SASAKAWA AFRICA ASSOCIATION

SASAKAWA GLOBAL 2000-ETHIOPIA

SG2000 Working Paper, No. 05, 2015

Promotion of Rice in Tigray Region, Ethiopia: The Contribution of Sasakawa Global 2000

The Monitoring, Evaluation, Learning and Sharing (MELS) Theme

Sasakawa Global 2000-Ethiopia

SG2000 Working Paper, No. 05, 2015

Promotion of Rice in Tigray Region, Ethiopia: The Contribution of Sasakawa Global 2000

Promoting Crop Diversification and Advanced Technologies in Tigray (PCDAT) Project, Sasakawa Global 2000 - Ethiopia

Multi-authored report by:

The PCDAT Project Team and the Monitoring, Evaluation, Learning and Sharing (MELS) Theme, SG 2000-Ethiopia

MELS Theme – SG2000 Ethiopia

Wondwossen Tsegaye
Semere G/Tsadik
Fikadu Chala
Kumsa Dandena

PCDAT Project Team

Sayako Tokusue
Kazuya Inui
Abera Gebreamlak
Muez Teare
Ashenafi Amare
Habtu Mekonen

SG2000 - Ethiopia (Management)

Dr. Aberra Debelo
Dr. Habtu Asefa

MELS Theme, SAA Regional Office

Ethiopia Tadesse

Sasakawa Global 2000 Ethiopia (SG2000)

Address: ***P.O. Box: 12771***
Addis Ababa, Ethiopia
Tel. +251-116-628810/11/15

Sasakawa Africa Association (SAA)

Address: ***P.O. Box: 24135 code 1000***
Addis Ababa, Ethiopia
Tel. +251-116-477-777

All correspondences to Wondwossen Tsegaye (wonde@saa-safe.org or wendsentsgay@yahoo.com)

Acknowledgement

This report was initiated by the management of the Sasakawa Global 2000, Ethiopia, to document SG2000 contributions in promoting rice in Tigray Region. The Monitoring, Evaluation, Learning and Sharing (MELS) Theme of SG2000 coordinated the data collection and report writing, while team members of the 'Promoting Crop Diversification and Advanced Technologies in Tigray' project have actively conducted the data collection and produced the draft report.

The PCDAT project was implemented in Tigray region by the Sasakawa Africa Association (SAA)/Sasakawa Global 2000 (SG2000) with financial support from the Japan International Cooperation Agency (JICA). Thus, the authors are very grateful for the opportunity offered by the SAA, SG2000 - Ethiopia management and JICA to write this report.

All SG2000 - Ethiopia staff and employees also deserve special thanks for their inputs during the preparation of this report. It is the earnest hope of the authors that all readers find the report factual, informative and a good example as a reference for other similar projects.

Caveat: All views expressed in this report, commissions and omission are the responsibility of the authors and not SAA nor SG2000 – Ethiopia.

Table of Contents

List of Tables

List of Figures

Acronyms

BoARDT	The Tigray Region Bureau of Agriculture and Rural Development
FLP	Farmers Learning Platform
FTC	Farmers Training center
JICA	Japan International Cooperation Agency
PHAP	Postharvest and Agro-processing
PCDAT	Promoting Crop Diversification and Advanced Technologies
PTPs	Production Test Plots
SAA	Sasakawa Africa Association
SG2000	Sasakawa Global 2000
TARI	Tigray Agricultural Research Institute
ToTs	Training of Trainers (ToTs)
N13	Nerica 13
MELS	Monitoring, Evaluation, Learning and Sharing
MT	Metric Tons
TOPs	Technology Option Plots
WADs	Women-Assisted Demonstrations

Executive Summary

This report assesses and describes the promotion and utilization of rice in Tigray Region, Ethiopia. It mainly highlights the contribution of Sasakawa Global 2000 in promoting rice in the region.

Tigray region has diverse soil types and vertisol, which is unsuitable for most crops but for rice production, is one of the most widespread soil type in the region. Considering the region's potential for rice production, SG2000 introduced rice in Tigray in 2006 in collaboration with the Tigray Region Bureau of Agriculture and Rural Development (BoARDT). In 2007, three rice varieties were introduced and selected rice varieties were demonstrated on nine farmers' fields. Results of the demonstrations convinced the Bureau (BoARDT) and these varieties were promoted to other different woredas in the region. About 143 ha of land was covered by rice in 2008 and it dramatically increased to 854 ha in 2010.

