Feasibility of OPV Srikandi Maize for Overcoming Productivity and Food Security Problems in East Nusa Tenggara, Indonesia

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Abstract. Maize is the staple food in East Nusa Tenggara (ENT) province of Indonesia. Productivity is only 1-2 t ha^{-1} as a result of poor input management. This study assessed the feasibility of new maize cultivation technology in an experiment with 30 farmers on 15 ha in South Timor Tengah district of ENT during the 2007/2008 rainy season. We compared the farmers' existing technology with new technology. The data were subjected to partial budget analysis including return:cost (R:C) ratio and benefit:cost (B:C) ratio calculation. Maize productivity under the improved package [which included open-pollinated variety (OPV) Srikandi maize and recommendations relating to fertilizers and planting distance] was 3.4 t ha^{-1} In contrast, under farmers' existing practices it was only 1.7 t ha-^{1}. TFarmers' income under the improved package was Rp. 4.8 million and the R:C ratio 3.28. Farmers' practices fetched an income of only Rp. 2.4 million. The applied maize technology was thus found to be worth disseminating on a wider scale in ENT.

Key words: Technology feasibility, dryland, maize, East Nusa Tenggara

Introduction

The East Nusa Tenggara province (NTT) of Indonesia has a predominantly dryland agroecosystem that is greatly influenced by the *muson* winds. The four-month rainy season begins in December and ends in March, and the eight-month dry season begins in April and ends in November. Rainfall is not spread evenly. During the rainy season, the highest rainfall (2000-3000 mm per year) falls in the western part of Flores Island, the western part of Sumba Island and the central part of Timor Island. The lowest rainfall (1500 mm per year) occurs in Timor, Flores, Sumba and Alor. The highest radiation (98%) takes place in October and the lowest (50%) in January (http://www.bkpmd-ntt.go.id/id/profil.html).

The province has potential for maize and bean production. The target for maize plantation in 2005/2006 was about 12 000 ha but only about 6000 ha was realized (Agricultural ENT Province 2004). This influenced the availability of food.

It is estimated that 89% of the people of ENT are farmers, 79% of them being dryland farmers with maize as their prominent crop. Land, soil and climatic conditions are the main determinants of agriculture in this province. The El Nino phenomenon, frequent drought, pests and diseases make ENT vulnerable to food scarcity.

Maize productivity is generally low at 1-2 t ha^{-1}. This is because of the use of traditional cultivation technologies with little attention being paid to to the variety used, seed, fertilizer and control of pest and diseases.

The open-pollinated variety (OPV) Srikandi, a good source of carbohydrate with high content of protein (especially lysine and tryptophan), could substitute local maize as the staple crop and consequently lead to an improvement in the people's nutrition. Compared with other excellent varieties such as OPV Lamuru, the lysine and tryptophan content of Srikandi (Azrai 2004) is almost double (protein 10.44%, lysine 0.410% and tryptophan 0.087%). Lysine and tryptophan are two of 10 essential amino acids are needed by the human body. The need for lysine and tryptophan is normally met by consuming meat and beans, but ENT farmers sell their beans and livestock to buy food for their carbohydrate needs. Therefore, any development strategy for this province must include maize with high productivity, drought tolerance and high protein content.

Objective

The aim of this study was to identify maize cultivation technologies that will enhance productivity and farmers' income as well as secure the food security of the dryland farmers ofEast Nusa Tenggara.

Methodology

Research location

Our research was conducted in farmers' fields in Tobu village in Tobu subdistrict in South Central Timor Regency (TTS)during the 2007/2008 rainy season.

Research approach

We adopted the approach of on-farm participatory research for this study. The study was conducted in farmers' fields with the active involvement of farmers, field officers and researchers. The introduced technologies were the OPV maize variety Srikandi and recommendations on fertilizers and plant spacing (Table 1). Our study was based on the principle of group empowerment of farmers to accelerate adoption of technology. The study involved a comparison of results achieved by participating farmers implementing improved technology (cooperator farmers) and and a control group of farmers using local technology (noncooperator farmers).

Data analysis

The analysis of income was done as perDowney and Erickson (1985).

$$I = \sum (y.Py) - \sum (x_i.Px_i)$$

Where
I = Income
Y = Output
Px_i = Input cost
Py = Output cost
X_i = input (i = 1,2,3….n)

The analysis was conducted by using partial budget analysis. The R:C ratio (*return:cost ratio*) was calculated as per Soekartawi (1995). Mathematically, it was calculated as follows:

$$a = \frac{R}{C}$$

R = Py.Y
C = FC + VC
a = {(Py.Y) / (FC + VC)}

Explanation:
a = R/C ratio
R = Revenue
C = Cost
Py = Price of output
Y = Output
FC = Fixed cost
VC = Variable cost

If a>1: reasonable
a<1: not reasonable
a=1: equal/breakeven (no loss)

Table 1. Farmers' existing practices and introducted technologies.

