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IMPROVING MAIZE SEED ACCESS AND CULTIVATION PRACTICES OF SUBSISTENCE FARMERS IN NUSA TENGGARA TIMUR, INDONESIA

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Abstract

Access to quality seeds and technical know-how markedly increased maize productivity of subsistence farming communities, contributing to increased food security for at least 18,000 households in 2012. The paper aims to describe how to improve maize cultivation practices for subsistence and poor farmers by introducing quality seed and improving capacity of extension staff in Timor Tengah Utara (TTU) District of Nusa Tenggara Timur, Indonesia. A cooperative approach between national and sub-national Indonesian Government agencies, and the Australian Government's aid agency (AusAID) was the main key to achieve these. Firstly, the Indonesian Government's National Seed Reserve Program (CBN) distributed 198 tons of Open-Pollinated-Variety (OPV) seed to 427 farmer groups in 106 villages across TTU district. Secondly, recognizing the limitations of district agricultural services to disseminate knowledge and understanding of better farming practices, the AusAID supported the District Government and NGOs to undertake an intervention in 2011/2012 to improve the effectiveness of the CBN Program, thereby increasing food security for small-holders farm communities. The results of the intervention showed that the use of the OPV seed improved maize productivity by 36% (from 2.6 t/ha to 3.5 t/ha) or increased by between 52-86% when cultivation was managed through Demonstrations Plots compared to local varieties used by farmers. Capacity building of field facilitators (Public Extension and NGO's staff) to help disseminate knowledge and an understanding of the improved technologies was provided through Training of Trainers and a number of other knowledge-sharing exercises.

Keywords: Maize, food security, capacity building, sustainability, Indonesia

Introduction

Maize is a staple food of the majority of the population, and among the major crops cultivated by farmers in the Nusa Tenggara Timur (NTT) province of Indonesia. Despite its importance and the potential of the province for rural and agricultural development (Barlow, 2006), maize cultivation is characterized by low input-low output subsistence farming practices that are consistently unable to meet food demand due to low productivity caused largely by limited use of agricultural inputs such as improved seeds and fertilizer, and technically equipped extension services to assist improved farmer practices (Swastika *et al*. 2004). A community needs assessment activity in the region revealed that many poor farmers are trapped in a spiral of dependency due to subsistence farming systems practices (World Food Program, 2009). The low incomes earned from agricultural activities is barely enough to buy food for the 3-4 month gap in grain supplies normally experienced before the next maize harvest in most NTT households (YMTM, 2007). Farmers in NTT tend to cultivate maize only on a piece of land, normally 0.2 to 0.5 ha, that they can manage with their own family labour, using traditional practices. This size of cultivation, however, is not sufficient to feed the household throughout the year, partly due to low-yielding-variety crop management practices, as well as substantial post-harvest losses due to weevil attacks. Research trials have shown that by using better seeds and farming practices, crop productivity will increase significantly (Bora and Murdolelono, 2006; Panikkai, 2009, Fargher and Kelly, 2012). However, most farmers in NTT recycled their own seeds from the previous harvest, a practice that eventually results in declining yields.

The Indonesian Ministry of Agriculture (MoA), under its mandate to increase maize productivity, has provided a subsidy for high-yielding-variety seeds to farmers across the nation through the National Seed Reserve (CBN) Program under the Directorate General of Food Crops (DGFC). The maize seed distributed through the CBN Program in 2011 was 4,600 ton nationwide (Ministry of Agriculture, 2012) and the Timor Tengah Utara (TTU) district of NTT received 198 tons of OPV maize seed. Factors that hindered the effectiveness of the program are lack of technical assistance, low technical capacity of extension services in the district level and lack of agricultural input supply, as well as the delayed arrival of seed in the area. Recognizing these limitations, the Australian Agency for International Development (AusAID) support the District Government of TTU and local Non-Governmental Organizations undertook an intervention to improve the effectiveness of the maize distribution program.

Material and Methods

The Approaches of Technology Demonstration and Dissemination Intervention

The intervention design was discussed involving the DGFC, the local government of TTU, local NGOs, farmers’ representative and AusAID. The technology intervention components introduced for improving maize production system were: introduction of high yielding open-pollinated-variety (OPV) of maize seed, planting density arrangement, increased cultivation area (from 0.5 to 1 ha), introduction of agricultural inputs (organic and inorganic fertilizers, pest management products), and post-harvest storage management. One hundred and ninety eight tons of OPV maize (Surya variety) was distributed to 427 farmer groups in 106 villages in TTU starting in early December 2011.