SG2000, through a project, "Promoting Crop Diversification and Advanced Technologies in Tigray (PCDAT)", has promoted improved production, postharvest handling, marketing and utilization of rice crop in three woredas of the region. The PCDAT intervention considered the increased demand and potential of rice in the region. Hence, the project introduced new rice varieties with improved agronomic practices, promoted improved rice mills and facilitated better market access. About 11,697 farmers were trained on crop productivity enhancing technologies. Seven rice mills, two multi-crop threshers and one seed cleaners were introduced. Extension agents, machine operators and farmers were trained on postharvest handling, maintenance and operation of the machines, and rice food preparation. The project further facilitated market linkages and contributed to improved consumption and utilization of rice in the project areas.

The different trainings and the rice mills promoted by SG2000 have created huge demand for rice and the machines brought real changes in rice production and consumption. About 75 percent of trained farmers reported that their knowledge and practical skills on rice production improved and they applied the skills on their farm. Rice demonstrations on farmers' fields have also registered yield up to 6.4 tons/ha. Rice production in Tigray region showed an increasing trend, from just 340 MT in 2008 to 14,456 MT (in 2012), and reached 10,195 MT in 2013.

Postharvest machines promoted by SG2000 provided service to about 5,016 rice farmers and about 681 MT of rice were processed. As a result of rice processing machineries, people in the area are now able to mill their rice for their consumption and sales.

Consumption of rice changed with increasing use of rice to make *Injera*, bread and different local drinks.

Increased production along with improved processing, marketing and food preparation has contributed for improved income and better acceptance of the rice crop in Tigray. Market price of paddy rice was also increased, contributing for positive change in income. SG2000 gave good focus for empowering women farmers with active participation in demonstrations and trainings from production to processing and marketing of rice.

While promoting rice in the region, SG2000 faced different challenges such as poor follow up from extension agents and marketing and other problems. Most of these challenges were solved with intensive follow up and trainings, and creating market linkages and other different measures. But, close follow up and support from the region's agricultural office is very crucial for further expansion and sustaining achievements in rice production and utilization in the region.

I. Introduction

1.1. Background

The National Regional State of Tigray is located in the northern part of Ethiopia. The Region is bordered by Eritrea to the North, Sudan to the West, National Regional State of Amhara to the South and Afar to the East. National Regional State of Tigray consists of six zones: Western, North-western, Central, Eastern, South-eastern and Southern administrative zones.

Rice was introduced in western and north western zones of Tigray region. Despite unsuccessful attempt to introduce the crop, some pocket areas of the southern zone of the region were believed to be potential to rice production. The region has diverse soil types. One of the most widespread soil types is the vertisol. This soil has high clay content and becomes rapidly water-logged in the rainy season rendering it unsuitable for most crops grown in the region. Therefore, the introduction of alternative crops such as rice which is cultivable on these soils could have a great impact on agricultural productivity in the region. Promotion of rice is a good opportunity to make use of waterlogged areas of the region; upland rice is well-suited to Tigray's climatic condition.

Rice can also have great impact on the region's productivity. Rice can also improve the "crop diversification" of the region and could possibly reduce risks associated with climatic conditions. Promoting rice in Tigray region, thus, play a big role to stabilize yields and overcome low productivity in addition to its benefits in diversifying meals and nutrition of the farming community.

Rice promotion in Tigray was started in 2006/07 as an initiative of the Tigray Region Bureau of Agriculture and Rural Development (BoARDT) and Sasakawa Africa Association "SAA/SG2000 - Ethiopia program". In 2007 production year, three rice varieties (Nerica 3, Nerica 4 and X-jegna) were introduced by SG2000, Ethiopia. Among those varieties, the Nerica varieties were selected as better performing varieties.

