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FRG II Project

# Empowering Farmers' Innovation Series No. 4

## Backing Rice Extension Rightly

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Ethiopian Institute of Agricultural Research

# Backing Rice Extension Rightly

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# Preface

Rice research and development in Ethiopia is gaining a momentum due to the concerted efforts made by different governmental and non-governmental partners and the private sectors in recent years. The rice sector development is guided by the Rice Research and Development Strategy and its implementation plan for 2011 - 2015.

This proceedings contain papers that were presented during a seminar entitled “Enhancing Rice Technology Dissemination in Ethiopia: Lessons, opportunities and Challenges” jointly organised by Ethiopian Institute of Agricultural Research (EIAR)/Farmer Research Group II Project (FRG II) and Ministry of Agriculture (MoA) Rice Secretariat. The purpose of the seminar was to discuss the status of rice technology extension and to facilitate sharing of experiences among different partners from within the country and abroad.

The first paper focuses on the current extension system along with rice extension packages that are promoted by the MoA and respective BoA in the country. Two papers that follow are related with rice technology promotion activity made by EIAR through pre-scaling up activities and FRG approaches. The fourth paper deals with the experience of rice technology and dissemination in Uganda through JICA projects and the last paper presents the experiences of Sasakawa Africa Association (SAA) in rice technology dissemination in selected African countries. The summary of the discussions and recommendation is also presented.

It is hoped that the availed information will help all stakeholders including extensionists, researchers, farmers, and the private sector to clearly understand the status, and existing challenges and opportunities in rice technology dissemination in Ethiopia and beyond paving the way for the development of more efficient intervention options for the future.

*Editors*



# Rice Extension Approaches and Extension Packages in Ethiopia

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## Introduction

Rice cultivation in Ethiopia is a very recent phenomenon *vis a vis* its utilization as a food crop. The cultivation of the crop has begun at Fogera (Amara Region) and Gambella plains in the early 1970's. Currently, Fogera, Gambella, Metema, and Pawe are major rice-producing areas in Ethiopia. The occurrence of wild rice (*Oryza longistaminata*) in the swampy and water logged areas of Fogera (locally known as zurha) and Gambella plains is believed to have prompted the cultivation of the crop at these locations. Subsequently, rice adaptation and screening experiments were initiated and conducted at Fogera, Gambella, Werer, Debre Zeit, and Arba Minch from 1968 to 1988.

The crop offers several advantages to farmers compared to other field crops grown in the country. It gives more yield per unit area, and contributes a lot to food security. At the current productivity level at farmers' fields, paddy rice produced from a hectare of land can sustain 4 more people. Furthermore, the crop is valued for its variety of uses e.g. in the preparation of local food and beverages (enjera, dabbo, genffo, kinche, shorba, tella, and katikalla) either alone or mixed with other crops such as teff, millet, wheat, barley, and maize. In general, rice could be considered as one of the best and the cheapest alternative technology available to farmers for efficient utilization of their scarce resources, especially the land and water in swampy and water logged environments. In addition, owing to its length of growing period, rice is suitable for sequential cropping. Rice is also primarily a cash-earning crop. The rice bran, hull, and straw are used as animal feeds. Furthermore, the straw is used for house thatching.

Considerable amount of arable lands are usually flooded during the rainy season, especially July and August, and vast area of land is left for open grazing in the country. Moreover, huge underutilized cultivable lands, potentially suitable for rice cultivation exist in many parts of the country. Therefore, encouraging rice production through the provision of all possible incentives and availing of appropriate measures for the alleviation of major production constraints is of paramount importance for enhancing productivity of the crop, thereby contributing to food security in the country.

## **Extension Support for Rice Production**

The rice extension is linked with the national extension system development as it is for other agricultural commodities and it has evolved overtime in the country. Over the years, MOA has followed different approaches to reach the farmer. In the 1960s, and early 1970s intensive regional agricultural development projects were launched. The first series of package programs were the so-called maximum package programs (MMPI). These include the establishment of Chilalo Agricultural Development Unit (CADU) in 1967, through the support of Swedish International Development Agency (SIDA), the Wollaita Agricultural Development Unit (WADU) in 1971 through World Bank support and the Ada District Development Project (ADDP) in 1971 through USAID support. These projects focused on providing comprehensive support including infrastructure and technological input to the specific region where the projects were located, and therefore, their geographical coverage was limited. In 1971, a more comprehensive minimum package program (MMPII) of the Extension and Program Implementation Development (EPID) was created within MoA (Amare, 1977). All the intensive regional development projects like CADU, WADU and ADDP were brought under EPID program as part of national extension network. EPID's programs were assisted by FAO's Freedom from Hunger Campaign (FFAC), whose major focus was on fertilizer followed by improved seeds and pesticides. These approaches also helped the development and expansion of commercial

farms prior to the 1974 revolution. However, the majority of the farmers were not the beneficiaries of these projects, perhaps with the exception of model farmers living along the roadsides.

As a follow-up of MPPII, the Peasant Agricultural Development Project (PADEP) was launched in 1983. PADEP was intended to enhance input distribution, promote the role of cooperatives in rural development, improve linkage between research and extension, and improve the performance of extension based on Training and Visit (T & V) concept. The three key elements of T & V approach were: promoting effective communication with farmers; strengthening linkage between research and extension; and improving the performance of extension based on training and visit. Under Ethiopian context, the T & V system narrowed the communication gap between the farmer and the extension agent, but the linkage between research and extension remained unchanged (Amare 1977). The training of extension agents on a bi-weekly basis was also tiring and redundant, and the system was not supported by effective and strong technology supply network. In summary, extension approaches prior to 1993 shared some common shortcomings. These include: inappropriate choice of extension approaches and strategies, lack of extension professionalism and relevant agricultural technologies, low research and extension linkages, and poor participation of farmers in generation and utilization of technologies. Thus, these situations led the current government to think about reforming the extension services to assist its economic development policy.

Starting from 1993, the Sasakawa Global-2000 program has become a major player in the extension system by promoting credit-support and supply of inputs, mainly seeds and fertilizers. This 'aggressive technology transfer' system was later taken up by the Ministry of Agriculture as part of its new extension strategy, known as the Participatory Demonstration and Extension Training System (PADETS), which combines training, visit and demonstration plot-based extension system with the SG-2000 fertilizer and seed credit package.



