THE PERFORMANCE OF MAIZE VARIETIES IN SOME AGRO-ECOSYSTEMS OF EAST JAVA

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INTISARI

Jagung merupakan tanaman pangan penting kedua setelah padi. Sekitar 64 % jagung diusahakan di Jawa dan memberikan sumbangan kira-kira 68 % terhadap produksi jagung nasional. Produktivitas jagung di Jawa Timur relatif lebih tinggi dibandingkan dengan rata-rata produktivitas nasional. Hal itu terutama karena penggunaan jenis jagung hibrida yang meluas di Jawa Timur. Meskipun demikian mayoritas petani khususnya di lahan kering dan lahan tadah hujan, mengeluh tentang tingginya harga input dan rendahnya harga jual jagung. Petani di lahan kering dan tadah hujan kurang akses terhadap pasar, karena mereka jauh dari industri benih, pakan dan makanan olahan. Studi ini bertujuan menelaah penggunaan varietas jagung dan tingkat profitabilitasnya di beberapa agroekosistem di Jawa Timur. Hasil studi menunjukkan bahwa: (i) Jagung umumnya ditanam di lahan kering dan sebagian di lahan tadah hujan pada musim hujan, sedangkan pada musim kemarau, jagung diusahakan di sawah tadah hujan dan irigasi; (ii) jagung lokal khususnya diusahakan pada lahan kering dan tadah hujan, jagung hibrida ditanam di sawah irigasi dan sebagian kecil di sawah tadah hujan, sedangkan jagung turunan hibrida ditanam pada lahan tadah hujan; (iii) penanaman jagung lokal umumnya ditujukan untuk konsumsi manusia, sedangkan jagung hibrida dan turunan hibrida untuk dijual dan (iv) tingkat produktivitas dan keuntungan paling tinggi diperoleh dari jagung hibrida murni yang ditanam di sawah irigasi. Beberapa kendala yang dihadapi petani dalam upaya meningkatkan produksi jagung adalah (a) rendahnya harga jual jagung selama musim panen; (b) tingginya harga input; (c) kurangnya promosi dari jagung komposit dan hibrida yang dihasilkan oleh pusat penelitian pemerintah, menyebabkan tingginya harga benih jagung dan (d) kurangnya modal usaha. Untuk mendorong petani dalam meningkatkan produksi jagung, pemerintah harus menyediakan subsidi benih yang layak. Pemerintah juga harus mendorong terjalinnya kerjasama saling menguntungkan antara pusat penelitian pemerintah dengan perusahaan swasta dalam hal pemuliaan jagung dan mempromosikan varietas jagung unggul baru yang dihasilkan dari kerjasama tersebut. Dengan demikian, diharapkan benih cukup tersedia dengan harga yang terjangkau. Upaha lainnya adalah pemerintah Indonesia harus membatasi impor jagung dengan menerapkan tarif yang signifikan, mendorong pihak swasta untuk melakukan investasi dalam pabrik pakan yang dekat dengan sentra produksi jagung, mendirikan Bank Rakyat atau Bank Pertanian dimana para petani dapat akses langsung, dengan prosedur administrasi yang sederhana.