Sasakawa Global 2000 (SG2000) - Ethiopia demonstrated selected rice varieties on nine farmers' fields around T/Koraro and Tsegede Woredas of Northwestern and Western zones of the Region. The demonstrations have registered an average productivity of about 2.8 tons per hectare (ha). The result convinced the Bureau (BoARDT), SG2000 Ethiopia and Tigray Agricultural Research Institute (TARI) to promote rice crop to other Woredas such as Tselemti and Wolqait where other crops such as sorghum, finger millet and sesame yielded less than 1 ton per ha.

In the following year, 2008, farmers showed interest in producing the crop, and 143 ha of land was covered by rice; i.e., a total of 434 farmers have grown the crop. Rice production increased in the subsequent years; in 2009, the area covered by rice increased to about 508 ha (1139 farmers), and in 2010 the area under rice production was 854 ha of 1858 farmers.

As area coverage and production of rice increased, farmers faced challenges while harvesting, polishing, processing, consuming and marketing of the crop. Noting these

challenges, SG2000, Ethiopia has designed a project called “Promoting Crop Diversification and Advanced Technologies in Tigray (PCDAT)” under JICA Partnership Program.

1.2. Sasakawa Global 2000 in Tigray, PCDAT Project

Considering the potential of rice production in Tigray region, in 2011, SG2000 initiated a project called “Promoting Crop Diversification and Advanced Technologies in Tigray (PCDAT)” which was funded by the Japan International Cooperation Agency (JICA). The PCDAT project aimed to increase agro-diversity by introducing new crops to the region and strived to improve production by training farmers on more efficient and effective crop production technologies. Rice was a focus crop for the project.

SG2000 project interventions followed a value chain approach; from production to marketing. Thus, the PCDAT was started to increase crop productivity and household income as well as to promote crop diversification through supporting rice farmers from production to processing and marketing. To overcome constraints affecting agricultural production, SG2000’s known approach of Farmers’ Learning Platform (FLP) was used. The FLP approach consisted training of farmers and extension agents and demonstrations of improved agricultural technologies. One FLP consisted of Technology Option Plots (TOPs), Women Assisted Demonstration Plots (WADS) and Production Test Plots (PTPs) as technology demonstration and dissemination plots.

Further, the project used Farmers Training Centers (FTCs) as a focal point to teach and promote new and improved crop varieties as well as postharvest technologies such as multi-crop threshers and rice polishers. Marketing of rice was facilitated through linking farmers to potential buyers using different means such as organizing experience sharing visits, exhibitions and forums.

PCDAT intervention was planned considering the increase in the demand and potential of rice in the region. Although more and more land was being covered by rice and number of farmers growing rice had increased over the years, much work was still required to exploit the region’s potential for rice production. Average cereal productivity in the region was only about 0.8 tons/ha. This low productivity was attributed to limited options of productivity enhancing technologies, limited access to markets and limited implementation capacity of extension delivery services. These and other problems were the major reasons for SG2000 “PCDAT” intervention in Tigray region.

The project was implemented from 2011 - 2015 in 6 Woredas and 24 Kebeles. Out of these sites, rice was promoted in 12 kebeles in Tsegede, Wolqait and Tselemti Woredas.

Figure 1. Project woredas of the PCDAT project, Tigray Region

1.3. Purpose of the Report

There are limited documentations on the introduction and promotion of rice in Tigray Region. This raised a need to assess and document rice promotion for sharing lessons for future project implementation. Thus, the recent efforts and contributions or successes of the PCDAT project need to be documented and lessons should be drawn on and shared to stakeholders. This facilitates learning and, above all, will also assure SG2000 the credit it deserves in promoting rice cultivation. Hence, the main purpose of this report is to assess and document contribution of SG2000 through PCDAT project on the introduction, promotion and utilization of rice in Tigray region.

II. Project Interventions: Implementation and achievements

2.1. Crop Productivity Enhancement

SG2000, Ethiopia has promoted technologies to enhance crop productivity in Tigray region. As explained earlier, SG2000 intervention on crop production followed an approach called Farmers Learning Platform (FLP). As a tool to disseminate technology, SG2000 utilized its FLP approach to promote rice. Elements of an FLP include Technology Option Plots (TOPs), Women Assisted Demonstrations (WADs), and Production Test Plots (PTPs), all hosted by farmers. Further, farmer groups were established for seed multiplication. As a result, a total of 124 TOPs, 355 WADs and 1123 PTPs were implemented from 2011 to 2014.

