to the project Kebeles. Project beneficiaries were provided with quite relevant trainings. From both the trainings and practical experiences, farmers reported that the benefits gained and the learnings, skills and results from the project need to sustain overtime.

The capacities built at Woreda and kebele levels also play a very important role for the sustainability of the project. The institutional arrangements, i.e., the partnership and the practical involvement of three Agricultural Research Centers (ARCs): Alamata, Humera and Maytsebri can be mentioned as the other areas that facilitated sustainability of implemented development activities.

Major partners of the project were well informed about the phase out of the project, and they were prepared to take up some of the best practices of the project. Almost all partners confirmed that the introduced crops and technologies would continue in the future even beyond the project life. Important steps have been undertaken by Tigray Bureau of Agriculture by incorporating plan of scaling up of the new crops particularly green gram, soya bean and N13 rice.

Despite the successful sustainability path, high turnover of extension staffs is a serious challenge which requires attention for the purpose of sustaining the recorded success stories and results of the project.

1. Introduction

Sasakawa Africa Association (SAA), through its country program of the Sasakawa global 2000 – Ethiopia (SG2000) worked for several years in the National Regional State of Tigray. SG2000 supports the country agricultural extension system through capacity building, promoting new and improved agricultural technologies and operationalizing Farmer' Training Centers (FTCs) at *kebele* levels. SG2000 works in partnership with differ partners, mainly MoA and research centers and the BoARDT. The capacity building mainly involves training of Extension Agents on improved agricultural technologies and practices.

Increasing crop diversity by introducing new crops improves risk management and reduces yield variability in the long-term. A more stable farm production certainly improves food security and allow for better planning of future development activities. These factors eventually contribute towards better livelihood conditions of farming households and stimulate development. In line with this, SAA introduced a project, called Promoting Crop Diversification and Advanced Technology (PCDAT), which was officially launched in July 2011 to fill the observed development gaps and complement the country plan for crop diversification and agricultural production.

The PCDAT project was a four-year project, from July 2011-July 2015, implemented in Tigray Region by the PCDAT project team of Sasakawa Global 2000 – Ethiopia based in Mekele in close collaboration with BoARD of the Regional Government of the National State of Tigray. The project was funded by JICA under JICA Partnership Program.

1.1. Socio-economic background of Tigray Region

Tigray, the target Region of the PCDAT project is located in the northern part of Ethiopia. It consists of six Zones: Western, Northwestern, Central, Eastern, Southeastern and Southern. Mekelle city is also taken as special Zone.

Tigray is one of the Regions that face unreliable climatic conditions. It is a semi-arid Region characterized by long dry season, with the main rainy season that goes from June to end of August. Some parts of the southern and eastern zones have bimodal types of rainfall pattern with short rains that come between February and April. Rainfall distribution is characterized by high temporal and spatial variability with annual precipitation ranging from 450 to 980mm. The Region has diverse soil types. One of the most widespread soil types is the vertisol, which has high clay content and becomes rapidly water-logged particularly in the rainy season rendering it unsuitable for most crops grown in the Region. Therefore, the introduction of crops cultivable on these soils could have an important impact on the agricultural productivity of the Region (Hagos *et al.,* 1999).

The major constraints that have affected the economic development of the Region are:

- Limited access to arable land;
- Limited access to markets, inputs and technologies;
- High population growth and high incidence of absolute and relative poverty;
- Frequent drought and high dependency on rain fed agriculture in areas with high rainfall;

- Very low literacy level among rural population (15 percent having some formal education but only 7 percent with some basic literacy skills (Pender and Gebremedhin, 2004).

Low agricultural productivity in the Region is attributable to the low productivity of labor and low application of fertilizers and low levels of adoption of productivity-enhancing technologies (Woldehanna, 2000; Pender and Gebremedhin, 2004). This is directly related to the drought-prone nature of the area and the uncertainty about rainfall, which increases the risk associated with the use of external inputs. The average household level production in the Region (which is 660 kg) covers about 38 percent of the annual food demand of an average household and only about 17 percent of the households are food self-sufficient (Hagos *et al.*, 1999). Such low productivity is also reflected in the high incidence of poverty, which in the Region is even far above the national average. About 45 percent of the rural population and 37 percent of urban population live below the nationally defined poverty line.

Raising productivity with simple low-cost technologies and improving skills and knowledge of small-scale farmers will increase the adoption of novel development interventions and have beneficial effects on the development of the Region. Encouraging farmers to use improved technologies and cultivate crops will improve agricultural productivity. Hence, agricultural extension and capacity building of farmers would result in significant advances in food security, economic crop production and income generation.

1.2. Issues and needs of the local people

Agricultural development which is resilient to climatic change and social unrest is very crucial in Tigray Region. Drought is one of the major challenges of the Region. Further, the Region had been affected by social unrest during the border conflict with Eritrea. Although the situation has considerably improved in the last few years, the Region is still missing investment opportunities and infrastructural development in all economic and social sectors and major in the agricultural sector. Such factors have affected economic growth and particularly, agricultural development in the Region. Hence, one of the most important development needs of the people in the Region is to increase agricultural productivity and implement cropping systems that is resilient to periodic biotic stress events such as droughts or nutrient deficiencies. This enables the local farmers to produce their subsistence requirements in terms of quantity and quality.

1.3. Promoting Crop Diversification and Advanced Technologies in Tigray (PCDAT)

Promoting Crop Diversification and Advanced Technologies in Tigray (PCDAT) project aimed to empower and enable farmers in targeted kebeles to improve their food security and overall livelihood situations. The project has promoted improved agricultural technologies. It mainly intended to increase crop diversity through introducing 'new' crop varieties and strive to improve production and productivity of crops in Tigray. The project also promoted improved technologies on existing crops. Identification and introduction of crops with better yields and high nutritional values that could improve the diet, feeding quality and income of the farmers

were some of the major interventions of the project. While implementing the project, SG2000 has worked very closely with research centers and extension workers of the MoA.

Objective of the PCDAT

The overall objective of PCDAT was to improve crop yield and income of the smallholder farmers through enhanced crop-diversity, use of improved technologies and marketing strategies. It followed the value chain approach of SG2000 - Ethiopia, which included interventions that range from crop productivity improvement up to agro-processing, storage and marketing of the products of the target crops. To realize this purpose, the project had set several objectively verifiable indicators that are listed below.

- Introduce at least 3 new crops and support to be cultivated by more than 3000 farmers in the target areas;
- Introduce crop production enhancing technologies for the traditional crops and support to be used by about 3000 farmers in the target areas;
- Increase crop yields of targeted farmers by more than 30% compared to the beginning of the project;
- Increase household incomes of the target farmers by at least 20% compared to the beginning of the project;
- Train at least 2000 farmers on the use of improved agro-processing or storage technologies for rice and alternative crops;
- Support at least 500 farmers to use improved agro-processing or storage technologies for rice and alternative crops;
- Train at least 500 farmers in marketing and other related topics on the production of rice and alternative crops; and
- Establish and/or strengthen at least 20 producer groups on rice and alternative crops.

Implementation and management

Sasakawa Africa Association (SAA)/SG 2000 Ethiopia has received grant from JICA Partnership Program to implement the project. Project implementation was done in partnership with the Ministry of Agriculture (MoA) in general and the regional BoARD, in particular. For the implementation of the project, six Woredas were selected. The project commenced in June 2011 and run for a period of four consecutive years up to July 2015. The project has four major area of interventions (Themes): namely; Crop and Livestock Production Enhancement (Theme 1), Postharvest and Agro Processing (Theme 2), Public Private Partnership and Market Access (Theme 3) & Monitoring, Evaluation, Learning and Sharing Themes (Theme 5).

SAA/SG 2000 management provided leadership support. PCDAT project staff include one Program Officer (PO) assigned for each Theme (four Themes (area) of interventions), Assistant Project Coordinator (APC) and Project Manager (PM) who were placed in Mekelle.

For the realization of project objectives, different new crops such as rice, green gram, soya bean and sunflower had been introduced to the operational areas. Other local crops such as sesame, *teff* and sorghum, etc. were also promoted. Together with these, improved

technologies like fertilizers, row planting, weed control, threshers, seed cleaners, par boiling of rice and storage had been introduced. Different training sessions were organized and conducted at Woreda, kebele and the farmers' levels on improved agricultural technologies, marketing and market access and other areas.

Project sites

The PCDAT project was implemented in three Zones and six Woreda s of Tigray Region: the Western Zone in Tsegede and Welkait Woredas; the Northwestern Zone in Tahtay Koraro and Tselemti Woredas; and the Southern Zone in Alamata and Raya Azebo Woredas.

Figure 1. PCDAT project sites, Tigray Region

Major factors considered for selecting the six Woreda s were:

- Accessibility (road and public transport);
- Areas with low agricultural productivity and with problems of food insecurity;
- Availability of sufficient Extension Agents (EAs), at least 2 EAs per FTCs, to conduct project activities;
- Suitable agro-climatic conditions for the cultivation of alternative crops (rice production); and
- Willingness of Woreda s and FTCs to collaborate with SAA to implement project activities.

Such conditions had, therefore, entailed Sasakawa Global 2000 for rural development interventions through designing the PCDAT project to improve food security of households found in 24 project Kebeles of the six Woredas of the Region.

Project Components

PCDAT project consisted of four major components that included: Crop Productivity Enhancement (CPE); Post-Harvest Handling and Agro-processing (PHAP); Public–Private Partnerships and Market Access (PPP-MA) and Monitoring, Evaluation, Learning and Sharing (MELS). The four major components of the project had their respective detailed activities implemented during its lifetime. One of the major and common activities of these components of the project was capacity building through different trainings which has been conducted at Woreda, *Kebele* and farmer levels. They were implemented to build sustainable human resources in the different areas of project implementation.

Project outputs/outcomes

The project had three expected outputs/outcomes, which were aligned with the above major components of the project. The first output aimed at improving crop and farm productivity, the second at agro-processing and value-addition and the third dealt with marketing, market access and income generations. The project outputs are the following:

Output 1: The number of farmers cultivating new crops (rice and alternative crops) and traditional crops with improved technologies is increased. The objectively verifiable indicators of output 1 are as follow:

1.1 By the end of the project at least 3 new crops have been introduced to the target area and are cultivated by more than 3000 farmers.
1.2 By the end of the project at least 3000 farmers cultivate traditional crops with improved technologies in the target area

Output 2: The number of farmers using agro-processing and storage technologies for alternative and traditional crops increased. The objectively verifiable indicators of output 2 are the following:

2.1 By the end of the project at least 2000 farmers trained in the use of improved agro-processing or storage technologies for rice and alternative crops.
2.2 By the end of the project at least 500 farmers use improved agro-processing or storage technologies for rice and alternative crops.

