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Full Length Research Paper

Roles of rice FRGS in technology dissemination in Benishangul Gumuz region

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This study focused on the evaluation of upland rice genotypes for yield performance and farmers' preference criteria under the upland ecosystem. The study was conducted at Bambasi area to identify farmer preferred best performing rice varieties. Four released and one local variety was evaluated under participatory varietal evaluation in upland ecosystem in randomized complete block designs with four replications. Each farmer's sites were considered as a replication. The number of varieties was decided by farmers to make it easy to evaluate and manage the trials. Prior to the establishment of farmers research group (FRG) the constraints of rice production were identified by prioritized following need assessment studies and participatory rapid appraisal, and the most important bottleneck was found to be lack of improved varieties. The selection criteria set by the farmers were grain yield, plant height, panicle length, tillering capacity and disease resistance. In participatory varietal selections (PVS) of upland ecosystem, farmers were evaluated the performance of rice varieties at three developmental stages namely vegetative, tillering and physiological maturity stage. However, the final selection criteria were set at physiological maturity stage and hence direct matrix and pair wise ranking were carried out for varietal selection. According to direct and pairwise ranking variety of NERICA-4 was the top preferred variety by farmers. For the tested rice varieties, the analysis of variance showed that shorter duration was required for NERICA-4 (130.75 days) whereas longer duration for FKRS variety (147.5 days) for physiological maturity. For grain yield, NERICA-4 (3395 kg/ha) was the highest yielding variety where as the lowest yielding variety was Kokit (2337 kg/ha). The finding of this study revealed that NERICA-4 was farmers' best preference and top performed variety and hence has to be produced by rice producers. The approach of farmer research group (FRG) based research had a bilateral benefit for researchers and farmers for knowledge and experience sharing. The role of the approach confirmed that FRG was a suitable mechanism for rice technology dissemination among farmers.

Keywords: Ecosystems, Farmer selection, FRG, Participatory varietal selection, NERICA-4, and Yield.

INTRODUCTION

In Ethiopia rice (Oryza sativa L.) has been recognized as a food security crop and a source of income and employment opportunities. The crop started to be recognized in the country because of its good productivity, available labor, and vast areas suitable for both rainfed and irrigated systems. It is estimated that about 30 million hectares are suitable for rice production in the country (MoA, 2010).

In Benishangul - Gumuz region, 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. Participatory varietal selection is used as an entry point to better understand the availability of improved cultivars and value of recommended or existing adapted materials to farmers. (Weltzien et al.,2003). PVS has been very successful both in facilitating adoption by poor farmers in

marginal environments, not previously reached by formal plant breeding, and in understanding farmers' preferences (Joshi and Witcombe, 1996).

A number of improved varieties offer immense potential for promoting upland rice production through farmers' early participation in variety development, and therefore, before dispatch varieties with traits they prefer. Their early participation favors farmers to select varieties according to their preferences, needs and other expected characteristics. Such system has been successfully tested in rice (Dorward et al. 2007; Joshi and Witcombe 2002).

Participatory variety selection provide an opportunity to the farmers a large number of varietal choices on their own resources, enhance farmers access to crop varieties and increase in diversity, Increase production and ensure food security, help to disseminate the adoption of pre and released varieties in larger areas, allow to varietal selection in targeted areas at cost-effectiveness and also in less time and help seed production at community based level.

The purpose of the FRG approach is used to facilitate the generation of readily acceptable technologies by encouraging farmers to participate in research and getting access to apply their indigenous knowledge. This study elaborated the performance of rice varieties and 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.

MATERIALS AND METHODS

Experimental Site and Design

The study was conducted in the western part of Ethiopia particularly in Benishangul-Gumuze region. The specific location was at Bambasi district which is one of the potential areas for rice production in the country.

The study area represents the agro ecology of the region which is characterized as rainfed upland and lowland rice ecosystem.

During the growing season, the area of Bambasi district received the mean annual rainfall of 1133.1mm and the mean minimum and maximum temperature were 13.5^0C and 28.84^0C, respectively. The experimental site was selected on the basis of the potential area coverage for rice production.