Kata kunci: *Varietas jagung, agroekosistem, Jawa Timur.*

ABSTRACT

Maize is the second important cereal crop after rice. About 64 percent of maize were planted in Java, and contributed about 68 percent of the national maize production. Maize yield in East Java was relatively high, compared to the average of national level. This was mainly due to a wide spread use of hybrids in this province. Nevertheless, most farmers, especially in dry-land and rain-fed, were complaining about high prices of inputs and low price of maize grain. Since they are away from seed, feed, and food industries, they have no access to those industries. This study is aimed to investigate the use of maize varieties and their profitability in some agro-ecosystem in East Java. The results of the study showed that: (i) maize is mostly cultivated in dry-land and some in rain-fed, especially during wet season, while in rain-fed and irrigated lowland during dry season; (ii) local maize is mainly cultivated in dry-land and rain-fed, hybrid is cultivated in irrigated, and some in rain-fed, while recycle maize in rain-fed; (iii) local maize is planted mostly for human consumption, while hybrids and their recycles are for sale; and (iv) the highest yield and net profit were obtained from pure hybrids in irrigated lowland. Some constraints faced by farmers to increase maize production are (i) low price of maize grain during harvesting season; (ii) high prices of inputs; (iii) lack of promotion of OPVs and hybrids bred by governments research centers, resulting in a high price of seed; and (iv) lack of capital. To encourage farmers to increase maize production, government should provide a reasonable seed subsidy. In addition, government should encourages mutual collaboration between public research centers and private companies, in terms of maize breeding and promotion of the new HYVs resulted from this collaboration. Therefore, seed is expected to be sufficiently available in an affordable price. The other efforts are that GOI should limits maize import by imposing a significant tariff; encourages private companies to do investment in feed mills close to maize production centers; as well as provide farmers with Rural Bank or Agricultural Bank, where farmers can access them directly, with a simple administrative procedure.

Key words: *Maize variety, agro-ecosystem, East Java*

INTRODUCTION

During the last decade, about 64% of maize was grown in Java, and contributed about 68% of the national maize production (CBS. 1990-2000). In terms of land type, during the period of 1980s about 79% of maize is grown in dry-land (Bastara, 1988; Subandi and Manwan, 1990; and Hairunsyah, 1993). Subandi recently reported that about 89% of maize were grown on rain-fed and dry-land with erratic rainfall (Subandi, 1998).

In East Java, area planted to maize was fluctuated. However, in general it was increasing from about 0.89 million ha in 1985 to 1.14 million ha in 1999, or it grew at a rate of 1.75 percent per year. On the other hand, the yield for the last 15 years was continuously increasing from 1.90 t/ha in 1985 to 2.97 t/ha in 1999, or growing at a rate of 3.23 percent per year. Therefore, the total production was increasing from 1.70 million tones in 1985 to 3.38 million tones in 1999, or it grew at a rate of 5.03 percent per year, as shown in Table 1.

Maize yield in East Java was relatively high, compared to the average of national level. This was mainly due to a wide spread use of hybrids in this province, especially in irrigated lowland. The use of hybrid varieties in East Java were more profitable than open pollinated and local varieties (Hadi et al., 1993; and Suhariyanto, 2000).

Table 1. Area and production of maize in East Java, 1985-1999

Year	Area (ha)	Production (ton)	Yield (ton/ha)
1985	893452	1701120	1.90
1986	1181134	2421916	2.05
1987	984577	2096035	2.13
1988	1237569	2527912	2.04
1989	1112391	2498459	2.25
1990	1122900	2578286	2.30
1991	1063976	2504905	2.35
1992	1304036	3023344	2.32
1993	1012051	2366252	2.34
1994	1117789	2636015	2.36
1995	1187136	2820868	2.38
1996	1269529	3417489	2.69
1997	1099603	3048041	2.77
1998	1329863	3915865	2.94
1999	1138311	3381235	2.97
Growth	**1.75**	**5.03**	**3.23**

The high adoption of new technology was supported by a good supporting system. East Java has a relatively good transportation facilities and agro-industry. East Java is also the center of hybrid seed production as well as food and feed industries. So that, farmers have a good accessibility to maize seeds and grain markets. The objectives of this study are: (i) to have a better understanding on the performance (yield and profitability) of maize varieties in some agro-ecosystems of East Java, and (ii) to investigate the constraints to increase maize production in East Java.

METHODOLOGY

This study took place in two districts of East Java, i.e. Tuban and Kediri. The agro-ecosystem in Tuban are dry-land and rain-fed, while in Kediri are irrigated lowland and dry-land. Four villages in each district were chosen. Therefore, a number of eight villages were selected, namely Margorejo, Hargoretno, Padasan, and Temayang in Tuban, while Plemahan, Mojo Ayu, Kebon Rejo, and Kampung Baru in Kediri. The primary data were collected directly from the farmers groups by using group interviews. Three group interviews and discussions were done in each village, in order to have a better information regarding application of maize technology, such as: varieties used, cropping pattern, inputs used, yield, and profitability, in these two districts. Intensive discussions in a participatory approach were done in this study. On the other hands, the secondary data were collected from some institutions, such as: Central Bureau of Statistics (CBS), Regional Agricultural Offices at Provincial and District level, and some private companies.