Output 3: Organized producer groups gain market access for their farm products. The objectively verifiable indicators of output 3 on the other hand include the following three fundamental areas:

3.1 By the end of the project at least 20 producer groups established.
3.2 By the end of the project at least 500 farmers trained in marketing aspects.
3.3 By the end of the project at least 3 buyers identified for purchasing farm products from the groups.

Project beneficiaries

Different people were identified to benefit from the project. The direct beneficiaries were small-scale farmers of the targeted Woredas. It was planned that farmers would receive trainings and participate in field demonstrations of new technologies. Furthermore, it was expected that they would be frequently visited by extension staffs for training, advice and other extension supports. Special attention was also intended to be given to woman farmers organized in groups and receive trainings at the respective Women Assisted Demonstrations (WADs). So, the project has planned to work with about 3,000 farmers who would use improved production technologies in their plots of lands, and train 6,000 more. It was expected that further scaling up and scale out would be possible and eventually most Woredas of the Region would benefit from the project. In addition to that, it was planned to train about 350 extension agents directly, and they would in turn continue training other extension agents.

Process of implementation

Implementation of the project started with detailed needs assessment and baseline survey. The survey was conducted in project Woredas to have firsthand information about the existing agricultural practices; to identify farm level constraints; to understand how the interventions are fit into the farming system of the project sites; and to set benchmarks to measure the progresses of the project for impact assessments;

There was joint planning of project activities with Woreda agricultural offices. A workshop was conducted in Tselemti and Tsegede Woredas. Joint planning of activities was one of the good practices of the project to effectively implement planned activities, and it also contributed for sustainability of the project.

Implementation followed participatory approach while selecting sites and prioritizing interventions. Selection of target areas, selection of target Farmers Training Centers (FTCs), selecting technology options for the targeted FTCs, conducting Needs Assessment (PNA) of farmers and the like were held by the project coordination office together with different partners of the project. Different monitoring and evaluation activities were designed and carried out periodically by the assigned program officer in a close collaboration with other staffs and partners. All the above conditions facilitated smooth process of implementation of the project. All in all, therefore, it is indicated by the Woreda and Kebele level partners of the project that strong follow ups were made from the project coordination office so as to keep the process on the right track.

Trainings were also organized and conducted at Woreda agricultural offices. Training on follow seasons and arranged as pre, mid and end-season. The trainings were on: land preparation, seed selection, line planting, use of improved seeds and application of fertilizer with recommended rates, timely weeding and harvesting, postharvest handling, and market access and marketing. In 2013/14, about 80 percent of demonstration host farmers received trainings from extension agents on SG 2000 promoted technologies. Farmers reported that their farming skills and knowledge has improved following the trainings, and they applied good agronomic practices such as better land preparation, appropriate input rates and good management practices.

2. The Final Evaluation

This evaluation was demanded by the SG2000 - Ethiopia and JICA to assess and document progresses made and changes realized against the established indicators. Three sample Woredas, namely Tselemti, Tesgede and Raya-Azebo were, therefore, chosen for the evaluation.. Three Kebeles were selected one from each Woreda: Medhanialem, Alem Genet and Genetie.

2.1. Objective of the evaluation

The final evaluation was intended to assess the progresses to date against the established indicators. It mainly aimed at measuring achievements of the project outcomes, strengths and challenges, and identify essential lessons that can be scaled-up and scaled out. The specific objectives of the final evaluation of the project included the following areas:

- Review and document key successes, best practices, lessons learned and challenges faced towards meeting the outcomes of the project;
- Assess relevance, efficiency and effectiveness of PCDAT interventions and measure the progresses towards key outcomes based on indicators stated in the project log frame;
- Identify the impact of the project on crop productivity and income of the target households including the factors for changes; and
- Identify key lessons and recommendations that would have strategic significance for possible future project initiatives.

2.2 Methodology

Participatory approach was followed to undertake this evaluation. Pertinent stakeholders, mainly Regional, Zonal, Woreda and Kebele level officials and farmers were actively involved both in facilitating the survey as well as providing relevant information. Such participations in the evaluation process helped to initiate senses of ownership of the undertaking as well as facilitating learning from the required results, through anticipating such results from project implementation.

While undertaking the final evaluation, three essential steps were followed: These were: pre-data collection, data collection phase in the field and data organization and analysis. Tools were developed and methodology designed during the pre-data collection phase. External resource person was involved for the data collection mainly from Woreda and *Kebele* level partners of the project. SAEDE project staffs were also highly involved starting from facilitating the survey to data analysis and finalizing the evaluation report.

Sample Project Sites and Households

The final evaluation was carried out in three selected Woredas: Tselemti, Tsegede and Raya Azebo Woredas; and three Kebeles: Medhnialem, Alem Genet and Genetie, one in each Woreda. The selected Woredas and sample Kebeles well represented SG2000 development interventions and agro-ecological diversities. A random sample of 35 households (representing project farmers) were selected from each Kebele, i.e., a total of 105. Out of these total sample households, 70% (65) of them were beneficiaries of the CPE component of the project: farmers participated as demonstration hosts of TOPs and WADs, and PTP farmers. On the other hand,

23 (30%) of them were postharvest beneficiaries, while 17 (16.2%) were beneficiaries of the Theme III components; market and credit access.

Both qualitative and quantitative data were collected from farmers using structured questionnaires. In addition to that, discussions were held at Woreda and Kebele levels using semi-structured questionnaires to supplement information collected from farmers.

Box 1. Processes followed for undertaking the evaluation

Initially, three separate questionnaires were developed to be used at three levels; at the Woreda, *Kebele* and farmers levels.

A resource person was deployed to handle data collection at the Woreda and Kebele level. The resource person was given orientations about the overall situation of the project and was tasked to also produce draft report.

Different documents were carefully reviewed by the resource person, such as project document, baseline report, project progress reports and other relevant documents.

Discussions were held with Woreda Agriculture and Rural Development Offices and Kebele level officials using semi-structured questionnaires.

Six enumerators were recruited and trained to interview 105 beneficiary households in the three sample Woredas, and the respective three Kebeles.

The evaluation team conducted case studies of six farmers involved in the production, consumption and selling of rice

Data entry and cleaning was handled by experienced data technicians, but analysis of information was done by the resource person and MELS Theme using SPSS software.

Draft report was produced and comments incorporated.

2.3 Limitations of the Final Evaluation

In undertaking this evaluation, some major limitations were observed in the process. While total number of beneficiaries of the project were expected to be 3,000 farmers, the sample size in this evaluation was only 105 farmers; accounting only 3.5 percent of the total. This proportion gets very low when it is assessed as a percentage of total number of households in the project Kebeles. Similarly, from the 24 project Kebeles only 3 kebeles (12.5%) were covered in this evaluation. Although these are serious limitations, secondary information, case studies and detailed household level assessments were used to supplement the study, and so as to minimize the degree of the above limitations.

3. Evaluation Results: Key Findings and Discussions

3.1 Background characteristics of sample households

Family size

As indicated in the table below, majority of the sample households have family size which ranges from 4 to 7 members, while only about 7% reported to have family size less than 3 on average.

Table 1. Household sizes by Kebele (in %)

Kebeles	Family size			Total
	1-3	**4-7**	**8-11**	
Medhanialem	11.4	60	28.6	**100**
Alem Genet	8.6	68.6	22.8	**100**
Genetie	0	74.3	25.7	**100**

Source: Field Assessment for Final Evaluation

Education levels

In terms of education levels of the households, the majority are illiterate. To the contrary, however, some of them have completed grade 10, while there were no households who have attained to the level of diploma or degree in their education. Except Alem Genet Kebele, no significant difference of illiteracy (cannot read and write category) was observed between male and the female respondents. But female respondents surpass their male counterparts with regard to attending grades 1-6 (see Table below).

Table 2. Education levels of households by sex (in %)

No.	Description	*Kebele*						Total
		Medhanialem		Alem Genet		Genetie		
		Male	Female	Male	Female	Male	Female	
1	Cannot read and write	3.8	6.7	1.9	13.3	8.6	13.3	**47.6**
2	Reading and writing	1.9	3.8	0	0.95	0	0	**6.6**
3	Grades 1- 6	0.95	7.6	0	7.6	2.9	7.6	**26.6**
4	Grades 7-10	0.95	4.8	0	1.9	0	0.95	**8.6**
5	Above grade 10	1.9	0.9	0	2.9	0	0	**5.7**
6	Not given information							**4.8**
	Total	**9.5**	**23.85**	**1.9**	**26.6**	**11.5**	**26.6**	**100**

Source: Household data of PCDAT Final Evaluation

Types of beneficiary households

The sample farmers are of three types with regard to their participation in the project. The majority of them (70% percent) are participants of crop productivity enhancement (T1) component of the project, while 22% participated in Postharvest and Agro-processing (T2) and 16.2% were involved in the Public Private Partnerships and Market Access (T3) component of the project.

Table 3. Types of farmers by Kebele and sex

Kebele	Types of Farmers						Total number of house holds
	Crop productivity enhancement (T1) farmers (TOP, WAD, PTP, CVP)		Postharvest and agro-processing (T2) farmers		PPP and market access (T3) farmers		
	Male	Female	Male	Female	Male	Female	
Medhanialem	10	5	0	12	0	8	35
Alem Genet	0	15	1	10	1	8	35
Genetie	12	23	0	0	0	0	35
Total in Percent	**20.95**	**40.95**	**0.95**	**20.95**	**0.95**	**15.24**	**100**

Source: Household level data of PCDAT Final Evaluation

3.2. Relevance of the Project

3.2.1. Project relevance to priorities and needs of target groups

Low agricultural productivity, and hence food insecurity, was one of the major problems of target project Woredas. The PCDAT project was designed and implemented considering these major developmental problems. Before project implementation, needs assessment was conducted to identify and prioritize project activities. Suitability of the agro-climatic conditions to grow rice and other crops were also assessed. Project sites were selected having good accessibility (road infrastructures as well as public transportation) and availability of sufficient EAs to implement the planned activities.