Extension strategy is determined by the National Extension Intervention Program (NEIP), which aims to ensure food self-sufficiency. The main strength of the NEIP or PADETS approach is that it considers three basic elements of an extension system, namely a package of technologies, credit and communication. These three elements involve many actors, such as the input co-ordination unit, the cooperative office, state council offices, credit institutions and private sector suppliers of inputs such as fertilizers, seeds and agro-chemicals. In summary, the existing extension system has the following basic characteristics:

- Effective field-level organization allowing extension personnel to work with farmers, both individually and collectively;
- Existence of sufficient number of trained personnel of different backgrounds capable to carry out the program from the planning stage to practical implementation on the farmer's holdings;
- Program of effective in-service training for existing personnel, and initial training for new recruits joining the service;
- Sufficient budgetary resources to cover program expenses;
- Close collaboration with the agencies concerned with agricultural research, seed production, quality control, agricultural credit, and marketing.

As it is for other crop technologies, the extension service in major rice producing areas was instrumental for rice technology transfer and considerable rice yield increment was recorded in the last few years mainly due to the attempts made in transferring the improved rice technologies (mainly varieties) to the farmers. The Ministry of Agriculture is responsible mainly for preparation of rice technology packages, conducting training, coordination of inter-regional activities, and provision of technical back-stopping. The role of other governmental and nongovernmental organizations, mainly Sasakawa Global 2000 and JICA in all these efforts was significant.

# **Production and Dissemination of Rice Seed**

Efforts for increasing agricultural productivity and production would be a futile attempt without the availability of improved seeds. Until 2009, there was no any formal seed producer supplying improved varieties of rice. In view of this, the newly developed rice research and development strategy emphasizes:

- Production of basic and certified seeds;
- Strengthening rice seed distribution network in the country;
- Supporting on-farm seed production;
- Creating awareness and provision of up to date information on availability seeds to farmers;
- Strengthening the capacity of public and private seed companies.

## **Major Production Challenges**

Extension packages are mainly prepared based on the existing knowledge and available technologies, and the packages are open each year for improvement as new technologies come into picture. The major rice production constraints faced in the process of developing rice extension package are the following.

### **Agronomic constraints**

The major agronomic constraints in rice production are identified to be weeds, pest, diseases, and lack of their control methods. Poor land preparation techniques are reported to be the third most important rice production constraint. Method and date of planting that is developed taking the rainfall patterns, soil type, and rice varieties into consideration is lacking. Problems associated with fertilizer use are viewed relatively less important mainly due to the limited utilization of chemical fertilizer currently.

### **Pre and post harvest handling**

According to the priority of rice production input constraints, post harvest handling particularly availability and access of equipments, for

example, thresher is also major constraint in rice production. Even though, producers do not store rice due to high market demand immediately after harvest, the lack of modern storage facilities is also a serious limitation. Rice husking and milling is accomplished mostly by using local flour mills. Thus recovery of good quality milled rice is very low due to excessive grain breakage. Although there are few rice mills in Fogera and Guraferda woredas, the availability of efficient de-hulling and milling equipments are reported to be the major constraints in rice production. Produce is stored in jute bags at home or in traditional storage bins. Hence, these storage practices are incapable maintaining the quality of the produce for a long period, and grain losses are high. Harvesting and threshing is done manually and by trampling of animals. Delayed harvesting and shattering are also serious problems that have to be reckoned with.

## **Extension Packages**

A step-wise approach of integrating new technological options into production systems with full farmer participation is essential to close the large gaps between actual farmers' yields and attainable yields under better management. The existing extension package for rice was developed in 2005 by the extension department of MOA in collaboration with JICA and SG 2000. An attempt was made to incorporate available technologies and improved practices, rice food recipes and extension service approach in the package.

Rice is a new crop and there are diverse potentially suitable agro-ecologies in the country, and therefore updating the package periodically with available new technologies and improved practices is required. Currently, the extension department is revising the package, incorporating recently released upland NERICA varieties. In the future, developing area specific and agro-ecology based extension package is going to be needed according to the intervention and implementation strategy.

The current rice extension package includes best agronomic practices and technologies i.e. improved varieties, fertilizers, and chemicals required to control pests; So far, 15 improved varieties (12 for rainfed and 3 for irrigation) are released. In order to encourage farmers to produce rice, information on costs and benefits of traditional and improved agricultural practices was included in the extension package.

## **Gaps and challenges**

### **Technologies**

- Lack of recommended transplanting technique;
- Lack of information on ratoon management; and
- Lack of recommendations on agronomic and cropping systems management  
Lack of information on parboiling techniques

### **Capacity**

- Limited skill of extension personnel; and
- Lack of experts specialized on rice and the knowledge gap.

The main challenges are related to inputs, agronomic practices, irrigation and water management, pre and post harvest technologies, markets, product utilization, investment, the limited human and institutional capacity, and to some extent policy.

## **Conclusion**

Rice has been cultivated in Ethiopia for 3 decades. However, there was no considerable progress made until the National Rice Research and Development Strategy was initiated and implemented in 2010. According to available evidences, the productivity of the crop has increased from 2.35 t/ha in 2008/09 to 3.2 t/ha in 2011/12. This is encouraging but still more needs to be done to close the great gap between research and actual farmers' productivity levels.

Agricultural extension has been instrumental in promoting the adoption of agricultural technologies and innovation, especially since the introduction of a new extension system with the support of SG 2000 in the early 90s and this needs to be further strengthened to make it more efficient and responsive.

Rice is a new introduction to Ethiopia, the role of extension to boost its production is enormous. Cognizant of this fact, the MoA has been promoting rice through development of rice extension package and supporting its implementation. Further efforts are needed to create synergy and complementarities among concerned stakeholders particularly in making use of the relatively good institutional capacity at both Federal and Regional level involving development partners such as SG-2000 and JICA.

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# Pre-Scaling up of Rice Technologies

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## Introduction

Experiences in recent years have shown that technologies generated by the national agricultural research system do hold considerable promise in substantially improving the agricultural productivity and production in various parts of the country (Tsedeke, 2006). The Ethiopian government is strongly promoting available improved technologies, and as a result the farmers' demand for technologies is greatly increasing. The Ethiopian Institute of Agricultural Research (EIAR) in collaboration with different actors including Regional Agricultural Development Partners' Linkage Advisory Councils (ADPLACs), farmers, administrative officials, extension workers, NGOs and traders has made successful progress in testing, adapting and promoting different agricultural technologies adapted to small-scale farming systems (Tsedeke, 2006). The principal features of the new, "coordinated multi-stakeholder partnership technology scaling up" approach (Seid *et al.*, 2006) included: technology as a package (i.e. variety and management practices); involvement of all stakeholders as partners with shared responsibilities, follow-up and technical backstopping by multi-disciplinary research team; direct researcher-farmers involvements at the grass-roots (district/*wereda*) level; training of farmers and other stakeholders; adequate and timely provision of required inputs (i.e. seed as revolving input returned in kind), regular on-the-field follow-up; and facilitation of marketing of produce. Such multi-stakeholder technology dissemination process has become a model by which farmers adopt and incorporate improved technology into their farming systems.