MAIZE PRODUCTION SYSTEM

Maize Production Growth in Two Selected Districts

During the last 15 years, production in two selected districts in East Java grew at a substantial rate. In Kediri, production was increasing from about 95 thousand tones in 1985 to about 224 thousand tones in 1999, or it grew at a rate of 6.32 percent per year. Most of the growth during this period was contributed by yield growth (3.71%/year), and the rest (2.52%/year) was contributed by area growth (table 2).

Similarly, in Tuban maize production was increasing from about 84 thousand tones in 1985 to about 233 thousand tones in 1999. It's growth was 7.53 percent per year. This high growth was mainly contributed by yield growth (4.02%/year), and about 3.38 percent per year was contributed by area growth. The high yield growth in East Java indicating the high progress of technological improvement, especially the rapid adoption of hybrids technology. In general, the yield level in Kediri was higher than it was in Tuban. Because, the use of pure hybrids with high level of fertilizers in Kediri was more common than it was in Tuban, where most of farmers were using local maize and recycle hybrids.

Table 2. Maize area and production in Kediri and Tuban, East Java, 1985-1999

Years	Kediri			Tuban		
	Area (ha)	Production (ton)	Yield (ton/ha)	Area (ha)	Production (ton)	Yield (ton/ha)
1985	37947	94763	2.50	49356	84419	1.71
1986	40943	104782	2.56	77599	146888	1.89
1987	47014	121885	2.59	53825	103751	1.93
1988	45088	103782	2.30	79305	154905	1.95
1989	43301	102900	2.38	63459	153315	2.42
1990	42576	105277	2.47	69644	157088	2.26
1991	43042	115288	2.68	64278	149736	2.33
1992	45343	120782	2.66	90361	194653	2.15
1993	42606	115164	2.70	70189	163236	2.33
1994	45311	124215	2.74	77062	177593	2.30
1995	45667	128601	2.82	91045	201354	2.21
1996	51690	158829	3.07	96147	255608	2.66
1997	50234	152162	3.03	80666	234753	2.91
1998	48267	235962	4.89	94832	297092	3.13
1999	53765	223610	4.16	78586	233414	2.97
Growth	**2.52**	**6.32**	**3.71**	**3.38**	**7.53**	**4.02**

The Use of Maize Varieties

In dry-land, most of farmers (47%) during wet season grew local variety, followed by hybrids (29%), recycle hybrids (22%), and improved Open Pollinated Varieties (OPVs) about 2%. Similarly, most of farmers in rain-fed lowland during wet season grew local variety (40%), followed by recycle hybrids (40%), and hybrids (20%). In dry season, all respondents in irrigated lowland grew hybrids, while about 80% of farmers in rain-fed grew local variety, followed by recycle hybrids (18%) and only 2% of farmers grew improved OPVs (Table 3). There are some reasons for farmers to grow local maize i.e: (i) they use maize as a staple food; (ii) high price of hybrid seed, (iii) scarcity of OPVs seed; and (iv) farmers have less experience to grow improved OPVs or hybrids, so that growing a new variety is risky.

As shown in table 3, only a few of farmers grew improved OPVs. This is due to limited availability of improved OPVs seed in the market. Farmers reported that the private companies collaborated with extension workers promoted the hybrids intensively and they made hybrids seed available. In contrast, no one promotes improved OPVs as well as government bred hybrids. Therefore, although more expensive, the use of private bred hybrids is much higher than improved OPVs and hybrids produced by government.