The needs assessment was conducted with active participation of farmers in the project sites. According to results of the needs assessment survey, one of the major problems of the targeted areas was that agricultural productivity was so low. Further, the assessment identified that sufficient number of Extension Agents (EAs) were available to conduct project activities, the project sites were accessibility with good road infrastructure and public transportation, and there were willingness of Woreda s and the FTC officials to collaborate with SAA in the process of implementation. Additionally, there were joint problem identification and planning processes with major project partners.

The appropriateness of project objective and consistency with the local situations and specific conditions of the Woredas are unequivocal. Considering development challenges in the project areas, PCDAT introduced new crops such as rice, green gram, soya bean and sunflower; promoted diversifications of other different local crops such as sorghum, *teff*, sesame, fingure millet and wheat; introduced postharvest technologies for rice and the other food crops; facilitated market linkages on rice and other crops.

All in all, the project was designed based on felt needs of farmers. It was designed with four major components and respective activities addressing major development challenges. The four major components were expected to address productivity and food insecurity problems of the areas. Woreda level partners indicated that the project was demand driven, hence, it was relevant to the project areas.

3.2.2. Project consistency with development policies and priorities

The project was consistent with government policy direction that takes poverty reduction as its central point. Addressing the problem of food insecurity of local communities is the priority of the development efforts undergoing in the country. PCDAT project was designed based on policies and the strategies of the Government of Ethiopia. It was in line with the Growth and Transformation Plan (GTP) of the country. For instance, recently, the Government of Ethiopian has identified rice as the 'Millennium Crop' and started promoting rice cultivation. For this, the Government has established the National Rice Research and Development Steering Committee and Technical Committees in which SAA and JICA are members. The Government is willing to facilitate the enabling environment for promoting production of rice while this project envisaged to contribute to the goal based on past experiences in the extension system, and particularly in rice production.

The project was designed with four major components that promoted alternative means of income to farmers by reducing dependencies on limited income sources of crop production such as sorghum, finger millet and *teff*. Hence, introduction of new crops and improved technologies created options by which farmers could select according to specific situations of their locality and their felt needs. All necessary project inputs were provided to enable to give wider opportunities to farmers to actively participate in their respective interests and preferences.

3.3. Effectiveness of the project

This evaluation assessed effectiveness based on major results per specific components of the project: crop and farm productivity, agro-processing and value-addition, and marketing and market accesses. Analysis of major findings and discussions of effectiveness would, therefore, be on the basis of targets and achievements of outcomes of major components of the project.

3.3.1. Crop Productivity Enhancement

This is one of the major components of the project, and aimed to promote improved agricultural technologies for enhancing crop productivity in the project sites. For realizing its objective a number of development activities were implemented in the last four years and corresponding changes and outcomes were recorded.

Training on crop production and productivity

Skills and knowledge of farmers and extension agents has improved following different trainings and advices provided through the project on improved crop production and productivity. During the four years of the project life, beneficiary farmers received different trainings and important advices both from extension agents and SG 2000 staff. From the technical supports provided, farmers indicated that they have learned new skills and improved agricultural practices and technologies. Almost all farmers (98%) reported that they have learned new skills and their farming practices have improved, and 87% of them said that their productivity has also increased. Important training sessions and advices provided by both the

extension agents and staff of the project have contributed for such change in skills and productivity.

Table 4. Farmers perception on training, new skills and change in productivity

Item	% of farmers reported
Proportion of farmers reported they have learned new skills/technologies from trainings	**99**
Proportion of farmers reported their farming skill improved	**98**
Proportion of farmers reported increased productivity	**87**

Source: Household level data of the Final Evaluation

Farmers were also asked to indicate specific areas where they received support from extension agents and project staff. Most of them reported that they received more support in the area of raw planting practices. Furthermore, farmers also indicated they received support in areas mainly in fertilizer application, improved seed, land preparation and timely weeding. Although all of the subjects and supports provided are very important as can be seen from the list, the single most important subject liked by the majority of the respondents (about 50%) was raw planting followed by improved seeds.

Table 5. Specific Supports provided to farmers on Crop Production (in %)

Description	Project Kebele		
	Medhanialem	Alem Genet	Genetie
Raw planting	61.7	45	46.3
Fertilizer application	18.3	9.8	10.4
Improved seed	11.7	28	25.4
Proper use of fertilizer	11.7	8.5	0
Land preparation	18.3	18.3	-
Timely weeding	11.7	13.4	-

Source: Household level data of the Final Evaluation

Knowledge and skill transfer

Transferring improved agricultural knowledge and skills was one of the very important aspects of the project. As can be seen from the Table below, about nine types of new and improved agricultural practices were very important to farmers. The major ones included row planting (reported by 96.2%), improved varieties (54.2%), proper fertilizer application (46.6), and seed rate and weed control (40% each).

Table 6. New skills and knowledge learned from EAs/SG2000 (%)

No.		Kebeles	

	Improved technologies /practices	Medhanialem	Alem Genet	Genetie	Total
1	Improved varieties	**54**	**25**	**82**	**54.2**
2	Methods of disease and pest control	**2**	**11.4**	**5.7**	**6.6**
3	Seed rate	**68**	**48**	**2**	**40**
4	Row planting	**100**	**94**	**94**	**96.2**
5	Proper seed spacing between rows and plants	**5.7**	**8.5**	**0**	**4.5**
6	Weed control and herbicide use	**68.5**	**40**	**11.4**	**40**
7	Fertilizer with recommended application	**60**	**60**	**20**	**46.6**

Source: Household level data of the Final Evaluation

Improved agricultural skills and knowledge transferred through the project have multiplier effects in non-project Woredas too. New skills and knowledge obtained through the project can be easily transferred through farmer-to-farmer social links. Farmers who participated in this project are expected to share their skills to fellow farmers. Studies confirmed that this method of knowledge transfer is much faster and effective than extension agent-to-farmers link.

Introducing new and alternative crops

One of the major objectives of the project was to introduce new crops and improve productivity of other locally grown ones in the project Kebeles. The project, therefore, introduced four new food crops: rice, green gram, soya been and sunflower. This evaluation also confirmed that different crop varieties were introduced and promoted to the project areas during the four years of the project life. Other different local crops were also grown by the farmers in the project sites; the major ones are: sorghum, *teff*, sesame, finger millet, maize, wheat, barley, chick peas, onion and *gesho*. Improved crop varieties of both the new and existing crops were promoted using SG2000 FLP approach aiming to improve productivity and production in the sites.

The crops were grown with the application of modern inputs such as urea, DAP and Improved crop varieties. Among the food crops, sorghum and rice used more fertilizers in the three sample K*ebeles*. To the contrary, however, very small amount of fertilizer were used for some crops such as green gram, barley, chick peas, onion and *gesho (see annex for details of major crops grown, and use of fertilizer and improved seed by crops)*

Use/Adoption of Improved agricultural Technologies

Implementation of the PCDAT project has contributed to the adoption or use of different types of improved technologies and practices. Some of the most important technologies or practices used by farmers in the project *Kebeles* are depicted in the Table below. Given that, the two most adopted ones are raw planting practice which was reported by over 85 percent and the use of improved seeds, by about 39.1 percent of sample farmers.

The main reasons for use/adoption of improved technologies and practices included intensive trainings (reported by almost all farmers) and better production, as reported by 83% of the farmers.

Table 7. Improved crop production technologies and practices used by farmers (%)

Description	Project Kebele		
	Medhanialem	Alem Genet	Genetie
Raw planting	94	85	85
Improved seed	25	20	71
Proper use of fertilizer	31	17	0
Land preparation	34	34	2
Timely weeding	54	60	-

Source: Household level data of the Final Evaluation

Use of Improved crop varieties

More plots are getting covered with improved varieties. Use of improved seed doubled in 2014/15 as compared to the situation during the baseline. On average 16.7% of plots were covered with improved varieties in 2010/11, whereas in 2014/15 it increased to 37.2%. For some crops, like rice, maize and wheat, there was a significantly high increment in the use of improved seed, while for some crops such as sorghum and millet the change was not encouraging.

Table 8. Crop varieties used during baseline and final evaluation period (%)

No.	Crop type	Baseline (2010/11)		*Final evaluation (2014/15)*	
		Crop variety		Crop variety	
		Local	Improved	Local	Improved
1	Sorghum	99	1	94	6
2	Rice	-	-	12.5	87.5
3	*Teff*	55	45	62.7	37.3
4	Millet	99	1	100	0
5	Sesame	87	13	75.6	24.4
6	Maize	77	23	54.2	45.8
7	Wheat	83	17	8.3	91.7
8	Green gram	-	-	20	80
	Mean/Total	**83.3**	**16.7**	**62.8**	**37.2**

Source: Household level data of the baseline and Final evaluation

Fertilizer use

Use of fertilizers and their proper use according to research recommendation was one of the important technologies SG2000 has promoted through the PCDAT project. Accordingly, this evaluation also asked farmers whether they have applied fertilizer based on recommendations and half of them responded positively.

Table 9. Proportion of farm plots used fertilizer based on recommendations

Crop Type	Sorghum	Teff	Rice	Millet	Green gram	Wheat	Maize	Sesame	Total Mean
% applied fertilizer as recommended	44.5	43	87.5	6	90	100	17	31	**50**

Line planting practice

Three different types of planting methods were used in the project sites; ordinary line planting, recommended line planting with proper spacing, and traditional broadcasting methods. Although ordinary line planting method was on a rise as compared to broadcasting method, only very few farmers (3%) practiced recommended practice with proper spacing. For crops like rice and maize over 70% of the farmers reported use of ordinary line planting practice, while line planting of teff was reported by 27% of the farmers.

Change in cropping pattern after the PCDAT project

PCDAT contributed to the change in cropping pattern in the projects sites, mainly through introducing new crops, like rice, and promoting improved agronomic practices. This evaluation assessed change in the cropping pattern in the sampled Kebeles using mainly the change in the use of cultivated land and production after the PCDAT project as compared to the baseline situation. Changes in the total cultivated land and production of sampled households were compared for seven major crops: sorghum, *teff*, millet, rice, maize and sesame.

The cropping pattern considering cultivated farm lands showed that rice as a new crop has covered more land particularly in Medhanialem and Alem Genet Kebeles. Cultivation of rice showed an increasing trend by a significant level, for instance, just from 0.25 ha to 10 ha in Medhanialem Kebele. Rice was totally a new crop in Alem Genet Kebele, where cultivated land jumped to 17ha from zero, showing PCDAT contribution in introducing rice. However, in Genetie Kebele rice cultivated land did not show any change as the crop was not promoted there. Cultivation of Teff has also shown a significant change, particularly in Medhanialem Kebele, indicating the contribution of the project mainly through promoting improved line planting practice (see Table below).