Trainings on Crop Production and Productivity

Training of Trainers (ToTs) was one of the basic interventions of SG2000 (PCDAT) project. Pre, mid and end-season trainings were provided to all respective partners at each project Woreda. The focuses of the trainings were on land preparation, seed selection, line planting, use of improved seed and fertilizer application with recommended rates, timely weeding and harvesting, postharvest handling and marketing and market access. Accordingly, more than 95 percent of the host farmers received trainings from trained Extension Agents on the technologies promoted by SG2000.

A total of 11,697 farmers (8,646 males and 3,051 females) were trained on the above subjects. From these farmers, 4,093 farmers (2,947 males and 1,146 females) have implemented some of the improved agronomic practices; such as line planting, use of improved seeds, proper application of fertilizers, pest and disease control practices on rice.

Introduction of Nerica 13 Variety and Adaptation Trials at Research Centers

SG2000 introduced new varieties of rice with close collaboration with Agricultural Research Centers. Three (3) Agricultural Research Centers (Maytsebri, Humera and Alamata) were supported in the PCDAT project. The research centers conducted adaptation trials on four varieties of rice such as Nerica 3, Nerica 4, Nerica 12 and Nerica 13, and established favorable ground to demonstrate improved agronomic practices at farmers' fields. This helped to promote new varieties of rice.

Establishing quality demonstrations were important component of the project to promote improved technologies, increase yield and to reach many farmers. Community Variety Plots (CVPs) were implemented at Farmers Training Centers to show different crop varieties and options of technologies. Selected rice varieties were demonstrated at the FTCs, visited and evaluated by the nearby farmers in 12 FTCs. This have facilitated learning and uptake of new varieties which shows better performance in terms of yield and other factors. Further, training and demonstration of improved agricultural technologies at farmers' plots helped to develop farmer's skills and knowledge.

Based on the verification at the research centers and on the CVPs, Nerica 13 (N13) was found to be more suitable to different areas such as Tselemti, Wolqait and Tsegede

Woredas. Following that, N13 variety was demonstrated on farmers' fields and multiplied on Tselemti Research Center and farmers' field as well.

Figure 2. A WAD host farmer (growing N13) in Tselemti woreda

About 1093 farmers have been directly involved in the demonstration of rice – Nerica 13 - by the direct support of the PCDAT project. Because of its high productivity and other qualities N13 have got high acceptance by the community at large. Many farmers have demanded the variety in these years. In addition, seed multiplication was also started in 2012 by 60 farmers, and conducted in 2013 by 95 farmers. A total of 155 farmers have practiced seed multiplication of N13 variety of rice on their farm plot.

In general, the following were achieved regarding crop productivity:

- Better yielding variety was obtained (released) by research centers,
- Seed multiplication activities both on research stations and on farmers' plots were conducted to meet demand for quality seed,
- Waterlogged farm lands which had been considered as waste lands became productive,
- Improved agronomic practices were demonstrated and adopted by farmers,
- Area coverage, production, productivity and farmers' participation increased, and
- Special attention was given to women headed households to participate in the demonstration, training and implementation of project activities.

Figure 3. A farmer multiplied N13 in Tselemti Woreda

2.2. Postharvest and Agro-processing Technologies

SG2000 has introduced and promoted postharvest and agro-processing (PHAP) technologies such as Rice Mills, Multi-crop Threshers and Seed Cleaners in Tigray region. 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.

Trainings on Postharvest and Agro-Processing (PHAP) Technologies

Capacity building of extension staff, farmers and technicians at every agro-processing center was among the major activities implemented by SG2000. During the past four/five years, SG2000 has provided different trainings and established demonstrations on PHAP technologies. ToTs have been conducted and about 269 Extension Agents (EAs) and 134 lead farmers were trained on improved agro-processing and storage management technologies (See Tables below).