The recycle seed were selected from the previous harvested hybrids. There were at least two reasons for farmers to use recycle seed (especially F2). First, the yield of F2 were still high (about 80-90 percent of the pure hybrids). Second, farmers do not have to buy an expensive seed, since they have a limited cash capital.

Table 3. Varieties grown by agro-ecosystem in East Java, 2000.

Item	Land Type (%)		
	Irrigated	Dry-land	Rain-fed
Wet Season			
a. Local	0	47	40
b. Improved OPV	0	2	0
c. Hybrids	0	29	20
d. Recycled seed	0	22	40
Dry Season			
a. Local	0	0	80
b. Improved OPV	0	0	2
c. Hybrids	100	0	0
d. Recycle seed	0	0	18

Local = white maize; OPV = Arjuna; Hybrids = Bisi-2, Pioneer 5, 7, and 11.

Cropping Pattern

Cropping Patterns are considerably different across agroecosystem. In general, cropping pattern based on rainfall and land types are shown in figures 1, and 2.

In irrigated lowland, maize is planted in late March or early April (after harvesting rice), and harvested in July, as shown in Figure 1. The cropping pattern in rain-fed lowland is almost similar to irrigated lowland. In this area, maize is also mainly planted after rice. Only a few farmers reported that they grew wet season maize in rain-fed. In irrigated and rain-fed lowland, rice the most important crop. As long as water is sufficient for rice, farmers will grow rice. Only in dry-land maize plays the first priority during wet season, as shown in figure 2.