Table 10. Total area cultivated (in hectares) before and after PCDAT interventions (2014/15)

Crops	*Kebeles*					
	Medhanialem		Alem Genet		Genetie	
	Before (2010/11)	After (2014/15)	Before (2010/11)	After (2014/15)	Before (2010/11)	After (2014/15)
Sorghum	23.05	19.5	53.51	49	40.11	47
Teff	5.5	14.5	0	0	28	26
Millet	10.5	10.2	7.87	7	0.25	1
Rice	0.25	10	0	17	0	0
Maize	5.46	5.85	0.375	0.6	1	1
Sesame	0.375	0.375	46.2	50	0	0

Source: Household level data of the Final Evaluation

Another essential comparison was made regarding the change in the total production of the crops after the project. It was found that significant change in production was recorded for rice, sorghum and teff, indicating PCDAT contribution in introducing new crops and promoting improved agronomic practices, particularly on those crops.

Table 11. Total crop production (in quintal) before and after PCDAT interventions

Crops	*Kebeles*					
	Medhanialem		Alem Genet		Genetie	
	Before (2010/11)	After (2014/15)	Before (2010/11)	After (2014/15)	Before (2010/11)	After (2014/15)
Sorghum	376	499.5	766	769	376	669
Teff	32.3	49	0	0	201	197
Millet	126.5	185	59.5	74	4	15
Rice	2.6	477	0	437	0	0
Maize	84	130.5	3	5.5	1	1
Sesame	18	20	178	210	0	0

Source: Household level data of the Final Evaluation

Crop productivity

Productivity of major crops showed an increasing trend compared to the baseline. Average cereal productivity (of major crops) was only 1.5 ton/ha during the baseline (2010/11), but in 2014/15 (end of project) productivity increased, on average, to 2.0 ton/ha, showing a 32% increment. The change in crop yield was a factor of many reasons, among others, better use of improved agricultural practices and improved seed were the major, for which the contribution of the PCDAT was significant.

Table 12. Crop productivity of major crops (in ton/ha), comparing baseline and final evaluation

Crops	*Kebeles*			*Average Yield 2014/15*	*Average yield 2010/11 (Baseline)*	*Change in crop yield (%)*
	Medhanialem	Alem Genet	Genetie			
Sorghum	2.6	1.8	1.5	2.0	1.4	43.4
Teff	0.89	-	0.97	0.95	0.8	18.9
Rice	3.2	3.0	-	3.1	2.4	30.5
Average	2.2	2.4	1.23	2.0	1.53	32.4

Source: Household level data of the baseline and final evaluation

Farmers were asked to rank the main reasons for the change in crop productivity, and majority (over 80%) of them reported three reasons. The reasons in order of importance are: use of improved agricultural technologies, favorable climate condition (rainfall), and attractive market prices motivating farmers to produce more. Whereas, about 25% of the households reported other reasons for the changes in crop productivity.

Table 13. Main reasons for the changes in crop productivity in (in %)

No.	Description	*Kebele*			Total
		Medhanialem	Alem Genet	Genetie	
1	Use of improved agricultural technologies	100	91	44	**78.3**
2	Favorable climate condition (rainfall)	97	51.5	100	**83**
3	Attractive market prices	27.3	30.3	4	**20**
4	Better access to credit	6.1	6.1	0	**6.1**
4	Other reasons	12.1	21.2	44	**25.7**

Source: Household level data of the final evaluation

3.3.2. Postharvest and Agro-Processing

Introducing and promoting postharvest and agro-processing (PHAP) technologies was the other important component of the PCDAT project as part of its objective of promoting advanced technologies. For the realization of this component, a number of activities were implemented and hence, corresponding results have been achieved.

The PCDAT introduced and promoted postharvest and agro-processing (PHAP) technologies such as rice mills, multi-crop threshers and seed cleaners. It has provided seven rice processing mills, two multi-crop threshers, one seed cleaner and one par-boil kit. These improved PHAP technologies were introduced to three rice growing Woredas of Tigray Region (Tsegede, Wolqait and Tselemti Woredas). After placing or installing the PHAP technologies, machine operators were identified and trained on maintenance and operation of the machines.

The project was effective in introducing, improving skills and knowledge of farmers and promoting the use of PHAP technologies in the project sites. Expected results of the project in the PHAP component were to train 2000 farmers, and 500 farmers were planned to use improved PHAP or storage technologies. In this regard, the project achieved over 100% as a total of 4549 farmers were trained, and 6,628 farmers used the PHAP technologies.

Training on the use of improved PHAP

Capacity building of extension staff, farmers and PHAP machine technicians was among the major activities implemented by SG2000 through the project. During the four years of the project, SG2000 provided different trainings and established demonstrations on PHAP technologies. At TOT level, 269 extension agents (EAs) and 134 lead farmers were trained on agro processing, food preparation and storage management technologies. Extension agents, in turn, have trained a total of 4549 farmers (12% women). Training on food processing, particularly on newly introduced crops such as green gram, rice and soya bean was provided to a total of 146 people (82% of them were women). Trainings were also provided to 57 machine operators, maintenance service providers and members of agro-processing groups.

Table 14. Training of Trainers and number of farmers trained on PHAP

Participants of Training of Trainers (TOT)							Farmers trained by Trained EAs						
Participants	**2011**	**2012**	**2013**	**2014**	**2015**	**Total**	**Sex**	**2011**	**2012**	**2013**	**2014**	**2015**	**Total**
SMSs	59	18	21	6	4	108	Male	-	1388	2191	-	406	3985
DAs	40	53	29	15	24	161	Female	-	128	303	-	133	564
Lead Farmers	**-**	**-**	**-**	**84**	**50**	**134**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Total	**99**	**71**	**50**	**105**	**78**	**403**	**Total**	**-**	**1516**	**2494**	**-**	**539**	**4549**

Source: Annual reports of the PCDAT project

Almost all sampled farmers and key informants reported that they have gained new skills and knowledge in PHAP technologies. The project provided four types of support, included: formal training (on storage management, rice mills and multi-crop thresher); informal consultation on the use of PHAP technologies; field days on PHAP technologies; and follow ups on the use and management PHAP machines. The supports and follow ups on the PHAP technologies played an important role in improving the knowledge and the skills of beneficiary households. Because of the integrated efforts exerted with the different types of supports, therefore, majority of the interviewed farmers reported that their skills and knowledge improved on the use of PHAP technologies. Key informants from project Kebeles have indicated that the new PHAP trainings have helped them to acquire important knowledge particularly in the area of improved way of harvesting and drying (particularly for rice) and improved storage techniques and materials.

Use/adoption of the PHAP technologies

PCDAT project promoted PHAP machines (10) through field demonstrations and field days. Many demonstrations and field days were organized particularly to promote the newly introduced rice mills, multi-crop threshers, seed cleaners and par-boil kits PHAP technologies. A total of 2,228 people (1760 farmers and 468 EAs) attended and learned from the PHAP demonstrations during the last four years.

The demonstrations on PHAP created huge demand from farmers, private entrepreneurs and government partners. The machines (e.g., the rice mills) were appreciated particularly by rice producing farmers, private service providers and Tigray Bureau of Agriculture. As a result, the Bureau has purchased six additional rice mills to provide service to farmers in the Region. One private investor and one Monastery also purchased rice mills after observing service provision of the SG2000 introduced rice mills in Tselemti Woreda.

Use of the postharvest machines increased in the project Woredas. As a result, 6,628 farmers (27% women farmers) used the service of these postharvest technologies, and Birr 315,324 was generated from the service provision. A total of about 849 MT of crops were processed by the technologies - rice polishers, multi-crop threshers and seed cleaners. The machine in Medhanialem Kebeles has performed better in terms of amount of polished rice than other Kebeles.

Table 15. Number of farmers used PHAP machines and amount of rice polished

Processing Center/Kebele	No. of farmers used the Service (Beneficiaries)			Polished rice (in tons)	Money Collected from the service (in Birr)
	Male	Female	Total		
Alem-genet	711	115	826	73.4	**29,365.20**
Maidele	238	69	307	15.4	**6,176.80**
Dedebit/Qeshi-gebru	799	235	1034	221.87	**71,426.00**
Selam	597	146	743	66.6	**22,982.30**
Endabo	54	19	73	10	**3,000.00**
Medhanialem	2393	805	3198	442.5	**177,001.60**
Tsaeda-qerni	329	118	447	19.72	**5,372.50**
Total	**5121**	**1507**	**6628**	**849.55**	**315,324.4**

Source: In-depth study on 'Success story of rice in Tigray', 2015

Benefits of the use of the PHAP machines

The PHAP technologies, particularly the rice mills have brought real change in rice production and consumption. Rice production increased primarily following promotion of Nerica 13 rice variety by SG2000, but there were challenges to process, use and market rice. Thus, promotion of the rice mills has solved these challenge and encouraged farmers to produce more. Furthermore, these processing machines helped farmers to utilize rice by preparing it in different food types for consumption. Trainings particularly on rice food preparation contributed to improved consumption of rice in the project areas. After polishing and processing of rice, farmers started using rice in the form of *Injera*, bread, boiled rice and local drinks.

Sampled farmers and key informants reported improvement in income and living standard after the use of the PHAP machines. Additionally, there were other benefits like improvements in quality of products and reductions of postharvest losses compared to the baseline situations. The improvements in the quality and reductions of the post-harvest losses enabled farmers to get attractive prices for their produce in the local as well as other markets.

Challenge

Promoting the use of the PHAP technologies has faced some challenges mainly related to management of the machines and lack of frequent maintenance service. The PHAP machines were working properly, but they did not process (thresh or polish) enough quantity of crops as compared to their capacity and potential. The rate of use or adoption of these machines was low as compare to their expected capacity. Particularly use of the threshers was very low due to mainly poor repair and maintenance service.

Despite the success, the rice mills were also processing low amount of rice compared to their potential. Polishing service provision was low, and they were underutilized compared to potential number of rice farmers and number of machines provided. One of the main reasons was lack of proper management of the machines. Farmers' cooperatives owning these machines need to be strengthened mainly with respect to business management and operation of the machines. Furthermore, they also need to be supported to actively engage in rice marketing in addition to their polishing services.

3.3.3. Public-Private Partnerships and Market Access

This component of the project contributed to improved marketing and market access in the project sites through establishing groups, training farmers in marketing and linking them with potential buyers. The project was effective in providing training to 462 extension agents and 3,638 farmers, and establishing and strengthening 18 groups engaged in production and marketing. The number of trainees was much higher than what was initially planned (500 farmers). The project has also done commendable task of linking farmers to potential markets, but still a lot is required in this aspect of the project.