Table 1. Participants of ToTs and Farmers Training

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**

Table 2. Training Participants on Machine Operation, Maintenance and Service Provisions

Participants	2011	2012	2013	2014	Total
Operators	16	10	11	11	48
M/M/S/Providers	1	3	3	1	8
M/S/Providers			1		1
Agro-processing	0	0	146	0	146
Total	**17**	**13**	**161**	**12**	**203**

Postharvest and Agro-processing technologies and use of rice

Introduction and promotion of PHAP machineries have encouraged farmers to utilize rice in different forms. SG2000 installed rice processing mills, multi-crop threshers, seed cleaners and par-boil kits in the project areas and machine operators were trained on the use and operation of the technologies. Introduction of these technologies have helped farmers to utilize rice 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 breweries.

Figure 4. Operation of a rice mill in Wolqait - Selam Tabia

Further, farmers started to sell processed and polished and/ or paddy rice to surrounding consumers or traders utilizing market linkages created by the project. Market price of rice has also increased from year to year. Because of such practices, rice has also become one important source of income to the households.

Outcome monitoring survey, in 2012, of a case study in some households indicated that out of the total annually harvested yield of rice in a household about 54 percent (0.27 tons)

was used for consumption, while 28 percent (0.14 tons) marketed and 18 percent (0.09 tons) was reserved for seed.

The rice mills introduced by SG2000 have generally created huge demand and the machines are expected to bring real change in rice production and consumption.

Table 3. Participants of Demonstration of PHAP Technologies

Participants	2011	2012	2013	Total
Officials	39	29	158	226
SMS	20	25	42	87
DAs	26	16	77	119
operators/technicians	14	11	11	36
Farmers	846	478	436	1760
Total	**945**	**559**	**724**	**2228**

Figure 5. Demonstration of multi-crop thresher in Tselemti Woreda

2.3. Public Private Partnership and Market Access

Trainings on Public Private Partnership and Market Linkage

The project conducted ToTs on marketing and farmers' organization and business management in all the 3 project Woredas (Tselemti, Tsegede and Wolqait) in 3 rounds. 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 number of trainees were 90 DAs, 70 SMSs and 103 lead farmers (i.e., 263, in total), of which 23 were female. Following the ToTs, EAs and Woreda cooperative experts trained 2639 farmers (1973 male and 666 female) on marketing and farmers organization.

Four rice seed producer groups were established and trained to produce good quality seed of rice (N13). Further, one rice seed producer group and five multi-purpose cooperatives and one Cooperative Union were strengthened and trained on marketing and organizational management skills that enabled them to interact better with markets. In addition, refresher training was provided each year as necessary.

Figure 6. Women rice seed producer group in Alemgenet kebele, Tsegede Woreda

Rice Marketing and Eat Local Rice Exhibitions

The PCDAT project facilitated market linkages and promoted use of rice. Different forums and discussions were held with partners and potential buyers on rice marketing. Exposure visit was also arranged for nine representatives of rice producing farmers to nearby towns such as Woreta, Shire and Mekele to get experience on marketing and establish market linkages. After the exposure visit and exhibition, the first linkage between rice producers and traders was established. Identified potential buyers included traders and retailers found in towns like Woreta, Shire and Mekele. Currently, farmers in Wolqait and Tsegede Woreda are selling their rice in bulk to Woreta town traders.

Eat local rice exhibitions were also conducted on 5 occasions to popularize utilization of rice and attract buyers from different locations such as Maitesbri, Dansha, Shire, Mekele and Addis Ababa. Stakeholder's events were also held with many partners and potential buyers on rice marketing. During exhibitions, different food types such as *Injera which* consists of 100% rice, 50% sorghum and rice, 50% teff and rice, 50% maize and rice as well as several types of bread made of 100% rice and 50% wheat and rice were presented for tasting. Boiled rice mixed with Green-gram and soya-bean were also displayed. Locally brewed beverage made of rice were also prepared and displayed for tasting. The project

also conducted several other exhibitions, aiming to create good linkages between rice producers and traders.

To create a second market linkage, some model rice producer farmers, committee members of primary cooperatives and the Tselemti woreda cooperative union leaders traveled to Shire and Mekele town for popularizing their rice produce to traders and other consumers. Cooperatives in each project Kebele participated in rice marketing and have started to play their role to solve 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.