Farmer Field Schools (FFS) through the establishment of demo-plot aimed to disseminate technical know-how of maize cultivation and to increase farmers’ skills and capacity. Seventy demonstration plots were established across the district and technical assistance was provided by expert from agricultural research and service delivery institutions to improve farmers’ and field facilitators’ skills. The FFS apply the necessary crop management practice, as agreed prior to the activity, and was managed by the NGOs field facilitators, public extension staff (PPL) and farmer group members. Cross visits of farmers (member and non-member groups) to the demo-plot sites were held to disseminate the maize technology being introduced. Field visits were conducted at different demo-plot sites and growth stages of the crop growing period, i.e., emergence, flowering and maturity.

The size of demo-plot is one hectare which was divided into 4 small plots (0.25 ha each) and treated with four different cropping system to allow farmers to learn the know-how of maize cultivation. The allocated cropping systems were as follows: (A) OPV maize seed, monoculture, planting distance 40 x 75 cm, application of organic fertilizer; (B) OPV maize seed, monoculture, planting distance 40 x 75 cm, application of inorganic fertilizer; (C) OPV maize seed, integrated with pulse (peanut), planting distance of (100-50)x40 cm, application of in-organic fertilizer; and (D) OPV maize seed, integrated with pulse, planting distance

(100-50)x40 cm. The respective application of an-organic fertilizer was 200 kg urea + 200 kg NPK/ha, and organic fertilizer was 2,000 kg/ha.

The economics of maize production was analyzed to assess the profitability of using new OPV seed and modern management practices over existing practices. The important variables considered were seed variety (local vs. OPV), fertilizer used, labour allocation and other management practices.

Capacity building was carried out for 275 field facilitators (Extension staff or PPL and NGO's field facilitators) through Training of Trainers (TOT) and undertaking efforts to ensure knowledge-sharing. More than 200 farmers were interviewed for their perception of technology introduced to them in the crop season of 2011/2012. Pre- and post-training evaluations were conducted to assess the improvement of their knowledge.

Post-harvest storage management was done by introducing hermetic drum storage to reduce post-harvest loss due to weevils. The project provides 70 drums, one drum in each demo-plot to try out how to use the drum for grain and seed storage.

Results and Discussion

Maize Productivity

Access to modern high-yielding variety seed and technical know-how markedly increased maize production and productivity of subsistence farming communities, providing increased food security for at least 18,000 HHs (or approximately 90,000 people). The improved varieties gave higher grain yield compared to the local variety. The average grain yield obtained from the demonstration plots were 4.5, 4.8, 4.2 and 3.9 t/ha for cropping systems of A, B, C, D, respectively, as detailed in Table 1. In comparison, the grain yield from the local variety and using existing farmers' practices was 2.6 t/ha. Field observations was also carried out on farmers who received OPV seed and planted it in their own farm, with limited fertilizer inputs (some used organic fertilizer, some none), the average grain yield was 3.7 t/ha (n=55). Table 1 shows the grain yield observed during the activity.

The provision of airtight food-grade storage of polyethylene (hermetic) drums enables farmers to protect the grain from weevil and rodents and reduces the grain loss. The grain stored in the drum was not attacked by weevil at all until the following crop season of 2012/2013. The traditional method of grain storage by smoking and hanging the maize cobs in the 'Lopo' (traditional storage hut) does not provide adequate protection against weevil. Studies conducted by deRosari *et al*. (2001) show that 20 to 50% of grain is lost to pests over the course of 9 months of storage. A study conducted by the World Bank found that grain storage using an airtight drum has showed reducing grain harvest-loss and eventually reduced seasonal variation in food consumption, anticipated food shortages and improved lean season health (Basu and Wong, 2012).

Economic Analysis of Improved and Local Practices

In the non-demo-plot practice, farmer participants employed similar planting distance practice to that of demonstration plots, but only a few farmers applied fertilizer. Among those who applied organic fertilizer the rate varies from approximately 500 kg to 2 t/ha, but none of them applied

Table 1. Grain yield at demo-plot sites and farmers' sites.