Trainings on Business Management and Market Linkage

The PCDAT project conducted ToTs on marketing and farmers' organization and business management in all the project Woredas. The training focused on basic marketing concepts, market linkages, collective action for market access and role of extension agents in supporting farmers and farmer groups for marketing. The trainees included DAs, SMSs and lead farmers. Following the ToTs, EAs and Woreda cooperative experts trained 3,638 farmers (of which 25% were female) on marketing, market linkage and business management.

Sampled farmers indicated that they received support on marketing and group formation in the form of formal training (69%), informal consultations (12%), participation in rice exhibition (10%) and through group formation and facilitation of market linkages (9%).

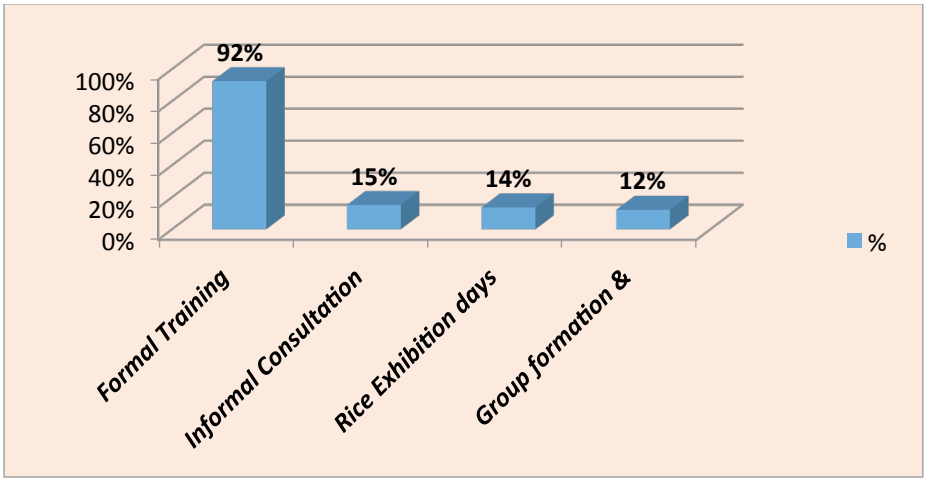

Figure 2. Support Received from SG2000 on marketing and market access

Establishing producer groups

With supports and follow ups from the project, development agents and cooperative leaders organized farmers in groups. In total, the project established seven groups, and supported and strengthened 11 groups to actively involve in production and marketing. The established groups engaged in seed production (four in rice and one in teff seed), honey production and agro-processing. The seed producer groups were trained to produce good quality seed of rice (N13) and teff.

Additionally, one existing rice seed producer group, eight multi-purpose cooperatives, one Cooperative Union, and one agro-processing group were supported and strengthened with trainings on marketing and organizational management skills. These skills enabled them to interact better with markets, and improved their negotiation capacity.

Creating market linkages and organizing exhibitions

The PCDAT project facilitated market linkages and promoted use of new crops, particularly rice. Different forums and discussions were held with partners and potential buyers on rice marketing. Exposure visits were also arranged for rice producing farmers, members and leaders of primary cooperatives and Unions to towns such as Woreta, Shire and Mekele to popularize their product, to get experience on marketing and establish market linkages.

As a result, market linkages were established with traders and retailers found in towns like Woreta, Shire and Mekele. Farmers in Wolqait and Tsegede Woredas became able to sell their rice in bulk to Woreta town traders. Cooperatives in project Kebele participated in rice marketing and have started to play important role solving market problems in some of the project Kebeles. In Tselemti Woreda polished rice was sold in open markets and retail shops, and some vendors were selling paddy and polished rice. Locally produced and milled rice meeting consumer preferences were sold in the domestic markets at Maitsebri and Dansha towns at a price of Birr 850 to 1100 per quintal (100 kg).

Eat local rice exhibitions were also conducted to popularize utilization of rice and attract buyers from different locations such as Maitsebri, Dansha, Shire, Mekele and Addis Ababa. Stakeholder's events were also held with many partners and potential buyers on rice marketing. The project also conducted several other exhibitions, aiming to create good linkages between rice producers and traders.

Change in marketing

Improved processing, marketing and food preparation has contributed for increased income and better acceptance of new crops like rice and green gram. Farmers were trained in improved agronomic practices, processing, food preparation, marketing, and better market linkages were also established with traders from different towns. Particularly, rice producers benefited from the market linkages created with grain traders from different towns such as Woreta, Amhara Region. The biggest sale of rice was also made through this linkage. Local traders were also encouraged and farmers in Tsegede and Wolqait were selling their rice to traders and cooperatives in their Kebeles.

After SG2000 interventions, certain changes were observed in the marketing of the crops produced in the project areas. Majority of interviewed households indicated that major changes have been observed in the areas of market access, price of output, quality of products and income levels. This evaluation attempted to assess opinion of farmers in the sampled Kebeles with regard to change in marketing and income, and except one project Kebele, Genetie, most farmers in two of the project Kebeles reported positive change in that aspect (see table 8).

Table 16. Percent of farmers reported improvement in marketing and income

No.	Changes observed	Project Kebeles		
		Medhanialem	Alem Genet	Genetie
1	Access to market improved and market linkages created	74.3	66.0	11.4
4	Income levels	77.1	51.4	14.3
5	Market price of a produce	57.1	51.4	14.3
6	Quality of products/crops	77.1	71.4	20.0

Source: Final evaluation of the PCDAT project

Ever increasing price of rice has contributed to change in income of rice farmers. In 2011, market price of paddy rice was 3,800 birr/ton and in 2012 it went up to 5,500 birr per ton. In 2013, the farm gate price of paddy rice was about 6300/ton. Change in the price of rice can be taken as a good sign for better acceptance of the crop and change in the income of rice farmers. This trend was also supported with some case studies conducted at random households indicating that rice has brought significant changes in income (see box below).

Box 2. Individual cases of Success:

There were changes in the consumption and sale of rice as indicated by these cases of two individuals.

A farmer called 'Birhane Tegegn' at Alemgenet Kebele, Tsegede Woreda, harvested about 3.3 tons of rice in 2011. He used 0.3 tons for consumption and seed, while the rest 3 tons of paddy rice was sold at birr 3,800 per ton. From this he earned about birr 11,400 as additional income. In 2012 production season, this farmer harvested about 2.1 tons of paddy rice, and sold 1 ton of paddy rice at a market price of birr 5,500 per ton and earned birr 5,500. He also stored 0.7 tons for later consumption and sale waiting for better market prices.

Another farmer, "Alehegn Millaw", from Selam Kebele of Wolqait Woreda, harvested 2.3 tons of paddy rice in 2012 and sold 1.3 tons, while 1 ton was stored at home for food.

Marketing by Selam Primary Cooperative

The PCDAT project has encouraged Selam Primary Cooperative, in Selam Kebele, Wolqait Woreda, to participate in rice marketing. In 2013, from January to March, the cooperative had purchased 51 tons of paddy rice from its members at a price of birr 5,200 per ton which was 200 birr higher than the then market price in Dansha. In July 2013, the cooperative managed to sell rice at a price of birr 6,300 per ton. Following that, the cooperative made a net profit of birr 900 birr per ton and shared birr 60/ton of its profit to members according to their transactions with the cooperative.

Although the project succeeded creating market linkages mainly by inviting traders from different towns such as Woreta, Amhara Region, it faced some obstacles while creating further linkages. The market linkages created, particularly in Tsegede Woreda was not to the required level as there less demand for farmers' produce. One of the serious challenges was the poor quality of rice in that it was broken and with some impurity as it was mixed with other unnecessary matters. This made it difficult for farmers to enter into other markets, as there was better quality rice in the market.

Despite this challenge, the PCDAT project tried and looked for new market opportunities to create market linkages for Tigray rice. In the future, as rice production increases, the need for bigger market will be critical. Meanwhile, there is an encouraging trend in which primary cooperatives and Unions have started to buy large amount of local rice from the farmers and sell it in bulk. The PCDAT project supported this activity and assisted the cooperatives by linking them to markets to sell their rice.

3.4. Change in income and livelihood

Income level: The project at a minimum achieved a 24% increment in annual income compared to the level during the baseline. Annual income was estimated only based on marketed product from crop production which is the major source of livelihood to farmers in the project sites. The project planned to reach about a 20% increase in income level of project targeted farmers in which the baseline was Birr 9, 779, whereas at the end of the project it reached Birr 12, 117. This average annual income was calculated taking average marketed production per household multiplied by respective price of the products at the baseline and final evaluation period (for details see Annex 2).

The increase in production of major crops such as sorghum, rice and millet, and high product price contributed for the significant change in income compared to what it was in 2010/11 (the baseline).

Table 17. Annual estimated income level

Items	Baseline: 2010/11	Final evaluation: 2014/15	Percentage change
Total gross income from producing all the seven major crops (in Birr)	21,836.01	27,413.9	25.5
Estimated average income per household (in Birr)*	10,331	13,069	25.5
Total Average Cost of production per household (in Birr)	552	952	72
Net average income from crop production per household (in Birr)	9,779	12,117	24

Source: Household level data of the baseline and Final evaluation

*Note: * :Average income per household was estimated based on the assumption that one household produce on average 2 of the top four major crops and one crop from the bottom three*

Change in livelihood: This evaluation found that following the PCDAT project some households have managed to save some money and diversify their livelihood. Project farmers, benefiting from their good harvest and its sale, have bought goats for the purpose of fattening. Such

investments helped them to build assets and create wealth. Others are trying to improve the quality of their houses and household utensils as a result of the income generated from their crop production.

The farmers covered in this project produced good amount of the newly introduced crops as well as existing local food crops. That has helped them to secure their food from year to year. In addition to that, they are able to have variety of foods compared to the situations before the interventions of the project. Such varieties of foods (e.g. rice) had shown good health benefits in respective family members. Others are trying to sell the surplus product in the local markets and hence they are able to collect income that was not the case before the project. Using the additional income some bought small ruminants particularly goats for reproduction and fattening.

The project also directly benefited women. They participated in a significant proportion in its technology demonstrations, implementation of activities and project benefits. This, in fact, was a good approach from development point of view as any development intervention that does not involve women in problem identification, planning and implementation of activities fail to sustain its benefit. A growing number of women farmers were, therefore, involved in the learning process, primarily through interventions like agro-processing, crop production and marketing. The project practically made women to participate in the training sessions, demonstrations (WAD), implementation of other activities. In this sense, the project has mainstreamed gender in its development endeavor.