## **The Approach**

Experience shows that incomplete stakeholders' participation in promotion of technologies has limited effectiveness, sustainability, and outputs. The technology promotion and/or demonstration using volunteer farmer's fields have been undertaken with dual objectives availing of technologies; and availing of seed on revolving scheme that enhances the exchange of the seed within and between localities.

On the basis of the success stories exhibited in limited areas, the EIAR has established focal task forces to scale up appropriate crop technologies suitable for major agro-ecologies. The scaling up of improved agricultural technologies requires partnership and coordinated action. To this effect, efforts have been made to establish synergistic and concerted team action. Consultative workshops have been organized in order to establish linkage and define roles and responsibilities of the participating stakeholders at individual and group levels. Training of subject matter specialists (SMS), development agents, farmers, and other stakeholders involved has also been implemented as one important aspect for the success of the scaling up activities. Furthermore, concerned institutions and farmers have participated in the supervision of the scaling up processes. Multi-disciplinary team of researchers and experts made regular field visits to observe the progress and to give advice, to fix problems on proper crop and field management practices.

### **Technology identification and training of trainers**

The success of technology dissemination program depends on appropriate prior orientation given to participants on introduced technologies, and the stepwise implementation of subsequent activities. Hence, technology based training was one of the activities in the process. Specialists in rice technology have offered training for SMS, researchers and other professionals. The training was supported by field practical demonstration with emphasis to best production practices of rice.

## Partnerships

The key stakeholders involved in the scaling up of rice technologies include agricultural research system, extension services, seed producing enterprises, and local/*woreda* administration were engaged in a win-win partnership (Figure 1). Agricultural research has availed new, best performing NERICA varieties that have wide adaptation. The extension participated in selecting participant farmers willing to plant the varieties on large plots (at least a quarter of a hectare). It also led on-job and class training of farmers on effective implementation of the new technology packages. The seed enterprises have encouraged or facilitated the quality seed production on the demonstration plots. On the other hand, the local administration has taken leading facilitation role in up scaling the best rice production practices. Participant farmers on their part took responsibility in undertaking the recommended full package of practices.

## Revolving seed scheme

Putting in place a decentralized seed system was considered as key intervention area in the crop technology pre-scaling up. Farmers got into agreement to use the loaned seed and return equal amount of seed back at the end of the season for re-distribution to others in subsequent seasons. Serious caution is exercised to maintain the quality of seed during collection and guarantee the produced seed to meet at least established standards e.g. C1 to C4 level for self pollinated crops.

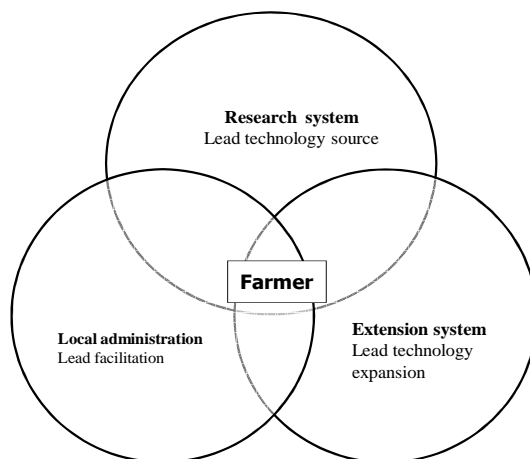




Figure 1: Integration of and the interface between key players and partners in the pre-scaling up program

## **Demonstration and spillover**

The means used for enhancing technology spillover was technology exhibition, organized in the form of field days, exchange visits, and plot side demonstration for passers-by. This has helped in influencing perceptions of visitors; and soliciting innovative ideas from participants. Spillover of technologies, knowledge, and skills among neighborhoods, *kebeles*, *weredas*, and zones was facilitated.

## **Results and their implications**

The crop productivity attained was about three tons per hectare on average (see also Kebebew et al., 2011). Of course, there was variability among locations, varieties and management methods. The three years pre-scaling up work was undertaken in more than ten *weredas* of Tigray and Amhara regional states. Basically the promotion effort of this globally important crop is still at its infancy. However, innovative producers are encouraged and this approach is helping in promoting rice as a crop of high potential in Ethiopia.

In the figures and tables below the number of participant farmers involved (Figure 2), amount of seed availed (Table 1). Overall all these parameters show an increasing trend. The results demonstrated that the decentralized seed exchange scheme implemented in partnership with key actors was instrumental in fastening technology promotion in a sustainable manner.

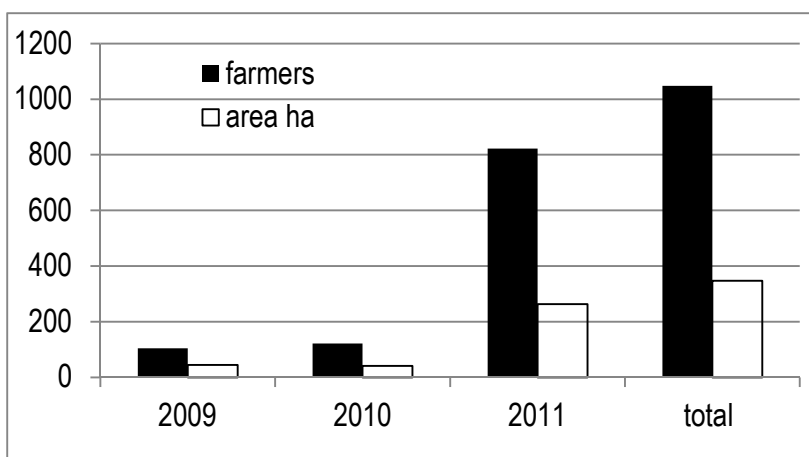


Figure 2: Number of participant farmers and area coverage of rice technology

Table 1. Rice seed supplied during the scaling up by variety

Region	Wereda	Variety			
		Nerica 4	Nerica 3		Superica
		2011	2009	2010	2009
Tigray	Tselemti		38		2
	Wolkait	38		50	
	Tsegede	30		100	
Amhara	Dawa chefa	20			
	Bahir Dar Zuria	80			
	Semen Achefer	1			
	Jawi	20			
	Libo Kemkem	57			
	Tach Armachio	30			
	Quara	50			
	Total	326	38	150	2