The experiment was conducted in an RCB design with five treatments (five varieties namely NERICA 3, NERICA 4, Kokit, FKRS and a local check). There were four trial farmers and each farmer's field was considered as a replication. The recommended agronomic practices were applied (seed rate 60 kg/ha, DAP and Urea 100 kg/ha each).

Participator variety selection

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 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.

Farmers' evaluation of rice varieties

Farmers were set their own selection criteria for rice varieties and participated to evaluate the performance of rice genotypes based on their selection criteria which includes grain yield, plant height, panicle length, tiller capacity and disease resistance. During the participatory varietal selection, twenty FRG member farmers and non FRG members with a total of fifty five male and female headed households (male=36, female=19) were participated. The evaluation was conducted at three developmental stages; namely vegetative, heading and maturity stages using farmers' selection criteria. Both direct matrix ranking and pairwise ranking were used to rank the tested varieties. Direct matrix ranking was particularly useful in identifying the important traits of interest and pairwise ranking was also a useful tool whenever it is important to explore and discuss the criteria for decision making between and among alternatives.

A direct matrix was prepared as per the selection criteria; for the rice varieties listed in the column and criteria in the row. The ranking procedure was explained to participants and then each criterion was ranked from 1 to 5 (5 = excellent, 4 = very good, 3 = good, 2 = poor and 1 = very poor) for each variety, ranking was done on consensus where differences were solved by discussion (de Boef and Thijssen, 2006). This methodology has

Table 1: Pnenological and growth parameters of some rice varieties

	Days to		panicle	plant	Number of				Seed	Grain
	heading	maturity	length	height	Tiller/	Effective	Grain/	Unfilled grain	shatter	yield
Variety	50%	75%	(cm)	(cm)	plant	tiller/plant	panicle	/panicle	(%)	kg/ha
NERICA-3	96.25	133.50	20.40	67.15	10.65	9.40	160.20	39.30	5.00	2484.00
NERICA-4	95.50	130.75	19.80	69.10	9.65	8.90	158.35	52.20	3.00	3395.00
Kokit	103.25	135.25	20.00	67.10	11.50	9.40	123.55	33.15	9.00	2337.00
FKRS	110.25	147.50	22.00	79.40	13.70	11.90	137.15	44.30	4.25	2957.00
Local	109.75	140.50	20.80	80.70	8.60	7.75	119.25	57.65	2.75	2415.00
Mean	103.00	137.50	20.60	72.69	10.82	9.47	139.70	45.32	4.80	2717.60
CV	8.48	4.20	4.39	4.62	24.28	30.23	7.67	17.08	74.89	14.96
LSD	13.45	8.91	1.39	5.17	4.04	4.41	16.51	11.92	5.54	622.00

been used by Alebachew (2012) on wheat participatory varietal evaluation. During direct matrix ranking farmers have given rating of importance (a relative weight) of a selection criterion ranked from 1 to 3 (3= very important, 2= important and 1= less important) and rating of performance of a variety for each traits of interest (selection criteria) was given based on their level of importance on the basis of common agreement of evaluators'. The score of each variety was multiplied by the relative weight of a given character to get the final result and then added with the results of other characters to find out the total score of a given variety. In the case of pairwise ranking the varieties were compared and ranked pairwise and hence both direct matrix and pairwise ranking were done for the upland rice varieties.

Data Analysis

Agronomic data were collected and subjected to statistical analysis using the SAS computer program, version 9.0 (SAS, 2002). Mean separation was conducted using Least Significance Difference (LSD) at 0.05 probability level. To clearly identify and decide farmers' selection criteria for each rice varieties a systematic and scientific procedure were applied by using pairwise ranking and direct matrix.

RESULTS AND DISCUSSION

Analysis of variance revealed that there was highly significant variation among the tested rice varieties. Rice variety of NERICA-4 was the top performed with mean grain yield of 3395 kg/ha and the local famers variety was the least performed with average grain yield of 24.15 kg/ha. The statistical result indicated that NERICA-4 was the highest in yield performance and in other traits as described in Table 1.