These days, locally produced and milled rice which meets consumer preferences has been sold in the domestic markets at Maitsebri and Dansha at a price of Birr 850 to 1100 per quintal (100 kg). Although there is no major trend of commercial farming of rice yet in the region, efforts made by SG2000 in collaboration with Tigray region BoARD and other partners have brought significant changes on coverage, productivity, utilization and marketing of rice by the farmers.

III. Successes and challenges of promoting Rice in Tigray

3.1. Use and adoption of Rice Production Enhancement Technologies

Farmers have gained new skills from the trainings on rice production, and have also started using some of the productivity enhancing technologies and agronomic practices. These include, planting of rice as an alternative crop, time of planting, and use of appropriate inputs and rate of application. Final evaluation of the PCDAT project showed that about 98 percent of the sample farmers in the project areas indicated that the trainings and advices helped them to improve their knowledge and practical skills on rice crop production and productivity. Out of the trained farmers (by the project), on average, 75 percent of them used or applied appropriate input rates with improved agronomic practices including improved land preparation. Their knowledge on threshing and milling rice crop has also improved.

Rice was performing well in terms of growth and productivity. This made rice preferable compared to conventional crops of the area such as sorghum and sesame. Rice demonstrations on farmers' fields have registered yield ranging from 3.3 tons/ha (in 2013) to 4.7 (2015) to 6.4 tons/ha (in 2014). Evaluation of the PCDAT project, in 2015, indicated maximum yield of 4.7 tons per hectare, while outcome monitoring surveys (in 2013) reported that SG2000 demonstrations (particularly TOPs) had, on average, obtained 3.3 tons of rice from a hectare. Women Assisted Demonstrations (WADs), similarly, registered rice yield ranging from 3.9 tons in Medhanialem Kebele to 4.2 and 5.4 tons in Alemgenet and Selam Kebeles, respectively. In 2014, SG2000 demonstrations (TOPs), on average, reported 4.7 tons per hectare, whereas Tselemti woreda registered the maximum rice yield, 6.4 tons/hectare.

Achievements of SG2000 demonstrations have created demand for rice production from farmers; both demonstrations host farmers as well as other farmers in the project kebeles. To satisfy these demand, SG2000 in collaboration with regional Bureau of Agriculture and Rural Development (BoARD) and other partners worked vigorously to scale up achievements in rice production within and out of the project Woredas.

This has resulted in an increase in coverage and production of rice from year to year. Overall rice production in Tigray Region has shown an increasing trend over the years. Rice production in Tigray has shown a significant increase as compared to what it was in 2008. In 2008, total rice production was only 340 MT, while in 2012 rice production reached to 14,456 MT.

In good rainfall season, the coverage and production increased fast. During good rain season, for example in 2012, the area covered by rice in Tigray jumped to about 3,090 ha with production of 14,456 MT. However, in 2013 production season, rice coverage and yield relatively decreased due to irregular distribution and onset of rainfall in some Woredas: land covered by rice was 1,947 ha, and rice production reached 10,195 MT. But rice productivity increased in areas where rainfall distribution was normal. Generally, rice

production, area coverage and number of farmers producing the crop increased compared to its level in 2008 (See Tables 4 and 5).

Rice production in Tigray can still be improved considering the production potential of the region and demand from farmers. According to surveys conducted by BoARD and SG2000, the total potential land which is suitable to rice production in Tigray was estimated to be about 6,000 ha with estimated annual production of 24,000 MT of paddy rice.

Table 4. Area Coverage and Production of Rice in MT during the last 6 years

Woreda	2008		2009		2010		2011		2012		2013	
	ha	Yield	ha	Yield	ha	Yield	Ha	Yield	ha	Yield	ha	Yield
Tsegede	39	65.5	107	300	479	1433	1955	7478	1575	6616	629	2581
Wolqait	38	92	161	97	172	828	314	1567	751	3299	224	1142
Tselemti	66	183	240	909	204	1210	332	2064	762	4541	1062	6472
Total	**143**	**340.5**	**508**	**1306**	**854**	**3,471**	**2,601**	**11,109**	**3,090**	**14,456**	**1,947**	**10,195**