Technology	Farmers' existing practices	Introduced technologies
Crop	Maize	Maize
Variety	Local	White Srikandi
Plant spacing	Irregular; 4-5 seeds per hole	100 x 40 cm
Time of planting	Beginning of wet season	Beginning of wet season
Fertilizer	No fertilizer	Urea 200 kg ha^{-1} + SP36 100 kg ha^{-1} (fertilization I: ½ dosage urea at 7-10 dap + SP36; fertilization II: ½ dosage urea 25-30 dap)
Weeding	Manual	Manual

Results and Discussion

Feasibility of maize cultivation technology

The new maize technology did increase productivity. Productivity under new technologies was 3.404 t ha^{-1} and under farmers' practices only 1.737 t ha^{-1} (Table 2).

The productivity of farmers who persisted with their conventional practices (noncooperator farmers) was lower than that of cooperator farmers who applied the new technologies. Srikandi maize, besides having high productivity, had lower plant height than the local maize

Table 2. Maize plant height, diameter and population under existing farmers' practices[1] and new technologies.

Technology	Farmers' existing practices	Introduced technologies
Plant height (cm)	203.30	184.37
Plant diameter (cm)	2.68	2.70
Plant population per ha	43 000	62 500
Productivity (t ha^{-1})	1.737	3.438

1. All cooperator farmers used OPV Srikandi and noncooperator farmers used a local OPV variety.

cultivar. This makes it suitable for ENT province where unpredictable climate particularly rainfall and wind causes lodging in the local maize cultivar (average height 2 m). As a result, pollination does not take place perfectly which in turn causes loss of production. The plant diameter of Srikandi maize is bigger than local maize. This gives a physiological advantage compared to local maize which tends to be damaged by wind when maize cobs start growing.

Srikandi maize is suitable for development in higher areas because it has high productivity, drought tolerance and higher protein content than local varieties. Azrai (2004) reported that white Srikandi maize has 0.410% lysine content and 0.087% tryptophan, which are needed for human nutrition.

Consumption of Srikandi maize grain (0.5 kg day^{-1} per capita) will render about 2.400 mg day^{-1} (0.48% x 0.5 kg) of lysine. Srikandi maize could be the answer to nutrition problems in this province (Hosang 2006).

Both cooperator and noncooperator farmers expressed interest in growing Srikandi maize because:

- The results were quite good in spite of constraints such as water stress and strong winds which affect local maize yields by up to 50%.
- The color of Srikandi maize grain is white, which is similar to that of local maize.
- The husk cover of Srikandi is closed which makes it tolerant to *S. zeamais* and enables storage for a longer period.
- If Srikandi maize is consumed before maturity, its taste is sweeter than that of local maize.

Table 3. Economic analysis of maize cultivation with introduced technologies in comparison with conventional technology.

Component	Introduced pattern	Existing pattern
Productivity (kg ha^{-1})	3438	1737
Input cost (Rp. ha^{-1})	1 693 932	718 750
Postharvest cost (Rp. ha^{-1})	405 000	405 000
Total cost (Rp. ha^{-1})	2 098 932	1 123 750
Benefit (Rp. ha^{-1})	6 876 000	3 474 000
Revenue (Rp. ha^{-1})	4 777 068	2 350 250
B:C Ratio	3.28	3.09
R:C Ratio	2.28	2.09
MBCR	3.49	

Feasibility analysis

The feasibility analysis of cooperator farmers' cultivation with introduced technologies and noncooperator farmers' persistence with local technology during the 2007/2008 rainy season is presented in Table 3.

Productivity of maize under the introduced technologies was 3438 kg ha^{-1} in comparison with 1737 kg ha^{-1} under farrmers' conventional practices. The reasons for this big difference in productivity were: (1) control farmers' use of local varieties with low productivity; (2) higher plant population achieved under the introduced package of technologies; and (3) the conventional farmers' practice of using no fertilizer.

The profits made by cooperator farmers varied from Rp. 4 656 000 to Rp. 9 404 000 ha^{-1} with a mean of Rp. 6 876 000 ha^{-1}. In contrast, the profits of noncooperator farmers ranged from Rp. 1 824 000 to Rp. 5 024 000 ha^{-1} with a mean of Rp. 3 474 000 ha^{-1}. Apart from lower productivity, the costs of production of noncooperator farmers were higher (average Rp. 1 123 750 ha^{-1}) in comparison with those incurred by cooperator farmers (Rp. 2 098 932 ha^{-1}). Further, the noncooperator farmers tended to use seed of the local variety continuously for years. Given the fact that rainfall during the 2007/2008 rainy season was lower than during the 2006/2007 rainy season, local maize yielded 50% poorer results than in the previous year. Apart from its other advantages, Srikandi maize was faster harvested (by about 20 days) than the local variety.

The economic analysis shows that the B:C ratio for maize under the new pattern of practices was 3.28 and the R:C ratio 2.28.In other words, each investment of 1 rupiah would result in an income 3.28 times higher. The MBCR for the new pattern worked out to 3.49 in comparison with the existing pattern.

Conclusions

- Development of the new cultivation technology of OPV Srikandi maize is feasible in the drylands of East Nusa Tenggara given the B:C ratio of 3.48 and R:C ratio of 2.28. Farmers' income increased from Rp. 2 098 932 ha^{-1} to Rp. 6 876 000 ha^{-1}, with an MBCR value of 3.49.
- Farmers were satisfied with Srikandi maize because it gave them higher productivity and enabled an earlier harvest (by 20 days) than their local variety.

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