Observation	Yield (t/ha)		Number of samples (n)
	Maize	Peanut	
Demo-plot sites:			
(A). OPV, demo-plot, monoculture, organic fertilizer	4.5		47
(B). OPV, demo-plot, monoculture, in-organic fertilizer	4.8	-	47
(C). OPV, demo-plot, integrated maize + pulse, in-organic fertilizer	4.2	0.17	47
(D). OPV, demo-plot, integrated maize + pulse, organic fertilizer	3.9	0.14	47
Farmers' sites:			
OPV, non-demo-plot, monoculture, limited agricultural inputs at farmers' plot	3.7	-	55
Local practice using local variety seed (control)	2.6	-	694

in-organic fertilizer. In the local practice, farmers use local seed varieties, traditional planting distance practices (100 x100 cm or wider), apply no fertilizer, and sow 3-5 seeds per hole. By using quality seed, it was found that a farmer could gain an additional IDR 747,500/ha. Further, by applying fertilizer in a monoculture system, an additional income of IDR 2.7 – 3.4 million would be obtained (Table 2). There was not much additional income generated from integration of maize and pulse, compared to monoculture. The plantation arrangement between maize and pulse and the quality of peanut seed contribute the lower marginal income of this system. Using the improved quality seed and better crop management would generate a marginal rate of return of > 120%, except the crop system of integrated maize + pulse with organic fertilizer which is caused by low yield of maize and peanut. This means that quality seed and crop management are economically feasible to be improved.

Capacity Building of Field Staff and Farmers

Training of Trainers improved the knowledge of the field staff. The basic agronomy skills of participants were evaluated before and after training to measure whether there was improvement of the knowledge. Some results of the training activity were:

- The average score achieved before and after training were 42.5 and 54.7%, respectively. While this shows some improvement due to training, it also shows that further improvement is needed.
- Female participants achieved higher scores than males (64.8% VS 52.4%).
- Public extension officers and NGOs Field Staff have comparable knowledge on maize agronomy (59.4% and 57.0%, respectively).

The Lesson Learned

During reflection on the activity, farmers and public and private extension staff provided very positive feedback about the initial outcomes, and also outlined areas for improvement. Initial key learning from the first year of intervention were:

- The participatory approach of all stakeholders from the beginning of the intervention produces a solid team to implement the activity. The public extension officer and the field officer of NGOs were working closely in assisting farmers on cropping practice.

Table 2. Marginal rate of return between improved OPV maize cultivation and local seed.

	Average Yield (t/ha)	Gross income* (IDR)	Seed and fertilizer cost (IDR)	Labour cost (IDR)	Gross margin (IDR)	Marginal income (IDR)	Marginal cost (IDR)	Marginal rate of return (%)
OPV, demplot, monoculture, organic fertilizer	4.5	11,250,000	1,025,000	3,860,000	6,365,000	2,747,500	2,002,500	137
OPV, demplot, monoculture, in-organic fertilizer	4.8	12,000,000	995,000	3,900,000	7,105,000	3,487,500	2,022,500	173
OPV, demplot, integrated maize + pulse, in-organic fertilizer	4.2 (maize) + 0.17 (peanut)	12,576,000	1,345,000	4,300,000	6,931,000	3,313,500	2,762,500	120
OPV, demplot, integrated maize + pulse, organic fertilizer	3.9 (maize) + 0.14 (peanut)	11,430,000	1,725,000	4,200,000	5,505,000	1,887,500	3,042,500	62
OPV, non-demplot, monoculture, limited agricultural inputs, at farmers' plot	3.7	9,250,000	475,000	2,900,000	4,365,000	747,500	492,500	152
Local practice using local variety seed (control)	2.6	6,500,000	62,500	2,820,000	3,617,500	-	-	-

*) Gross income is the value of sales of the grain, valued at IDR. 2500/kg and IDR 12,000/kg for maize and peanut, respectively, at harvesting time. 1 US$ = IDR 9,500.

- The combination of access to improved seed varieties, expert technical assistance and mentoring of extension staff improved crop yield and enhanced food security of the communities.
- Improved maize cultivation methods and using quality agricultural inputs will increase the marginal rate of return, and may feasibly increase incomes of subsistence farmers.