## **Challenges**

- Lack of processing machinery;
- Limited knowledge and expertise on the crop;
- Weak seed system (the informal seed sector is the only rice seed source, and those used for this program all came from this program); and
- Poor marketing structure

## **Lessons Learned**

- Integrating the technology pre-scaling up program with a seed exchange system is a guarantee for the sustainability of the technology dissemination scheme;
- Identifying key stakeholders and task sharing ensures attainment of set out targets;
- Rice is receiving acceptance because of its competitiveness, diverse home uses, market values, adaptability, non displacement of other crops; and
- The crop is responsive to agronomic management and there is still room for more exploration to further enhance crop performance

## **Direction**

- There is need for further work on variety/ies and agronomic practices;
- More effort is needed to establish enhanced seed system (PVT, informal, formal);
- More research has to be conducted on the production-processing–utilization-marketing continuum ; and
- Pursue wide dissemination of rice technologies to other un-addressed but suitable agro-ecologies

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# **Roles of Rice FRGs in Technology Dissemination in Benishangul Gumuz Region**

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## **Introduction**

Rice is a recently introduced crop and therefore rice research and extension is at an infant stage. However, in the last few years, promising varieties were released and extended to farmers, which are having significant contribution for the enhancement of rice production in the country. In Benishangul - Gumuz, it is estimated that the crop can be cultivated on about 4.9 million hectares of land under rain fed conditions. However, the land allocated for rice was about 10,080 ha in 2009, which is very low in view of its potential (MoA, 2010). Several reasons can be cited for the low rice production in the region but the most critical are inaccessibility to improved seeds, poor agronomic practices and weak extension system. As part of the endeavor in addressing the stated problems participatory research in the form of Farmers Research Group (FRG) has been promoted in the region.

The purpose of the FRG approach is to facilitate the generation of readily acceptable technologies by encouraging farmers to participate in research and getting access to apply their indigenous knowledge. This paper documents the experience gained through FRGs in rice technology dissemination in terms of technology selection, adoption, linkages created, and level of farmers' awareness in the region.

## **Methodology**

In 2011/12 cropping season, prior to the establishment of the Farmer Research Groups (FRGs), the constraints of rice production were indentified and prioritized following need assessment studies and participatory rapid appraisal at Bambasi district, and the most important bottleneck was found to be lack of improved varieties.

Before carrying out the project, innovative farmers were selected to form FRGs. Theoretical and practical training was given on rice production and FRG concepts to the members of the group. The members were divided into four sub-groups where the experimental trials were conducted. The experiment was conducted in an RCBD design with five treatments (five varieties namely NERICA 3, NERICA 4, Cukit, FKRS and a local one). There were four trial farmers and each farmer's field was considered as a replication. The recommended agronomic practice was applied (seed rate 60 kg/ha, DAP and Urea 100 kg/ha each). The established groups were responsible for managing the activities and facilitate skill, knowledge, and experience sharing among different key stakeholders that was imperative to expand rice production technologies. Meetings, discussion, and field visits were scheduled in order to effectively evaluate and monitor the progress of the research activities. Farmers' comments and suggestions were considered to improve the research activities. During field days farmers and other relevant stakeholders were given the opportunity to conduct participatory variety selection and identify the best performing rice varieties using their own selection criteria.

## **Achievements**

### **Technology selection**

The most outstanding variety, NERICA-4 was selected by farmers during participatory variety selection (Tables 1). The yield potential of

the variety was higher than other varieties. Furthermore, resistance to diseases and drought tolerance were some of the unique features of the variety that were taken into consideration during the selection process. NERICA-4 registered the highest yield of 33.9 q/ha, followed by FKRS (29.5 q/ha) and NERICA-3 (24.8 q/ha). The check gave 24.2 q/ha, which was 9.8 q/ha less compared to NERICA-4 (Table 2). The farmers have cited the following reasons for selecting the variety:

- Early maturity as compared to other varieties;
- Its tolerance to drought;
- Resistance to rice diseases especially brown spot and blast;
- None shattering grains; and
- Its good response to fertilizer application

## **Technology adoption**

The experience with FRG approach encouraged member farmers to practice improved rice production management, which received wider acceptance not only among FRG member farmers but also farmers in the surrounding areas.

## **Linkages and participation**

Farmers, agricultural experts, multidisciplinary research teams and other relevant stakeholders have actively participated and worked together during the research process. As a result, strong linkage is formed among key stakeholders that would have a considerable impact for technology dissemination in sustainable manner. During the process, farmers had an opportunity to run their own experiment and get access to apply their local knowledge, skill, and experience. To strengthen farmers' participation in the research and exploit their indigenous knowledge, a deliberate effort was made to enable them take part starting from problem identification and later suggest solutions for the problems faced. So the process was participatory from beginning to end.



## **Awareness creation**

FRG members and development agents have acquired the skill and knowledge on improved rice production and FRG concepts during the training, field trials, experience sharing, meeting and field visits. The attitude of farmers has changed and they have showed strong desire to produce rice at a wider scale. The recognition on the importance of using improved varieties with appropriate agronomic practices has also significantly improved among the farmers. Not only farmers but also researchers have benefitted from the farmers' indigenous knowledge and experience.

## **Challenges**

Different challenges were faced during the implementation of the FRG activities. The major encountered problems were:

- Lack of milling machine has discouraged farmers to involve in rice production. Manual removing of rice bran is time consuming, tedious and a huge burden especially for women;
- Lack of motivation among key stakeholders partly caused by overlapping seasonal farm activities; and
- Limitation of private sector involvement.