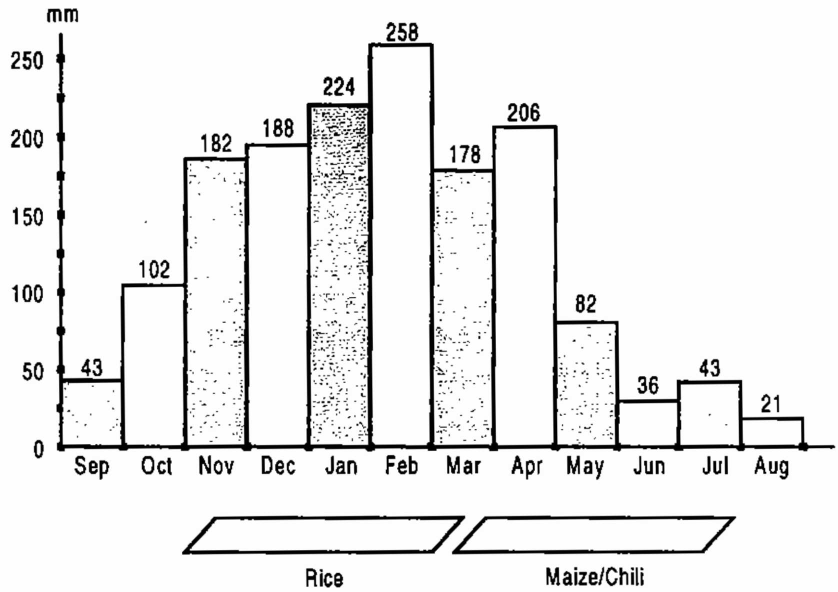

Figure 1. Cropping Pattern in Irrigated Lowland, East Java

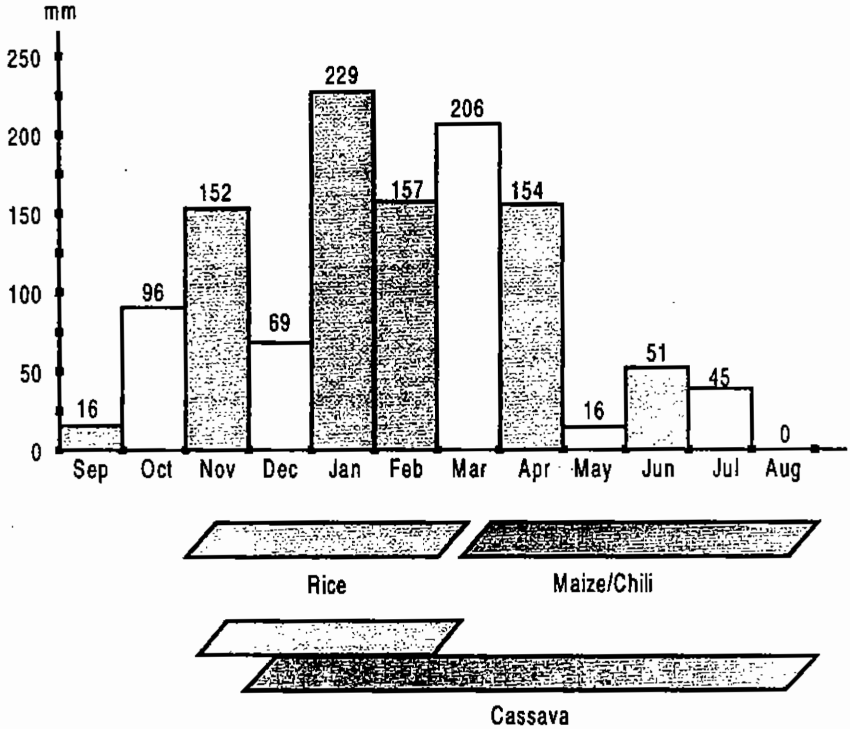

Figure 2. Cropping Pattern in Dry-land, East Java

Inputs Use

Level of inputs use in each agro-ecosystems and seasons, are as follows.

Seeds. Farmers used maize seed about 20 kg/ha for local, recycle, as well as pure hybrids. Planting (seeding) is done by hand, either in hole made by sticks or in the plow furrow. Crop spacing varied from 75 x 30 cm to 100 x 40 cm, depending upon individual practices.

Fertilizer. Respondents in the study area used Urea at the average rate of 100 kg/ha in rain-fed, 150 kg/ha in dry-land, and 390 kg/ha in irrigated area. They are equivalent to 45 kg N/ha in rain-fed, 67.5 kg N/ha in dry-land, and 175 kg N/ha in irrigated area. Urea is usually applied twice, together with the first and second weeding. Another form of nitrogen used by farmers in irrigated lowland was ZA. The phosphate fertilizer, in the form of SP36 was commonly used in irrigated area, and relatively few farmers in rain-fed. The average use of SP36 in rain-fed was 25 kg/ha, while in irrigated area was 150 kg/ha. Potassium in the form of KCl, only used by farmers in irrigated area at the average of 52 kg/ha. Farmers in dry-land and rain-fed were not applying potassium. In addition, most of farmers in the study area applied manure. In fact farmers applied manure ranging from 1500 kg to 7500 kg/ha. Farmers in irrigated area applied higher manure than farmers did in dry-land and rain-fed.

Pesticides and herbicides. Farmers are familiar with many pests and diseases, but they reported that these pest and diseases did not reduce yields seriously. No one was using pesticides and herbicides for crop protection. Maize in this study area often infested by white grubs in the early stages of growth. A major factor causing this infestation was late planting of maize. Late seeding of maize during rainy season usually due to uneven distribution of early rains and competition for labor with other wet season crops, especially wet season rice in rain-fed. The summary of inputs use are shown in table 4.

Table 4. Material Inputs Use per ha by agro-ecosystem in East Java, 1999/2000

Inputs	Agro-ecosystem					
	Irrigated		Dry-land		Rain-fed	
	Quantity	Value	Quantity	Value	Quantity	Value
1. Seed (Hybrid)	20	350,000	20	350,000		
Non-hybrid	-	-	20	30,000	20	30,000
2. Fertilizer						
(a) Urea	392.5	451.375	150	172,500	100	115,000
(b) ZA	112.5	135,000	0	0	0	
(c) SP36	150	270,000	0	0	25	45,000
(d) KCl	52	104,000	0	0	0	-
(e) Manure	7500	150,000	1500	30,000	2250	45,000
3. Pesticide	-	-	-	-	-	-
4. Herbicide	-	-	-	-	-	-
Total (Hybrid)		**1,460,375**		**552,500**		
Non-hybrid				**232,500**		**235,000**