The other contribution of the project was that some farmers have started sending their children to schools. The project also enabled and showed them that there are different options in their agricultural businesses. For more detailed information see Box 3 which describes cases of some households.

Individual cases of change in livelihood

Five cases of two men and three women were assessed to look at the change in livelihood after the PCDAT project. Brief description of each of the six cases is presented in the following box.

Box3. Individual cases of project participant households

1. Medhanialem Kebele, Tselemti Woreda

Ato *Azenaw Wegesha,*

Ato Azenaw is a 50 year old farmer from Medhanialem Kebele. He is a father of 7 children (4 boys and 3 girls), 6 of them attend nearby primary and secondary schools. He cultivates one hectare of land, of which half was used for production of rice during the last crop season. That, according to him, was a change in his crop production starting from two years before.

Before his engagement in rice production, his living standard was somehow at the middle compared to his neighborhood. He used to sell some of his animals to buy food for his family.

His family life has completely changed now, particularly after using his plot for rice production. During the last season, for instance, he produced 2 tons of rice from the half hectare and sold one ton of unclean rice for Birr 7,000 and cleaned rice for Birr 12,000. At the moment, therefore, he owns 5 oxen, 18 cows, 2 donkeys and 25 goats. He has also improved his housing condition by constructing two new additional rooms and bought one bed. As a result of the changes, he is now categorized

among the high wealth farmers in the village.

Wellbeing of his family members has improved. Rice was also used for consumption, preparing it in different form like *enjera, ambasha, kita, nifro, genfo* and local beer. He indicated that he found rice good for health as none of his family members has ever been sick for the past two years.

Other fellow farmers started to come to his place to learn from his experiences.

He described the benefit he got from the project: "*I have learned good skills from the trainings and gained practical experiences in rice production during the last two consecutive years*. *Hence*, *I will never go back to my previous situation.*

Woizero Fantaye Mamuneh

A woman farmer from Medhanialem Kebele, Woizero Fantaye is 25 years old, and a mother of two sons. Since her husband passed away, she has started to manage the family by herself. She has one and half hectare plot of land used for the production of different crops, half of which was used for rice production.

Her living standard was very low before the project and her engagement in rice production. Now, her family livelihood has improved following good rice production. She managed to harvest 2 tons of rice from her rice plot and sold with a price of Birr 7,000 per ton. Presently, therefore, she owns 4 oxen, 7 cows, 3 donkeys and 20 goats. She also used part of her rice for consumption preparing it in the form of *enjera, ambasha, kita, nifro, genfo* and local beer. Her children also enjoyed the rice production as they prefer consuming rice to any other food prepared from locally grown crops. She said: "*Now I know the benefit and I will continue producing rice*".

Woizero Yalem Teshager

Woizero Yalem is another woman farmer from Medhanialem Kebele. She has two children (a boy and a girl) attending a primary school. She has a half hectare plot of land used for production of local crops such as finger millet and sorghum. The household rented additional plot of land for producing rice.

Livelihood of the household improved following the rice production, thanks to the PCDAT project. At the moment the family has 3 oxen, 5 cows, 20 goats and a donkey. In addition to that, the household has saved Birr 2,000 in one of the financial institutions in the village. That, according to her, was possible following the good yield of rice. She believed that consumption of rice gives good energy particularly to people involved in physical work, and said, "*food prepared from rice and eaten at the morning keeps people with no feeling of hanger almost for the whole day*".

2. Alem Genet Kebele, Tsegede Woreda

Ato Nigusu Alemu,

Ato Nigusu is a 46 years old farmer who lives in Alem Genet Kebele. He has five children, and owns 5 hectares of land. Four years ago, that means before the introduction of rice to the area, he used to produce crops such as sorghum, finger millet and sesame. His living condition was good and he fulfilled food requirement of his family.

Following the PCDAT project, he started to use two hectares of his plot for the production of rice. From that he managed to get 3 tons of rice every year. Half of the produce was used for own consumption while the remaining was sold in the local market. One important lesson he learned was that rice uses a plot of land that cannot be used for other crops.

With the production of rice, his life improved and moved beyond fulfilling food requirement of his family. He has been able to save Birr 14,000 and presently, he owns 4 oxen, 10 cows, 10 goats, 2 donkeys and 8 traditional beehives. However, he reported absence of maintenance service and lack of

spare parts of the machine used for threshing as a major challenge with regard to the production of rice.

Woizero Alemtsehay Berhane

A woman farmer from Alem Genet Kebele, Woizero Alemtsehay is a mother of 3 sons. She has 0.75 hectare of land, from which half was used for rice production. After her engagement in rice production (following the project) her living condition has improved a lot. She started to produce 2 tons of rice, and obtained Birr 3,000 from marketing half of her produce. She utilized the money to educate her children and part of it to rent oxen for ploughing.

The problem with rice, according to her, was that rice land requires to be ploughed more frequently, which is labour and time consuming. Rice is easily affected by weeds, and management of which requires frequent ploughing. The other problem mentioned by her was that the price of rice is going down rapidly mainly due to increased production while demand has shirked tremendously.

3.4. Efficiency of the project

The PCDAT project efficiency was assessed in terms of its timely commencement, timely implementation of planned activities, delivery of project inputs, accomplishment of planned activities with the required budget and timeframe. In this regard, this evaluation interviewed key informants including project staff, Woreda and Kebele level partners, and they indicated that the process of implementation of the project was up to the expected level of precision. The project started immediately after a formal agreement was actualized. Together with that, all the necessary preconditions, such as allocating required budget and office space, and recruiting required personnel, were done on time. It was especially important to note that the project office was hosted at the Tigray BoARD in Mekele and all staff except for the Japanese project manager were from the region who are well acquainted with the agro-ecology, culture and language of the target areas; the project's four out of 5 technical staff were former employee of the Tigray BoARD, which was additional value to the project in terms of network and smooth communication with the stakeholders. Although it was the first time for SG2000 Ethiopia to establish such satellite type office, it greatly contributed to smooth information sharing and collaboration among the team and the Bureau. As a result, the project received most necessary support and facilitation from Tigray BoARD since the very beginning till the end of the project according to the agreed timeframe.

Flow of project inputs such as finance, equipment, agricultural inputs and others, was efficient, according to discussions held with partners and implementing staff. Timely flow of inputs facilitated the whole process of implementation of the project; starting from the coordinating office and down to the grassroots level. Woreda and *Kebele* level key informants indicated that the flow of project inputs encountered no major problem in the process. The smooth and efficient flow of project inputs can be taken as important lessons for developing and implementing similar projects at SG2000 or for any other development projects.

Planned activities of the project were accomplished within the allocated budget and timeframe. Furthermore, implementations of activities utilized efficient collaboration with the primary implementing partners. Particularly, planned activities in the areas of training were undertaken

at different levels in close collaborations with Regional, Woreda, Kebele and farmer level project participants.

There was also a periodic and continuous monitoring and evaluation of the project which facilitated delivery of the intended outputs and outcomes of the project. The process of implementing planned development activities and project monitoring and evaluation carried out with active and full participations of different partners.

3.5. Project Sustainability

Sustainability of the project requires, above all, improved capacity of extension agents for scaling up/out and project best practices and to sustain long term benefits of project results. The project has introduced new crops such as rice, green gram, soya bean, and improved production of existing crops with promoting improved technologies to the project Woreda s and Kebeles. Project beneficiaries were provided with relevant trainings on improved crop technologies, postharvest handling techniques, marketing and business management. From the trainings along with practical sessions, demonstrations and experiences sharing events, farmers reported they obtained new skills and knowledge that helped them to improve their productivity and increase farm income. They proposed and suggested that the benefits they gained and the development impacts achieved so far should be sustain overtime and scaled to fellow farmers.

For this, improved capacity of extension agents in technical skills and implementation capacity of Regions, Zones, Woredas and Kebeles are very important. The project has built capacities of extension workers mainly at Woreda and Kebele levels, which played important role for the sustainability of the project. Together with this, the institutional arrangements, the partnership and practical involvements of the three Agricultural Research Centers (ARCs): Alamata, Humera and Maytsebri can be mentioned as the other areas that facilitated sustainability of implemented development activities.

The advices and trainings provided to the farmers have created knowledge, technical skills, capacities and confidences in the operational areas of the project. Advices and different trainings were also provided to the Woreda and Kebele level partners of the project. All these were very important for the sustainability of the different efforts exerted and resources invested as the partners are the ultimate responsible bodies of the process.

Additionally, almost all partners confirmed that the introduced crops and technologies would continue to be implemented even after the project phased out. Out of the newly introduced crop varieties; green gram, rice Nerica 13 and soya bean as well as postharvest technologies such as rice mills, multi-crop thresher and seed cleaners were fully taken up by the bureau of agriculture for further scaling up to other sites. Beneficiary farmers of the sampled Kebeles have also confirmed, saying: '*The project has shown us the correct way and then it is up us to continue in the same manner'.*

However, high turnover of the extension staff members of the local government structure needs immediate solution by the partners for the purpose of sustaining the already achieved successes, and scaling up of best practices and lessons of the project.

3.6. Summary of Project Achievements/Outputs

Most of the planned activities of the project were implemented, and accomplishments were above the plan. Furthermore, outputs of the project motivated farmers and created demand for improved technologies. Alternative and new crops, which the project introduced in the project areas were appreciated by the farmers. Number of farmers using improved technologies such as proper application and utilization of fertilizer, line planting, proper weeding, improved postharvest technologies like rice polisher increased from year to year. Market linkage was also strengthened compared to the situation before the project. As a result, yield of major crops and income of farmers have shown significant improvements. Several stakeholder meetings were conducted for increased awareness of project partners on the achievements and best practices of the project.

The following Table summarizes the major accomplishments of the project during its life time.