## **Conclusion**

- It has been demonstrated that FRG is a suitable mechanism for rice technology dissemination among farmers in Benishangul Gumuz;
- The approach has helped to establish strong collaboration among researchers, development agents, farmers and the private sector. Therefore such collaboration has to be further promoted for the advancement of rice research and development;
- The approach has also helped to improve awareness of key stakeholders, particularly farmers on participatory research, motivating them to engage in rice production. It has facilitated sharing of skills and knowledge among farmers, researchers, and other stakeholders ; and

- The approach has a significant contribution in terms of empowering farmers in decision making on technology selection, adoption and dissemination, therefore, the system has to be promoted more aggressively in Benishangul Gumuz region

## **Reference**

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Table 1. The ranking of rice test varieties by farmers

Variety	Adjusted grain yield at 14 % moisture content (q/ha)							
	Farmer 1	Rank	Farmer 2	Rank	Farmer 3	Rank	Farmer 4	Rank
Nerica -3	29.44	4	23.50	4	22.34	4	20.89	2
Nerica-4	42.10	1	30.12	1	33.12	1	30.45	1
Cukit	26.89	5	20.00	5	31.00	2	15.58	4
FKRS	40.73	2	27.89	2	29.78	3	19.89	3
Local	36.66	3	25.39	3	19.58	5	14.97	5

Table 2. The yield performance of the tested rice varieties

Variety	Days to		Panicle length (cm)	Plant height (cm)	Number of				Seed shatter %	Grain yield (q/ha)
	Heading 50%	Maturity 75%			Tiller/plant	Effective tiller/ plant	Grain/ panicle	Unfilled grain/ panicle		
Nerica-3	96.25 <sup>a</sup>	133.5 <sup>bc</sup>	20.4 <sup>b</sup>	67.15 <sup>b</sup>	10.65 <sup>ab</sup>	9.4 <sup>a</sup>	160.2 <sup>a</sup>	39.3 <sup>c</sup>	5 <sup>ab</sup>	24.84 <sup>b</sup>
Nerica-4	95.5 <sup>a</sup>	130.75 <sup>c</sup>	19.8 <sup>b</sup>	69.1 <sup>b</sup>	9.65 <sup>b</sup>	8.9 <sup>a</sup>	158.35 <sup>a</sup>	52.2 <sup>ab</sup>	3 <sup>b</sup>	33.948 <sup>a</sup>
Cukit	103.25 <sup>ab</sup>	135.25 <sup>bc</sup>	20 <sup>b</sup>	67.1 <sup>b</sup>	11.5 <sup>ab</sup>	9.4 <sup>a</sup>	123.55 <sup>bc</sup>	33.15 <sup>c</sup>	9 <sup>a</sup>	23.368 <sup>b</sup>
Fkrs	110.25 <sup>b</sup>	147.5 <sup>a</sup>	22 <sup>a</sup>	79.4 <sup>a</sup>	13.7 <sup>a</sup>	11.9 <sup>a</sup>	137.15 <sup>b</sup>	44.3 <sup>bc</sup>	4.25 <sup>ab</sup>	29.57 <sup>ab</sup>
Local	109.75 <sup>b</sup>	140.5 <sup>ab</sup>	20.8 <sup>ab</sup>	80.7 <sup>a</sup>	8.6 <sup>b</sup>	7.75 <sup>a</sup>	119.25 <sup>c</sup>	57.65 <sup>a</sup>	2.75 <sup>b</sup>	24.15 <sup>b</sup>
CV %	8.48	4.204	4.385	4.618	24.284	30.234	7.674	17.081	74.89	14.96
R-square	0.604	0.665	0.875	0.921	0.477	0.381	0.854	0.756	0.59	0.822
LSD 5%	13.45	8.9	1.39	5.17	4.04	4.411	16.51	11.92	5.538	6.22

*NB: Means with the same letter are not significantly different*

# Experiences of Rice Technology Generation and Dissemination in Uganda

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## Introduction

Rice is rather a new crop in East Africa in general and in Uganda in particular, and therefore, there are not enough rice researchers and not much research has been done. Also, extension workers do not have enough knowledge and experience on rice cultivation. In areas where rice is a new crop, it is essential to conduct proper training and capacity building on rice cultivation for researchers and extension workers.

In 2004, there was no rice section and rice researcher at National Crops Resources Research Institute (NaCRRI) in Uganda. It was in the stated year when a senior and experienced Japanese rice expert was assigned by the Japan International Cooperation Agency (JICA) that rice in general and NERICA cultivation technology promotion in particular started in an organized manner. This paper presents the experiences of NERICA cultivation technology promotion in Uganda specifically in terms of variety selection, seed production, agronomic practices, rice technology package, and post harvest management along with overview of the importance of rice related training centers.

## Variety Selection

Planting improved varieties is the most effective and feasible technology for rice farmers. Therefore, variety selection is the first priority for

research. Variety selection is usually done in variety trials established to examine yield, maturity days, resistance to diseases and insects, shattering habits, food values and so on. Ensuring that seeds are true to type after variety release is essential along with the selection of the type of variety the farmers most prefer. For instance, there were farmers that prefer rice variety with better yield and more straw for animal feed, which required making available good quality seed of NERICA 7 variety. This may be the case in countries like Ethiopia where rice straw might be needed for animal feed.

## **Seed Production**

Once varieties are selected, then the research institutes are responsible to multiply seeds for seed growers and provide training on rice cultivation. The aim of seed production in research institute is for maintaining purity and quality, not just for quantity. The protocol requires that the produced seed is inspected for purity and viability before distribution to seed growers. Accordingly, the seed growers produce and market the rice seed of the preferred/selected varieties.

## **Agronomic Management**

Up on release, varieties are packaged along with newly prepared agronomic management recommendations. The package includes planting time, plant spacing, seeding rate, sowing depth, fertilization, weeding practice, diseases and insect management, and time of harvest. These management components are identified through experiments. Planting time (cropping calendar) is decided by analyzing meteorological data such as rainfall and maximum and minimum temperature. Development of other useful management practices is also needed. For example, conservation tillage, terracing effect, ratoon management, irrigation, and weeding.

## Rice Packages

For instance, the recommended package according to Tatsushi (2012 a-d) for upland and lowland rice production systems in Uganda are:

### Upland

Variety:	NERICA 1, 4, 10
Planting:	Drill 30 cm x 1.8 cm,
Dibble:	30 cm x 12.5 cm (7 seeds/ hill)
Sowing depth:	2-4 cm
Seeding rate:	50-60 kg/ ha
Fertilization:	55-23-0 NPK kg/ ha
Weeding:	Two times hand weeding
Diseases and insect management:	Usually not necessary

### Lowland

Variety:	K-85, Supa, WITA 9
Nursery bed and seeding rate:	35 kg/ ha (100g seed for 1m <sup>2</sup> nursery bed)
Planting:	Seedling age 3 weeks, 3-4 seedling/ hill
Transplanting depth:	3-4 cm
Plant spacing:	30 cm x 15 cm (22.2 hills/ m <sup>2</sup> )
Fertilization:	55-23-0 NPK kg/ ha
Weeding:	Two times hand weeding
Diseases and Insect management:	Usually not necessary

### Training on rice agronomy

Dissemination of new technology package which normally comprises variety and agronomic management package should be preceded with training. The experience in Uganda indicates that training should be

conducted using teaching materials such as cultivation manual, and seeds. Also, it is important to conduct small field demonstration to complement the training with a practical exercise, especially on sowing depth, plant spacing, fertilization, and so on. Training without seed is meaningless, so seed must be prepared to be delivered to trainees. Since rice is self pollinated crop, seed can be produced by farmers themselves. In case of the Ugandan experience, after training, 1 kg of seed is given to each participant. One kg of seed can be planted on 200 m<sup>2</sup>, and at a yield level of 2.5 t/ ha, 50 kg of seeds can be harvested from such plot, which is enough for planting one ha after a year.