Labor use. Labor are needed for land preparation, planting, weeding, fertilizer application, harvesting, shelling and transportation. Land preparation was fully done by male. Only for planting and harvesting in irrigated area, male and female took place equally. Weeding and fertilizer application were mostly done by male. In dry-land, most of work in the field were done by men, and partly done by women. The total labor cost spent for maize cultivation were about Rp 1.25 million per ha in irrigated area, about Rp 0.67 million per ha in dry-land, and Rp 0.76 million per ha in rain-fed. In more detail, the labor use for all activities are presented in table 5.

Table 5. Labor use for maize production in the study area of East Java, 1999/2000

Item	Agro-ecosystem					
	Irrigated		Dry-land		Rain-fed	
	Quantity (days)	Value (Rp)	Quantity (days)	Value (Rp)	Quantity (days)	Value (Rp)
1. Land prep:						
(a) Manual	4	60,000	3	45,000	3	45,000
(b) Animal power	7	245,000 *)	6	270,000	6	270,000
(c) Tractor	2	350,000 *)	-	-	-	-
2. Planting:						
(a) Male	10	125,000	6	60,800	6	86,000
(b) Female	10	90,000	-	-	6.75	71,200
3. Weeding:	17.5	136,500	3	41,800	2.75	40,700
(a) Male						
(b) Female	9.5	104,500	2	15,000	2.75	30,500
4. Fertilizer Appl:						
(a) Male	3.5	56,000	2	27,000	3	40,500
(b) Female	-	-	1	13,300	2	22,000
5. Harvesting:						
(a) Male	10.5	108,500	9	43,000	11	64,500
(b) Female	10.5	87,500	7	32,000	8	33,000
6. Shelling:						
(a) Male		42,000	2	9,000	2	13,500
(b) Female	-		1	3,000	1	4,500
7. Transportation	-	142,000	-	7,000	-	37,500
Total		**1,249,500**		**566,900**		**758,900**

*) Farmers are either using animal power or tractor.

Maize Yield

In the study area, the yield of maize obtained by farmers in irrigated area was ranging from 5.4 to 7.4 t/ha, with the average of 6.35 t/ha. It was much higher than the same variety in dry-land (2.9 t/ha), and the recycle in dry-land (2.3 t/ha) as well as in rain-fed (2.6 t/ha). The yield of local variety even lower, i.e. 1.5 t/ha in dry-land and 1.6 t/ha in rain-fed, as shown in Table 6. These gaps were mainly due to at least three factors. First, the use of pure hybrids with high inputs in irrigated lowland versus local and recycle maize with low inputs in dry-land and rain-fed. Second, soil fertility in irrigated lowland is better than that of rain-fed and dry-land. Third, during wet season, farmers in irrigated lowland planted rice with high inputs, especially fertilizers. The residual effect of slow release fertilizer, especially SP36, is still there, when maize is planted.

Table 6. Yield level of maize in the study area of East Java, 1999/2000

Agro-ecosystem	Local		Hybrids		Recycle	
	Average	Range	Average	Range	Average	Range
Irrigated	-	-	6.35	5.4–7.4	-	-
Dryland	1.53	0.8–2.03	2.90	2.4–3.7	2.32	1.9-3.0
Rainfed	1.56	0.9–1.9	-	-	2.61	2.2-3.3

Cost and Benefit

Inputs used for maize cultivation in irrigated area were higher than it was in dry-land and rain-fed. As a result, the yield and net profit in irrigated area was much higher than they were in dry-land and rain-fed. If family labor is taken into account as a part of labor cost, then the net profit in irrigated area was more than six times and ten times compared to that of local maize in dry-land and rain-fed, respectively. Compared to recycle maize, the net profit of pure hybrids in irrigated was 2.7 and 2.6 times in dry-land and rain-fed, respectively. It was also 2.4 times compared to pure hybrids in dry-land. In other words, this study found that maize production system in irrigated area using pure hybrids was the most profitable compared to other varieties in other agro-ecosystems.