Source: Woreda office of Agriculture and Rural Development, Annual Reports

Table 5. Number of rice producing Farmers, from 2007- 2013

Farmers producing Rice	Production Years						
	2007	2008	2009	2010	2011	2012	2013
Male	9	429	1082	1822	2583	4872	3119
Female	0	5	57	36	230	497	253
Total	9	434	1139	1858	2813	5369	3372

Source: Woreda office of Agriculture and Rural Development, Annual Reports

3.2. Use of Postharvest and Agro-processing Technologies

One of the increasing demands from farmers was to learn more about how to utilize rice product. This came following the significant increase in rice production due to introduction and promotion of Nerica 13 rice variety by SG2000. Unless they know how to process or sell it, there is no way they can take advantage of the increased production. Hence, a series of request for postharvest handling and agro-processing technologies came from rice producing farmers.

SG2000 responded to the request by introducing and promoting postharvest technologies. Postharvest machines such as Rice mills, Threshers and Seed cleaners were introduced in the project woredas and have created huge demand for postharvest services. The challenges raised by farmers were partially solved after the PCDAT project introduced and

promoted 6 Rice mills to 3 Rice producing Woredas. The machines were greatly appreciated by rice producing community and Tigray Bureau of Agriculture.

Promotion of the rice mills has also created more demand both from public and private partners**.** Tigray Bureau of Agriculture purchased six additional rice Mills with technical support from the project for service provision to farmers in the region. There was also one private investor and one Monastery who purchased rice mills after observing service provision of the SG2000 introduced rice mills in Tselemti Woreda. All these have created a new chapter on Tigray rice production activity.

Table 6. List of SG2000 supported Rice Processing Machines in Tigray

Project Site	Type	Power	Kw/hp	Qty	Status
Tsegede Woreda					
Dedebit	Two stage/SB-10D	Diesel	18.5/27	1	Functional
Maidele	Two stage/SB-10D	Electrical	18.5/27	1	Functional
Alemgenet	Two stage/SB-10D	Diesel	18.5/27	1	Functional
Wolqait					
Selam	Two stage/SB-10D	Diesel	18.5/27	1	Functional
Endabo	Two stage/SB-10D	Diesel	18.5/27	1	Functional
Tselemti					
Medhanialem	Engel Berg/N110	Electrical	11/15	1	Functional
Tsaeda Kerni	Two stage/SB-10D	Diesel	18.5/27	1	Functional

Use of postharvest machines increased in the project woredas immediately after introducing and demonstrating the machines. SG2000 demonstrated the postharvest machines to about 1,347 farmers and 201 Extension Agents. As a result, more than 5,016 rice farmers used the service of these postharvest technologies. Number of farmers or beneficiaries getting these services has increased year after year depending on efficiency of operators and cooperative management committee members. A total of about 681 MT of rice were polished by the PHAP technologies - rice polishers, Multi-crop threshers and seed cleaners. The machine in Medhanilem, Tselemti Woreda, has performed (in terms of amount of polished rice) better than others (Table 7).

Table 7. Amount of Polished Rice by the Machineries

Processing Center	Service Users (Beneficiaries)			Polished amount (in tons)	Money Collected from the service (in Birr)
	Male	Female	Total		
Alem-genet	562	72	634	73.41	26,875.20
Maidele	68	19	87	11.44	4,572.80

Dedebit/Qeshi-gebru	799	235	1034	221.87	71,426.00
Selam	327	63	390	36.58	10,974.30
Endabo	54	19	73	10	3,000.00
Medhanialem	1771	661	2432	308.82	123,527.60
Tsaeda-qerni	278	88	366	19.7	5,292.50
Total	**3859**	**1157**	**5016**	**681.82**	**245,668.40**

As a result of rice processing machineries, people in the area are now able to mill their rice for their consumption and sales. Consumption of rice has also changed with increasing use of rice to make *Injera*, bread and different drinks. Local alcoholic drinks were vastly spread within rice producing communities. Rice producers also benefited from the market linkage created which enabled them to sell their rice to grain traders from Woreta area, Amhara region, which remains to be the community's biggest buyer of rice. Furthermore, in Tselemti Woreda, local market venders started to sell rice locally.