### **Post harvest**

NERICAs are varieties that do not shatter easily, so threshing is difficult. Therefore a machine is needed for efficient threshing. Training on thresher manufacturing methods was conducted in Kampala, Uganda on two types of threshers (foot pedal type and engine driven type) that are available in the country. Drying process is a key to obtain good quality rice and farmers were thought on slow drying techniques. Furthermore, a rice mill machine was assembled on a truck, which was named "Mobile rice mill", and it was operated in areas where NERICA rice is newly introduced, and where there are no rice mills.

### **Mechanization**

Rice cultivation is rather labor intensive compared to other crops, and implements such as hand operated tractor and thresher should be developed and in effort is underway to make available these technologies.

## **Regional Rice Research and Training Center**

This facility was constructed by Japanese grant aid program to support the rice research and training for the region. It is equipped with 600 m<sup>2</sup> screen house for irrigation experiments on upland rice, and 2 ha irrigated

lowland rice field. In experimental fields, different rice varieties of varying growth habit are grown all year round. All kinds of field practice can be done within 3 days training, for example, exercises on yield estimation in the morning and followed by transplanting in the afternoon. The center often provide five days long basic rice training course for extension workers and three weeks advanced rice training course for subject matter specialists.

## **Post-harvest Training Center**

The Post Harvest Training Center was established by JICA to support the provision of capacity building mainly for rice millers and operators. The center currently provide four days long training course on rice milling for rice mill operators, and so far more than 150 operators have been trained. JICA has also supported the center by sending two post harvest researchers to Japan for training on rice milling that are now key training providers in the center.

## **Present status of rice sector in Uganda**

Uganda's rice production increased from 150 thousand tons with 80 thousand hectare in 2004 to 280 thousand tons with 140 thousand hectare in 2012. The achievement has been due to Ugandan Government's effort together with stakeholders such as JICA and SG2000. JICA's supports have contributed to the achievement significantly. Currently, about 20 rice related research projects and 15 Ugandan rice researchers are counted at NaCRRI and Zonal Agricultural and Rural Development Institutes (ZARDI). These rice researchers were trained under JICA supported projects.

## **Conclusion**

Uganda's rice development has made significant improvement since 2004 when JICA started its technical support in research and extension



in the country. While JICA experts developed appropriate rice technologies in Uganda in areas of varieties, seed production, agronomic management, postharvest and mechanization, they also contributed in human resource development through training of farmers, extension personnel and researchers. Most of these activities were implemented at NaCRRRI and Post Harvest Training Centre and ZARDIs.

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# **Experience of Sasakawa Africa Association in Rice Research, Development, and Capacity Building in Selected African Countries**

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## **The Role of Sasakawa Africa Association in Agricultural Extension**

Sasakawa Africa Association (SAA) has worked since 1986 in sub-Saharan Africa with the objective to improve livelihoods of small-scale farmers by increasing their agricultural productivity. SAA collaborates with the National Agricultural Extension Systems (NAES), providing their extension agents (EAs) with training and operational funds, and thus enabling them to disseminate improved and/or new agricultural technologies, knowledge, and skills to African farmers. Presently SAA operates in four African countries, Ethiopia, Mali, Nigeria and Uganda, although it had activities in about 15 countries during the last 25 years.

After an internal restructuring process, SAA developed its new approach to agricultural extension by working along the agricultural value chain starting with input provision, agricultural production, post-harvest processing, and storage, to market access and Public Private Partnerships. Hence, SAA sees extension service provision as part of an innovation process, which is carried forward and influenced by multiple stakeholders. It is a participatory process where all partners (farmers, service providers, extension agents, traders etc.) play a significant role and their function might affect positively or negatively technology adoption, knowledge, and skills' acquisition.

In order to make best use of the inputs and skills of different stakeholders, SAA works through Farmer Learning Platforms (FLP) and Post Harvest Extension Learning Platforms (PHELPS) where all stakeholders are invited to participate. The Platforms are based on three distinct pillars, which are

- demonstrations of new production technologies, of processing machinery and storage facilities either in farmers' fields or at central villages;
- capacity building through training (in combination with the demonstrations) of EAs and farmers; and
- organizing farmers to interact with other stakeholders, for example for input provision or market access.

Furthermore, the technologies which SAA brings to farmers should be sustainable (limited resource use), scalable and cost-effective. That means in consequence that these technologies cannot be too complex in terms of inputs (amounts and sophistication), knowledge and skills, that they have to be effective in the short and long term (increasing productivity and profitability) and that their economic risk is manageable by the farmer.

## **SAA and Rice Technology Dissemination**

Although rice has quite a distinct history in the West and East African countries, being an important staple and grown for centuries in Mali and Nigeria and being only recently introduced to Uganda and Ethiopia, the rice sector of both groups of countries show several commonalities:

- there is a high demand, especially in urban centers, but only a limited local supply;
- rice can be a highly profitable crop with an input-return ratio of 1.8 or even higher;
- there are efforts by governments and decision makers to reduce rice imports and give more support and incentives to national rice production; nevertheless the actual investment in infrastructure, in research and in post harvest and processing handling is rather limited;
- agricultural productivity is still low, especially of upland rice, in most countries;

- there is a substantial risk involved in rainfed rice production, because of the high water consumption of the crop and the input costs (fertilizer, herbicides, pesticides); and
- rice processing (cleaning, milling, packaging) does not meet international standards, hence product quality is often inferior to imported rice and therefore nationally produced rice is less competitive.

Being aware of these conditions but also of the potential rice can have for farmers and national agricultural productivity, SAA became heavily involved in rice technology dissemination in the last 15 years.