Table 18. Summary of Achievements of the Project

No.	Expected outcomes/outputs of the project	Verifiable indicators set		
		Plans	Achievements	%age
1	Increase the types of crop to be cultivated	3	>3 crop with different varieties	>100
2	Support farmers' to cultivate the newly introduced crops	3000	3230	>100
3	Support farmers to use improved technologies for traditional crops too	3000	13631	>100
4	Increase the yields of the targeted farmers in the *kebeles*	20%	32%	
5	Increase the incomes of households of the target farmers	20%	24%	
6	Train farmers on the use of improved agro-processing or storage technologies for rice and alternative crops,	1500	4,549	>100
7	Support farmers to use improved agro-processing or storage technologies for rice and other alternative crops,	500	6,628	>100
8	Train farmers in marketing and related topics on rice and alternative crops	500	3,638	>100
9	Establish and strengthen producer groups on rice and alternative crops.	20	18	90
10	Identify potential buyers of rice and alternative crops	3	Above 3	100

The Table below summarizes effectiveness of the project with respect to achieving its planned outcomes/outputs.

Table 19. Project component, expected outputs, indicators and achievements

Project Expected Outputs/ indicators	Actual achievements
Project Component 1. Indicator - The number of farmers cultivating new crops (rice and alternative crops) and traditional crops with improved technologies increased	
1.1: By the end of the project at least 3 new crops have been introduced to the target area and are cultivated by more than 3000 farmers	The project introduced three new crops; rice (Nerica 13), Green Gram and Soya Bean). The FLPs (TOPs, WADs, PTPs and CVPs), and particularly the CVPs were used as means of demonstrating new crops to farmers for introduction to the project areas. Hence, 41 CVPs were used to demonstrate 10 crop types and 38 varieties in the 24 project FTCs. The crops and varieties demonstrated were: • Teff – 5 varieties (Kuncho, Tsedey, Smada, Boset and 1 local); • Wheat: 2 varieties (Picaflor and Mekelle 3); • Rice: 4 varieties (Nerica 13, Nerica 3, Nerica 4, Nerica 12 and Nerica13; • Finger Millet – 4 varieties (Baruda, Dibate, Tadesse and 1 local); • Maize: 8 varieties (e.g., Melkassa 6 and AMH-760); • Soya Bean: 6 varieties (Afgat, Gishama, Wogayen, Gizo, Aw-95 and Nova); • Sesame: 3 varieties (Humera 1, Setit 1 and 1 local); • Sun flower: 2 varieties (Oissa and R-black); • Haricot bean: one variety, Lucpin; and • Green gram: 3 varieties (Bored, SML-668 or Arkebe and Sheraro); In line with the demonstration of the crops, adaptation trials were conducted in the Agricultural Research Centers (ARCs). Rice and green gram were recommended by the ARCs for further demonstration. Maytsebri Research Center had tested and approved two rice varieties (N12 and N13), which were found to be suitable for Woreda s like Tselemti, Wolkait and Tsegede. The ARCs recommended that green gram is suitable to the Woreda s. Besides, soya bean and sun flower were tested in the ARCs and demonstrated. The crops performed well. In 2014, more than 3412 farmers planted rice in 1920 ha and more than 90% of them planted Nerica 13. Green gram was also expanded in Alamata, Raya Azebo and Tselemti Woreda s. Soya bean was the third new crop that was popularized, and it was planted on 16.5 ha in Tselemti Woreda by 69 farmers. In general, 2657 farmers produced these crops and technologies in the project areas during 2011 - 2014. Major reasons for the promotion of the three introduced crops are listed below: **Rice N13** became popular in Tselemti, Tsegede and Wolkait Woreda s. Most of the time, the majority of the land mass receive high amount of rain fall, with area become water lodged, that cannot be used for other traditional crops. Rice performed well on this kind of land, gave good yield and have become more appropriate crop for the target Woreda s. **Green Gram** introduction and dissemination started by testing for its adaptation in the ARCs since 2011. From the results of the trial, it was understood that the crop is early maturing, can be harvested within 60-70 days, gives good yield and is drought tolerant. So, it was demonstrated in Raya Azebo and Alamata Woreda s for two years. In 2011/12 production year, Raya Azebo was seriously affected by drought. The demonstration plots of green gram received little shower at the planting time, but

	performed well whereas all other local crops failed. **Soya bean** was tested in the ARCs and evaluated by the community. It was found to be high yielding provided it gets early weeding. It tolerates late growing weeds by the help of its high green biomass. It can also grow well in rice fields and serves as one means of crop rotation in the fields. Because of such qualities, many farmers requested the seed and was found to be one of the alternative crops in the project areas.
Indicator 1.2. By the end of the project at least 3000 farmers cultivate traditional crops with improved technologies in the target area.	In total, 13631 farmers (26% woman farmers) were trained on improved agronomic practices of different crops. The trained farmers has applied different improved agronomic practices like line planting, use of improved seeds, proper application of fertilizers, pest and disease control practices on the newly introduced and existing crops.
Project Component 2. Indicator - The number of farmers using agro-processing and storage technologies for alternative and traditional crops is increased	
2.1. By the end of the project at least 2000 farmers trained in the use improved agro-processing or storage technologies for rice and alternative crops.	Different TOTs were provided to the EAs and lead farmers on the use of postharvest and agro-processing technologies. In total, 269 people participated in the TOTs. Extension agents in turn trained a total of 4549 farmers on improved postharvest and agronomic practices. Additionally, Following the introduction of new crops: rice, green gram and soya bean, in total 173 people (83% female) were trained on food processing, agro-processing, marketing, business planning, financial management and record keeping.
2.2. By the end of the project at least 500 farmers use improved agro- processing or storage technologies for rice and alternative crops.	The project introduced and promoted the use of six rice processing mills, two multi crop threshers, one seed cleaner and one par boiling kit. By the end of the project a total of 5831 farmers used these improved postharvest and agro-processing technologies, mainly the rice mill, but the use of the multi-crop threshers were very small, only 35 farmers.
Project Component 3. Indicator - Organized producer groups gain market access for their farm products	
3.1. By the end of the project at least 20 producer groups established.	From 2011 to march 2015, TOT on marketing, farmers organization, business management and market extension were given to 462 trainees. Following that, a total 15 groups were established and strengthened; 5 seed producer groups, 6 rice producers and marketing cooperatives, two marketing of agro-processing groups, one beekeeping group and one vegetable producer irrigation cooperatives.
3.2. By the end of the project at least 500 farmers trained in marketing aspects,	TOTs were provided to the EAs, different training sessions of farmers on marketing, farmers' organization and business management have been organized in the last years. As a result 1149 have been trained from 2011-2012 and from 2013-rnf of 2014, a total of 3638 farmers had been trained.
3.3. By the end of the project at least 3 buyers identified for purchasing farm products from the groups.	Different forums and discussions were held with partners and buyers on rice marketing. Representatives of rice producing farmers were mobilized to the traders. In 2013, exhibitions and field visits were conducted to popularize the feeding of rice and attract buyers in areas like Maytsebri, Mekelle and AA. After the exhibition, good linkage had been established between rice producers and traders. Cooperatives in each *Kebeles* had participated in rice marketing and had started to contribute their role in solving some of the market problems.

Source: Summarized from the JPP2 Annual Report (16th July, 2011 to March 30, 2015)

3.7 Project Monitoring and Evaluation

This is the fourth important component of the project. A number of activities have been implemented under this component and corresponding results have been reordered.

Mechanisms developed for project monitoring and evaluation

Monitoring, Evaluation, Learning and Sharing (MELS) Theme of SG2000, liaising with its staff at the PCDAT project office in Tigray, was responsible for periodic monitoring and evaluation of the project. Monitoring and evaluation plan of the project derived from the main strategy of SAA MELS Theme. MELS major activities include: needs assessments, baseline studies, periodic outcome monitoring, evaluation and impact assessment. MELS component of the project, therefore, undertook activities following the above chains. Using MELS approach, it was made possible to continuously and systematically collect, analyze and report monitoring data/information of project intervention.

The project started with a needs assessment and baseline survey which were coordinated by the MELS team. The project prioritized interventions based on findings of the needs assessment and benchmarks established using results of the baseline study. Periodic, quarterly, outcomes monitoring were conducted assessing progresses and tracking results of the project.

The project gave high emphasis to outcomes monitoring. Outcomes of the project were periodically monitored and results were continuously shared to staff including management for improved implementations and performance of the project. The monitoring provided evidence whether or not the project was going on the right track in terms of what was being done on the ground. It also gave evidence needed to verify as well as evaluate process of implementations and approaches followed by SG2000. The outcomes monitoring created a learning platform from which information and knowledge flows and shared continuously.

3.8. Project management

SG2000-Ethiopia implemented various development projects and activities for over two decades in collaboration with local partners. The project management practiced for implementing the PCDAT project has capitalized on SG2000 experiences in the agriculture sector. One of the strengths of SG2000 lies in its strong collaboration with the Ministry of Agriculture and working with in and utilizing existing structure of the country's extension system. In line with this, direct implementation of project activities were handled by SG2000 Mekelle Coordination Office working in close collaboration with the BoARD. This was supported by Woreda agriculture offices through establishing technology demonstrations, training farmers and closely following up implementation of the project.

Necessary inputs provided to Woreda and Kebele level implementers for actual implementation of project activities. Project staff also undertook continuous monitoring and supervision to

track progresses of planned activities, and to identify challenges and take corrective measures. Technical support to extension agents from project staff, and experience sharing visits enabled better implementation and improved performances of the project. This created the opportunity to understand project progress, identify gaps and take necessary and timely actions.

There was good participation of relevant stakeholders of the project. Joint planning was done particularly with Woreda and Kebele level agricultural offices. There was also joint follow up of implementations with Region al and Woreda offices. Participation of farmers in all aspects of the project including in this final evaluation was extremely high. The presence of such strong participation of relevant stakeholders played crucial role for smooth resource utilization and for sustaining benefits of the project and scaling up of good practices.

The partners at Woreda and Kebele levels were involved in the process of implementation starting from identifying and prioritizing needs to actually implementing activities to monitoring and supervision. On the importance of integrating complementary activities and efforts of the partners was underscored in the discussions made at the Woreda level. During the implementation process, partners at Woreda levels were expected to provide technical supports to extension agents at the Kebele level. They also played crucial role through follow ups and providing technical guidance to development agents and beneficiary households. In general, efforts from project staff and collaborating partners realizing the roles and responsibilities while managing and coordinating project implementation found to be encouraging.

4. Major Challenges and Lessons learnt

Major Challenges

Implementation of the PCDAT project was not always smooth and there were some major challenges; among them were DAs and SMS' lack of commitment, their busy schedule due to seasonal and urgent tasks, and continuous reshuffling of trained Extension Agents, particularly during its first year of operation. Due to overwhelming workloads, trained DAs and SMSs did not have sufficient time to organize and implement their action plans. They were overburdened with their regular work such as distributing inputs and mobilizing and orienting farmers on many different development and other agendas.