Despite significant successes of the PHAP technologies, there were some challenges related to management of the machines. All the processing machines were functional and have been working properly, but they did not thresh or polish enough quantity of rice and other crops as compared to their capacity and potential. The rate of adoption and use of rice mills for the last two years was not as high as it had been expected; polishing service provision was generally 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. Rice Marketing and Change in Income

Increased production along with improved processing, marketing and food preparation has contributed for improved income and better acceptance of the rice crop in Tigray. The project introduced new rice varieties, rice polishers, and farmers were trained in rice agronomic practices and rice food preparation and marketing. Further, market linkage with traders were facilitated. Currently, there is no market problem. Many local traders are encouraged and farmers in Tsegede and Wolqait are selling their paddy rice to these traders and cooperatives in their kebele.

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).

Individual cases of Success

There were changes in the consumption and selling of rice as indicated from 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 were 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 about 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 cooperatives, 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 520 which was 20 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.

The PCDAT project, further to improving income of rice farmers, has created a learning platform from which information and knowledge flows and shared continuously. Some of the observed changes include: knowledge gained on line planting practice of rice and Teff crops, increase in understanding and confidence of farmers to practice new technologies and agronomic practice, increase in the number of food items, effective and feasible changes in the consumption habit of community at large.

The project has also empowered 11 women farmers of Alemgenet Kebele by providing opportunities to participate in demonstration and trainings from production to processing and marketing.

Regarding marketing, the project created linkages with buyers and encouraged farmers to set reasonable price to benefit from their produce. Most of the rice producers believed no urgent problem in marketing rice because they were able to sell enough to local vendors and traders from Amhara and Tigray regions. These situations made farmers less interested for further market linkages where competition exists and expected price is low. Setting a competitive price, however, is essential to sell the relatively lower quality rice of Tigray. This was attractive mainly for those who prefer economical way of making *injera*. However, it has been difficult to convince farmers to set reasonable price as they were able to sell their product locally with their proposed price.

During final evaluation of the PCDAT project attempt was made to assess opinion of farmers in three kebeles with regard to change in income and marketing, and except one project kebele, Genetie, two of the project kebeles reported positive change in that aspect (see table 8).

Table 8. Percent of farmers in three kebeles reported improvement in marketing and income

No.	Changes observed	Project Kebeles		
		Medhanialem	Alemgenet	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

Although the project succeeded creating a market linkage mainly by inviting traders from Woreta, Amhara region to buy rice produced in Tigray, it faced some obstacles while creating further linkage. One of the serious challenges was the poor quality of the rice in Tigray which is mostly broken with little purity as it is mixed with other unnecessary matters. This made it difficult to enter into the market, as there was better quality rice in the market. Seeking solution to this, the project made numerous efforts to improve quality of the produce among which was convincing producers to set prices that could make them competitive.

Despite this challenge, the PCDAT project tried and looked for new market opportunities to create linkage to market 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 Major Project Challenges and Measures taken

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 DAs, 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, low 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.

Measures taken to solve some of the challenges

Several efforts have been done to solve these 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 3460 farmers have used improved agro-processing technologies such as rice polishers, Multi-crop threshers and seed cleaners.

About six cooperative leaders and business persons were trained on marketing of rice and five 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.

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

Finally, although the PCDAT project took different measures to solve the above challenges, further follow ups and support are highly required for expansion and sustaining current achievements.

IV. Conclusion

The PCDAT 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 equipments 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 stable food 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 the PCDAT project, SG2000.

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 these project could also be guaranteed with continuous support and follow ups from partners, particularly the BoARD.

Annexes

Table 9. Grain Yield of TOPs by Woreda (Ton/Ha), 2014

Woreda	Crop Type	Yield	DAP+urea (Ton/Ha)	NPS+Urea (Ton/Ha)
Tsegede	**Rice**	**Mean**	**4.2**	**4.4**
		Minimum	3.5	3.2
		Maximum	5.0	5.5
Wolkait	**Rice**	**Mean**	**2.2**	**2.9**
		Minimum	1.5	2.0
		Maximum	3.0	4.0
Tselemti	**Rice**	**Mean**	**6.2**	**6.4**
		Minimum	5.7	5.6
		Maximum	7.2	7.7
Total	**Rice**	**Mean**	**4.2**	**4.6**
		Minimum	3.6	3.6
		Maximum	**5.1**	**5.7**