Usually SAA disseminates technologies for the production and processing of staple food crops, such as cereals, pulses or roots and tubers, to address the needs of food insecure farmers but also of commercially oriented farmers. Although no specific preference is given to any of these crops, rice has played an outstanding role, because SAA has been instrumental in introducing and distributing (upland) rice in Ethiopia and Uganda and lowland and upland NERICA varieties in Nigeria and Mali. In all countries SAA has worked according to a ‘field to table or plan to plate approach’, which means that SAA gave support to activities starting with research, introduction of new varieties and provision of quality seed, dissemination of improved production technologies, capacity building, processing and storage and finally rice commercialization and marketing, linking farmers to millers and traders. These interventions resulted in a tremendous increase in rice production in Ethiopia and Uganda and an improved productivity in Mali and Nigeria.

## **Research support**

SAA collaborated with international research institutes (Africa Rice Center, IRRI) and national programs of Guinea and Madagascar to introduce new upland and lowland varieties to the four countries (Table 1). It supported national research efforts to test and evaluate this new genetic material on-station and on-farm and helped to multiply it for further dissemination. SAA showed these varieties to farmers and was involved in participatory variety selection programs to select the most

suited varieties and to give feed-back to the research system on desired morphological and physiological characteristics.

Table 1. Rice varieties introduced in recent years to 4 African countries and seed production activities

Country	Variety	Seed production in 2010	Original provider
Nigeria	Nerica 1,2,3,4,8; Sipi*, Wita 4*	450 t 1000 t*	ARC§, Mali
Mali	Nerica 4,8,9,12 WAS* 69, 161, 163, 179; LM* 1 & 2	170 t	ARC
Uganda	Nerica 1,4,10, WAB-C-165, WAB 189	15 t foundation seed (1999); 2000 t annual (85% Nerica)	ARC, Guinea;
Ethiopia	Nerica 1,2,3,4; Superica 1 Shebelle*, Gode-1*, Hoden*	230 t	ARC, Guinea, Madagascar

\* lowland varieties; § ARC – Africa Rice Center

## Seed Production And Dissemination

Initially SAA multiplied and provided seed of new varieties for the national research institutes and farmers. Then farmers either were trained to be seed producers, as individuals or in community based seed systems or alternatively seed companies were capacitated to produce and market quality seed. In Uganda, for example, seed production started with 15 t of foundation seed in 1999 and has reached up to 2,000 t annually in 2009, being the third most important crop in terms of seed production after maize and beans. The objectives were to satisfy the demand for the new varieties, show farmers the importance of quality seed, and give them a new market opportunity as seed producers (Table 1). In this process, SAA also trained field inspectors in rice quality standards and certification procedures.

## Rice production technologies

SAA demonstrates proven technologies to farmers, which are orientated according to the 'Best Agricultural Practices' of that specific crop and good agronomic practices in general. Hence, for rice the package of technologies consisted in

- timely planting;

- line planting with proper spacing;
- use of quality seed;
- making bunds for water harvesting in upland rice;
- transplanting technologies for lowland rice;
- timely weeding and weed management with herbicides; and
- appropriate use of pesticides for pest and disease control.

Additional to these common agricultural practices for rice production, SAA showed different rice varieties and different levels of nutrient and fertility management (Table 2).

Table 2. Technologies for rice production demonstrated at different African countries.

Country	Uganda	Ethiopia	Mali	Nigeria
Constraints	climate, investment in labor and inputs, provision of inputs, simple tools, crop and fertility management, seed production, quality and purity, segregating Nerica varieties, pests and diseases, organoleptic demands;			
Technologies: for irrigated, lowland and upland rice	varieties, quality seed, 50-60 kg of seed/ha for line planting and bunding, 30-40 kg seed/ha for planting in pockets weed management and herbicide use pest and disease control: birds, rodents, termites, blast, smut, virosis fertility management: timing, type, placement, quantities of fertilizer; input provision – seed, fertilizer, pesticides			
Fertilizer application and other technologies	3-4 t OM/ha 30 kg P + 60 kg N 15 kg P + 30 kg N minimum tillage herbicide testing	3-4 t OM/ha 70 kg P + 100 kg N 35 kg P + 50 kg N	2-3 t OM/ha 20 kg P + 46 kg N in 2 splits 10 kg P + 23 kg N	2-3 t OM/ha 40 kg P + 20 kg K + 130 kg N in 2 splits 20 kg P + 10 kg K + 65 kg N in 2 splits
Mean yields of TOPs*	2.5 – 4.0 t/ha	2.5 – 4.5 t/ha	3.0 – 6.0 t/ha	2.5 – 4.0 t/ha
Impact	50,000 ha upland rice planted	160,000 ha upland rice planted	large scale NERICA distribution	

\* *Technology Option Plots*

SAA uses Technology Option Plots (TOPs) to demonstrate different options of the same technology to farmers, so that they can decide which level of inputs they want to use to achieve an economically beneficial yield. The TOPs consist of three treatments and each treatment is shown on a 500 m<sup>2</sup> plot. These treatments could be, for example, two improved rice varieties in comparison with the farmer's own variety or two levels of fertilizer application compared with the farmer's practice, which

means no fertilizer in many regions. If fertilizer is the demonstrated technology, SAA regularly chooses the application rate recommended by the research or extension system as the highest level and half that rate as the medium level compared to farmers' zero fertilizer application. However, these recommended rates are often blanket recommendation at country or regional level, based on insufficient research and a gross overestimation of farmer's willingness and ability to invest monetary resources in external inputs. Therefore, SAA considers these recommendations just as options which a farmer might follow or not, according to his/her resource base, but puts more emphasis in teaching the farmer the principles of fertility management. He/she should understand:

- the difference among the different inorganic fertilizer types (DAP, urea, N-P-K and others);
- the difference between organic and inorganic fertilizers and the benefit of using them both;
- when to apply which fertilizer type – at planting, after weeding etc; and
- how to apply inorganic fertilizer in order to improve its efficiency, reduce costs and increase yields.

These principles help the farmer to make best and most efficient use of inorganic fertilizers and even if the farmer does not follow the recommended rates, he/she will experience the beneficial effects of additional nutrient applications. Based on this experience the farmer may decide in the following season to increase his/her investment in external inputs to achieve higher yields and a better rate of return.