While the impact of the seed distribution was significant, the potential barriers to the adoption of outputs include:

- Farmers rely on the distribution of free maize seed by Government. The unreliable nature of government assistance means that seeds are often not to arrive in time for the planting season, decreasing the effectiveness of the distribution program in achieving higher maize crop productivity.
- No availability of OPV seed and erratic availability of other inputs in the local market. The OPV maize is not available from the local input suppliers in the district. Some retailers offered OPV seed stock a few years ago, but because the Government distributes OPV maize seed for free the commercial market for OPV seeds has disappeared. Furthermore, there was erratic availability of fertilizer in the market which meant the program was unable to apply inorganic fertilizer at full rates.
- Nothing for free. Lessons from past experience show that farmers who receive inputs for free attach little value to them, and they may not use properly or even not use at all. Free inputs also encourage dependency and distort market value of inputs.

The Way Forwards

To ensure sustainable access to quality seed and necessary technical assistance, it is necessary to build an intervention model that assists to develop markets for good quality seed, rather than farmers relying on annual Government subsidies, and encourages farmers to adopt better cultivation methods suited to their local conditions. Taking into consideration participants' reflections and interviews with beneficiaries and potential partners, the next stage of the project will build on the success of the seed distribution program, but will add a new set of partners from the local private sector. The involvement of local private seed producers who are capable of supplying seed at affordable prices, available when needed and easy to access at the village level is required to accelerate the development process.

Concluding Remarks

The distribution of good quality seeds coupled with capacity building support has significantly increased maize production in target communities. Program data shows that the use of the OPV seed improved maize productivity by 36% compared to local varieties (from 2.6 t/ha to 3.5 t/ha) at the farm level. When maize cultivation was intensively managed through Farmer Field Schools, productivity increased by 52-86% compared to local varieties.

Instead of the usual but unsustainable practice of handing out agricultural inputs for free, development should focus on building farmer’s capacity to identify needs, review and test options, and make better informed decisions of what change would work for them. Simultaneously, services and inputs required by farmers to implement the change need to be made available, either through public or private service providers.

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References

Barlow, C., and R. Gondowarsito. 2006. Economic Development and Poverty Alleviation in Indonesia: the case of Nusa Tenggara Timur. Working Paper No. 18, Institute Kajian Malaysia dan Antarabangsa. University of Kebangsaan Malaysia.

Basu, K and M. Wong, 2012. Evaluating seasonal food security programs in East Indonesia. A working paper for Japan Social Development Fund and The World Bank.

Bora, Y and B. Murdolelono, 2006. Pengaruh pemupukan pada budidaya jagung Ahuklean di Besikama, Belu, NTT. (The effect of fertilizer application on maize cultivation using ‘Ahuklean’ technique in Besikama, Belu NTT). Berita Biologi Vol 8(1). Pusat Penelitian Biologi, Lembaga Ilmu Pengetahuan Indonesia, Jakarta.

DeRosari, B., D.B. Meke and A. Bamualim. 2011. Pascapanen jagung di Pulau Timor. Laporan Tahun Kedua (Maize post-harvest management in Timor Island). Kerjasama Balai Pengkajian Teknologi Pertanian Nusa Tenggara Timur dengan Winrock International. Unpublished report.

Fargher, J., and D. Kelly. 2012. From Seed to Scale Up: Lessons learned from Australia’s rural development assistance. ODE-AusAID, Canberra.

Ministry of Agriculture. 2012. Laporan Kinerja Kementerian Pertanian 2011 (Annual Report of Ministry of Agriculture year 2011). Kementerian Pertanian, Jakarta.

Panikkai, S. 2009. Penyebaran varietas unggul jagung di Sulawesi Selatan (The dissemination of high yield varieties in South Sulawesi). Prosiding Seminar Nasional Serealia 2009. Balai Penelitian Tanaman Serealia, Maros. ISBN: 978-979-8940-27-9

Swastika, D.K.S., F. Kasim, K. Suhariyanto, W. Sudana, R. Hendrayana, R.V. Gerpacio, and P.L. Pingali. 2004. Maize in Indonesia: Production Systems, Constraints, and Research Priorities. Mexico, D.F.: CIMMYT.

World Food Program. 2009. National Food Security and Vulnerability Atlas of Indonesia. Dewan Ketahanan Pangan, Departemen Pertanian dan World Food Program.

YMTM, 2007. Baseline survey for the implementation of Agroforestry Program under The Australia Nusa Tenggara Assistance for Regional Autonomy, 2007-2010. Kefamenanu, Nusa Tenggara Timur.