Farmers' selection criteria

The selection criteria were assigned by farmers and each variety was evaluated by male and female household headed farmers. The five selection criteria suggested by farmers were grain yield, panicle length, plant height and disease resistance. Grain yield and disease resistance were proposed as very important criteria as indicated in Table (2). Grain yield was considered as the most selection criteria for each rice varieties and this is also in agreement with varietal selection of rice reported by Sangay et al (2010) and Alebachew (2012) for wheat varietal selection The second most selection criteria was disease resistance because brown spot and blast is becoming an important diseases in rice growing areas.

Based on farmers selection criteria comparison was conducted among the tested rice varieties. The rice varieties were identified for their morphological performance and ranked as indicated in Table 3. Hence, in pair wise ranking of rice varieties NERICA-4 was considered as best varieties, whereas the local variety as the least preferred variety by farmers Table 3.

In direct matrix ranking of rice varieties NERICA-4 was considered as best variety followed by NERICA-3 and FKRS. The local variety was the least ranked variety because of susceptibility to rice diseases and less productivity per unit area. Variety of NERICA-4 ranked first because of higher productivity, resistance to major rice diseases (Blast and brown spot) and tillering capacity as shown in Table (4).

Table 2: Pairwise ranking of farmers selection traits for rice varieties

Selection criteria	Grain yield	panicle length	Plant height	Tillering capacity	Disease resistance	Total rank	Rank
Grain Y						4	1
Panicle L.	Grain Y					2	3
Plant H.	Grain Y	Panicle L				0	5
Tillering C.	Grain Y	Panicle L	Tillering C			1	4
Disease R	Grain Y.	Disease R	Disease R	Diseases R		3	2

Grain Y= Grain Yield, Panicle L = Panicle Length, Plant H=Plant Height, Tillering C = Tillering Capacity and Disease R= Disease Resistance

Table 3: pairwise ranking of rice varieties based on farmers selection criteria

	NERICA-4	NERICA-3	Kokit	FKRS	Local variety	Total score	Rank
NERICA-4	x					4	1
NERICA-3	NERICA-4	x				3	2
Kokit	NERICA-4	NERICA-3	x			2	3
FKRS	NERICA-4	NERICA-3	Kokit	x		1	4
Local variety	NERICA-4	NERICA-3	Kokit	FKRS	x	0	5

Table 4: Direct matrix ranking evaluation of rice varieties

Selection criteria	Relative weight	NERICA-4	NERICA-3	Kokit	FKRS	Local variety
Grain yield	3	**15**	**12**	**12**	**12**	**6**
		(5)	(4)	(4)	(4)	(2)
Panicle length	2	**10**	**6**	**6**	**8**	**6**
		(5)	(3)	(3)	(4)	(3)
Plant Height	1	**4**	**3**	**3**	**5**	**4**
		(4)	(3)	(3)	(5)	(4)
Tillering Capacity	2	**10**	**10**	**6**	**8**	**6**
		(5)	(4)	(3)	(4)	(3)
Disease resistance	3	**15**	**12**	**12**	**9**	**6**
		(5)	(4)	(4)	(3)	(2)
Total score		**54**	**43**	**39**	**42**	**28**
Rank		1	2	4	3	5

In overall direct and pairwise preference ranking methods NERICA-4 was among the best preferred varieties, while the least varieties was local variety. This result indicated that NERICA-4 was farmers' best preferred and top performed variety which can be considered as a promising variety to be widely produced by rice farmers.

Achievements of FRG based rice research

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. In both farmers' preference and agronomic performance the variety could be the highest in all traits particularly for grain yield. At participatory varietal selection (PVS) both farmers research group (FRG) and none farmers research group (NFRG) members selected NERICA-4 variety to be produced in wider acreage.

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 way. 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 been benefitted from the farmers' indigenous knowledge and experience.

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.

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