Busy schedules and lack of commitment of some DAs and SMSs also contributed to poor follow up and extension advice to farmers. Particularly, host farmers of demonstration sites were not regularly visited by extension agents, and hence there was little close supervision on the technologies they applied. This limitation contributed to poor demonstration for some plots as they were not done with care and appropriate follow ups.

Other challenges included irregular rainfall onset and erratic distribution in some potential areas, i.e., drought mainly in southern zone and sometimes also in western zone, inadequate supply of good quality seed of required varieties, low business management capacity for rice mill operation, lack of skill and knowledge in operating rice mills, lack of spare parts, high proportion of rice breakage during polishing and milling which lead to low grade and inadequate seed cleaners and multi-crop threshers.

Others included:

- Rice production is labour intensive as it requires frequent ploughing and weeding (at least two times in a single season);
- Distance of the project Woreda s from the center and at the same time from each other required staff to drive long hours to get to the sites and accomplish tasks;
- Farmers use their produce for some unproductive and costly consumptions such as for wedding, funeral related expenses (*teskar)* and other cultural ceremonies;
- Price of rice in Tsegede Woreda plummeted. Some believed that increased production and supply of rice contributed to this, while others said demand has shirked

tremendously. But it could also indicate the need for more effort to establish good market linkages.

Measures taken to solve some of the challenges

Several efforts have been done to solve some of the challenges. Low skills of machine operators and low capacities of cooperative leaders were minimized by intensive follow ups and periodic and regular refresher trainings and orientations. EAs and farmers were mobilized, trained and regularly oriented on how to reduce breakage of rice through improved harvesting, threshing and storage techniques of rice. More than 4,010 farmers have been trained on use of postharvest and agro-processing technologies, and about 6,628 farmers have used improved agro-processing technologies such as rice polishers, Multi-crop threshers and seed cleaners.

To improve lack of spare parts of postharvest machineries, private service providers were advised and encouraged to supply spare parts for rice mills.

About six cooperative leaders and business persons were trained on marketing of rice and groups were formed and became functional on seed production and marketing. Several stakeholders' events, rice food exhibitions and experience sharing visits to partners and farmers have been organized and efforts were made to solve the above mentioned problems of quality seed and marketing.

Finally, although the PCDAT project took different measures to solve the above challenges, further follow ups and support are highly required from Woreda level partners for scaling up and sustaining current achievements.

Lessons learnt

During implementation of the project, there were essential lessons learned in process. These included the following:

- Introducing new crops and new agricultural technologies along with practical trainings increases options of smallholder farmers and plays important role in diversifying income sources.
- The project enabled partners including farmers to learn the possibility of changing some previously idle plot of lands (marshy areas) and making them productive through rice production. Rice grows in marshy (waterlogged) areas that cannot be used for the production of other local crops.
- Although four different new crops were introduced to the target Woreda s of the project that include rice, soya bean, green gram and sunflower and all the newly introduced crops have respective benefits, the widely and intensively produced crop was rice. The reasons for that include high productivity of rice (2-4 tons/ha), possibility of preparing rice in different forms (like *enjera, kita, ambasha, genfo, nifro* and local beer), and the residue of rice could also be used as feed for livestock, which is also good for the practice of zero grazing in the project areas.
- Rice can be prepared and consumed in different forms, and it is also possible to mix rice with other crops, and prepare different foods having good tests.

- Consumption of rice was appreciated by farmers as it has good health benefits and preferred by children as compared to other local crops, which were cultivated and used in the project areas for generations.
- The flow of project inputs from the main office to the ground can be taken as an important lesson by other similar development projects.
- Joint planning of project activities with major partners particularly with Agriculture and Rural Development at Regional and Woreda levels facilitated ownership and contributed for better project performance.
- Smooth relationships with major partners found at different structures: Regional, Woreda, *Kebele* as well as the farmers' levels is very crucial for efficient implementation of project activities.
- Close follow up, and periodic monitoring and evaluation on a regular bases contributed for progresses made in producing required results of the project.
- Participation of local community members in the whole process of implementation of the program has been found to be quite determinant that deserves adequate recognition. This is in fact the basis for the sustainability of the components and activities implemented.
- The commitment of the project staff and the cooperation of different partners found at Regional, Woreda, *Kebele* and farmers' levels for successful implementation of the project was of paramount importance that can be taken as one of the major lessons for designing similar projects.

5. Conclusion and Recommendations

Conclusion

The final evaluation of the project '*Promoting Crop Diversification and Advanced Technologies in Tigray'* was conducted in March 2015. This four-year project was implemented in six Woredas and 24 *Kebeles* of the Regional Government of the National State of Tigray. The project was one of the various development endeavors in the Region aimed at contributing for the food security situation of the Region.

This evaluation was carried out based on the established criteria: relevance, effectiveness, efficiency and sustainability the project.

The project followed proper procedures to identify priorities and needs of farmers and to contextualize the project components and respective activities in line with development challenges of the project sites. As a result, the project was found very relevant to the priorities of Woreda, Kebele level partners including farmers. It was also consistent with existing development policies of the country and particularly the Region. Participation of partners in the process of planning was also found to be encouraging. The collaboration of the stakeholders of the project was strong and it was accompanied by timely flow of project inputs.

The project generally progressed on the right track towards the realization of the overall goal and the objectives. It has introduced new crops (e.g. rice, soya bean and green gram) as well as new technologies that have contributed a lot to the change in the livelihood farmers in the project areas. The project not only created capacities that sustain over time but also enabled farmers to build assets in the forms of livestock and construction of houses together with better household utensils, etc.

Moreover, the project contributed a lot to the introduction, promotion and utilization of rice in Tigray despite several challenges related to climate and other factors. Most of the project plans were accomplished while some problems such as drought, irregular distribution of rainfall and intensive work load on EAs were hindering implementation of PCDAT project activities. Significant improvements on production and productivity of rice have been recorded. Farmers have developed more demands for the crop. The rice mills and other equipment have also created favorable conditions for processing and utilization of rice. Market linkages were established between rice producers, local consumers and some external traders. In terms of

consumption, rice is becoming one of the stable foods manly in rice producing areas of the National Regional State of Tigray.

Overall observed changes include:

- Increased understanding and confidence of farmers to practice knowledge acquired on line planting of rice crop and other improved agronomic practice,
- Improved use of postharvest handling techniques and technologies
- Increased number of food items,
- Increased production and consumption of rice, and
- Increased income of households living in rice growing areas.

In general, it was observed that farmers who had previously been experiencing poor production on their waterlogged land are now able to secure their food through producing rice and using improved technologies. This had made tremendous effect in solving food security of farmers and this was one of the biggest accomplishments of the PCDAT project of SG2000.

Important lessons were learned from implementation of the project that could be taken as spring boards for planning and implementation of other development projects in the future. Working in close collaboration with Regional Bureau of Agriculture and Rural Development (BoARD) helped SG2000 to build capacity and develop effective strategic ways for extension delivery. Sustainability of achievements of this project could also be guaranteed with continuous support and follow ups from partners, particularly the BoARD.

Recommendations

- Intensive follow ups and technical supports are required as that are paramount importance to make the rice mills more effective and functional.
- Further support to strengthen seed producers group is important and can contribute for satisfying the high demand of seed.
- Price adjustment on rice in parallel with the quality and national market price is very important for sustaining the market linkage of the crop.
- Provision of some technical supports to the PTP farmers is very important to fill some technical and information gaps on the process of implementation of the new crops, and applying improved technologies on the traditional crops.
- Farmers in the project area are still using part of their produce for ceremonies such as wedding, *teskar* and other cultural ceremonies. If this continues in the same manner, the required change may not be achieved within a relatively shorter period of time. Therefore, further awareness creation and trainings are needed to reduce such unproductive ways of using the crops.
- The price of rice in Tsegede Woreda in particular is said to have been going down overtime. Regardless of the reasons at the present situation, integrated efforts have to be made by Woreda level partners of the project to create workable market linkages with different parts of the country in general and Tigray Region , in particular. Creation of market linkages are the actions that have to be done so as to be able to bring about

basic solutions to the price challenge.

- The problem of timely maintenance and the poor supply of necessary spare parts for the threshers and the seed cleaners introduced in the project sites requires close attention of Woreda level partners. Looking a solution for such challenges would have its own positive contribution for the sustainability of efforts exerted, resources mobilized and results achieved by the project.
- As the changes seen in the operational areas of the project are remarkable, it would be reasonable from JICA and SG2000 to consider next phase of the project particularly to introduce and promote technologies to other areas of the Region.

- This evaluation assured that rice is very important crop in different aspects. The Federal Government of Ethiopian has also identified rice as the 'Millennium Crop'. This means, therefore, integrated efforts have to be made to promote the diffusion of rice for cultivation to the marshy areas of the country in general and the Region in particular so that the problem of food insecurity would totally be arrested once and for all.

Annexes

Annex 1: Major crops grown in the sampled sites and use of fertilizer and improved seeds by crops

Crop types	Total Land cultivated (in hectares)			Quantity of DAP used in quintals			Quantity of urea used in quintals			Quantity of seed used in kilograms		
	Kebele			*Kebele*			*Kebele*			*Kebele*		
	Medha-nialem	Alem Genet	Genetie	Medha-nialem	Alem Genet	Genetie	Medha-nialem	Alem Genet	Genetie	Medha-nialem	Alem Genet	Genetie
Sorghum	24.245	45	36	1792.5	423	640	1542.5	372.75	730.37	596.5	684.5	613.5
Rice	12.97	22	0	1344.5	1485.25	.	1252	1085.25	.	1279	2175	.
Teff	5.5	0	29.5	239.5	.	444	231.5	.	446	217	.	651.8
Sesame	2.625	41.62	0	95	637	.	95	271.5	.	70	429	.
Millet	10.18	2.5	0	429	0	.	359	0	.	341	46	.
Maize	4.622	0	0.5	111.5	.	0	86.5	.	0	166.5	.	13
Wheat	0	0	5.655	.	.	116	.	.	126.5	.	.	137.3
Green gram	0	0	4.625	.	.	29.3	.	.	31.25	.	.	29.5
Chick peas	0.687	0	0.725	22	.	0	7	.	0	77	.	45
Barley	0	0	2.5	.	.	37.5	.	.	37.5	.	.	208
Onion	0	0.15	0	.	10	.	.	0	.	.	550	.
Gesho	0	0	0.75	.	.	25	.	.	25	.	.	26

Source: Household data of the Final Evaluation