## **Technologies with a potential to improve rice productivity**

There are technologies that might increase rice yields but have not been tested and/or demonstrated. SAA will include them in the future to widen the options for farmers and to improve agricultural productivity. These technologies include:

- seed priming (in rainfed conditions) to accelerate seedling emergence and crop development;

- fertilizer deep placement in irrigated and lowland rice to improve fertilizer use efficiency;
- bunding for water conservation;
- mechanization of weeding and harvesting operations; and
- further improvements in soil fertility and nutrient management.

On the other hand, there are also demands on the research sector to provide varieties which are more resistant to the most frequent pests and diseases and which can withstand moisture stress events for prolonged periods. Another area which research should tackle is to classify rice varieties according to their nutritive value and improve processing (milling, parboiling) in order to increase the nutrient content and quality of rice. Especially in countries like Ethiopia, where rice is often used to substitute cereals of higher nutritive value in food preparation, this might be an important factor to be considered.

## **Processing, Post-harvest Handling**

Processing and product quality are decisive factors in rice marketing and being able to compete with high quality rice imports. In West Africa, where rice is a traditional crop, the imported rice is often preferred by consumers, not because it is cheaper but because it is cleaner, with less broken grains and of better organoleptic quality. In many African countries, the paddy supplied to mills is of low quality mixed with stones and other objects and the mills produce a poor product, because they are old or not adjusted to the new varieties. Although these problems are obvious, there is little investment in research and human capital building to improve processing and post-harvest handling.

SAA is one of the few NGOs who are active in this area. SAA imports and/or sources regionally or locally processing machineries such as cleaners, threshers, mills or par-boiling equipment and demonstrates their use to farmers, cooperatives, machine operators, EAs etc. in PHELPS. To increase sustainability of this approach and the operating life of these machines, local artisans are encouraged to produce spare parts and take care of the maintenance of the equipment. This approach is rather cost



intensive for the NGO, therefore demonstrations on post-harvest processing can only be done at few sites each year.

## **Capacity Building**

Training and capacity building is a very important pillar for both the FLPs and the PHELPS. SAA provides training for trainers (EAs), who in turn are supposed to train farmers. SAA trains trainers several times before and during the growing season in general agronomy, implementation of field demonstrations, record keeping and data collection, participatory methods and other topics required by farmers. It is important that the farmers' training is being done using the demonstration sites as examples so that farmers gain a direct 'hands-on' understanding of the training contents. Adult learning concepts are rather directed towards examples, demonstrations and making use of own experiences. The training should be a dialogue between trainer and trainees but also an exchange of opinions and experiences among all participants. Likewise is the training at the PHELPS handled, where machine operators and artisans are capacitated to run the machines and farmers learn about improved drying and storage methods. Another important objective of these platforms is to help organize farmers, for example, in processing and marketing groups, and give them training in agro-business management.

## **Market Access and Commercialization**

The last step along the value chain, where SAA is trying to help farmers, is linking them to markets. This is a very crucial step, because only if farmers can market their produce they are willing to invest in improved technologies to increase productivity and profitability. In this respect SAA does not only do capacity development with farmers and producer groups but also with agro-dealers and traders in order to bring them together and generate a better mutual understanding of market needs and demands and specific constraints on the producer side.

## **Strategy Development and Decision Making**

SAA is recognized in the four countries as an organization, which supports the national extension system, demonstrates innovative approaches with an aim to develop the agricultural sector of these countries and the well-being of small-scale farmers and under-served groups. Based on the long experience and success of the organization in disseminating rice technologies, SAA has been invited to participate in national committees for strategy development in Ethiopia, Uganda, and Nigeria. In these committees, SAA tries to influence policies and decisions to enable the national systems and NGOs to tackle the constraints and demands of a rapidly growing African agriculture sector.



# **Summary of Seminar Recommendations, Comments and Suggestions**

## **Rice technologies and package**

- In the last 10 years, the country has accumulated substantial amount of rice technologies, and because of those technologies, rice production is expanding all over the country.
- If there is demand for specific technologies, we should look for the sources from abroad where the technologies are already available;
- MoA has rice extension packages, which are updated every year. However, they are often not complete and recommendations on seed and postharvest are particularly insufficient and also limited to cater for agro-ecological differences;
- Extension packages may be available but it is necessary to examine their contents and their availability on the ground where DAs and rice farmers need them. All the participants agreed that extension packages are not necessarily readily available at DAs and farmers levels and more locally specific (agro-ecology specific) packages need to be developed; and
- Similarly, extension materials may be there but they may not be accessible due to language barriers. It is recommended to

compile a complete list of technologies available at national level as well as local levels and make them available to all stakeholders.

## **Membership in Africa Rice Network**

Being a member of Africa Rice Network is essential for getting access to technologies and information that are missing within the country, but the country has not become a member yet. It was agreed that the country will benefit from Africa Rice membership not only in accessing rice technology and information but also in local capacity building and experience sharing.

## **Processing technologies**

Processing technologies are still lacking in many potential rice growing areas. The existing extension package is only on agronomy but postharvest technology is missing despite its importance to improve marketability hence stimulate production. One participant from Fogera shared a story of a group of processors who shared the cost to send their representative to China to look for new technology, and this demonstrates the growing demand for post harvest and processing technologies. Acquiring processing machineries, handling technologies, and benefiting from the training opportunities that are available in Japan, China, and Uganda should be given due attention. A JICA project in Uganda, PRiDE, is offering a training course for mill operators.

## **Technology dissemination**

- To enhance technology dissemination, more technologies that fit to specific local conditions including agronomic and seed technologies are required;
- The present way of training of DAs may not be fully effective, as they are given so much information on many crops at once, and the whole approach needs revisiting;
- FTCs, FLP and/or FFS are useful means for technology dissemination and need to be strengthened; and
- It was suggested that available technologies need to be readily available to partners and establishing a rice database at MoA is required.

# About FRG II

**T**HE PROJECT FOR Enhancing Development and Dissemination of Agricultural Innovations through Farmer Research Groups (FRG II Project) is to enhance the capacity of researchers to take part in innovations through farmer research group approach (FRG approach). Implemented by a technical cooperation between Ethiopian Institute of Agricultural Research (EIAR) and Japan International Cooperation Agency (JICA), the FRG II covers all the agricultural research institutions in the country through training on the approach, financing FRG based research projects in selected priority research areas and filling gaps and enhance linkages between research and extension by delivery of technical information. For more information, visit

<http://www.jica.go.jp/project/english/ethiopia/001/>

or

<http://www.eiar.gov.et/projects/110-japan-international-cooperatin-agency-jica>