Based on break even analysis, the maize yield in irrigated using hybrids, was not permited to be lower than 3011 kg/ha, while the minimum yield of hybrids in dry-land should be 1244 kg/ha. The minimum yield of local maize should be 969 kg and 1205 kg/ha, respectively in dry-land and rain-fed. Similarly, the minimum yield of recycle maize should be 969 kg and 1205 kg/ha, respectively in dry-land and rain-fed.

The minimum price of maize grain in irrigated area should be higher than Rp 427/kg, while in dry-land should be higher than Rp 522/kg, Rp 345/kg, and Rp 386/kg, respectively in local, recycle, and hybrids. In rain-fed, the minimum prices of local and recycle maize should be higher than Rp 637 and Rp 381/kg, respectively, as shown in table 7.

Table 7. Cost and return analysis of maize production in East Java, 1999/2000

Item	Irrigated		Dry-land		Rain-fed	
	Hybrids	Local	Recycle	Hybrids	Local	Recycle
Material cost	1,460,375	232,500	232,500	552,500	235,000	235,000
Labor cost	1,249,500	566,900	566,900	566,900	758,900	758,900
Total cost	2,709,875	799,400	799,400	1,119,400	993,900	993,900
Yield (Kg/ha)	6,350	1,530	2,320	2,900	1,560	2,610
Revenue	5,715,000	1,262,250	1,914,000	2,392,500	1,287,000	2,153,250
Net Profit	3,005,125	462,850	1,114,600	1,273,100	293,100	1,159,350
R/C Ratio	2.11	1.58	2.39	2.14	1.29	2.17
BEY	3,011	969	969	1,357	1,205	1,205
BEP	427	522	345	386	637	381

Note: BEY=Break Even Yield; BEP=Break Even Price.

CONSTRAINTS TO INCREASE MAIZE PRODUCTIVITY

There were at least three constraints to increase maize productivity in the study area, i.e. natural hazards, socio-economics, and institutional constraints. In terms of natural hazards, the a-biotic constraint experienced by farmers was drought, which occurred every 4-5 years. The worse drought was happened in 1997, causing 25-75 percent yield losses. There was no significant biotic constraint face by farmers in their maize production. Rat and insects attacked maize in a low rate, so that, there was no significant yield losses.

The socio-economic constraints consists of: (i) low price of output, particularly in the harvesting season, (ii) high price of inputs particularly hybrid seed and fertilizers, and (iii) lack of cash capital. Low price of output was mainly due to low accessibility of farmers to the market. They are away from feed mills, especially farmers in dry-land and rain-fed. Farmers in dry-land and rain-fed had no choice to sell their grain. Only the traders who come to the villages were the one who buying their maize. So that, farmers were the price takers, because they had no bargaining power about price. On the other hand, they have to sell their maize immediately for debt repayment, daily expenditure, and other purposes. This condition had made some farmers in dry-land and rain-fed could not afford to buy inputs, to adopt the improved technology of hybrids properly. In contrast, a high price of seed and fertilizers have led farmers to use recycle hybrids with low inputs, and consequently, low yield.

There is no institution who in charge to make HYVs bred by government, such as improved OPVs or hybrids, be available at farm gate. As a result, there is no improved OPV or hybrids, bred by government research center, available in the market at a lower price. It was almost impossible to find improved OPVs (Arjuna, Bromo, Bisma, Wisanggeni, Lagaligo, etc) and government bred hybrids (Semar-1 to Semar-9) in the agriculture material shops. Only hybrids bred by private companies (Pioneer, Bisi, Cargill, etc) were available in the market with the high price. In addition, a high price of fertilizers in line with lack of cash capital, have made farmers to use only Urea and SP36 at a low rate, except farmers in irrigated area.

Another institutional constraint is the marketing system of maize. There was no marketing agent worked for farmers. Farmers groups and cooperatives were not doing a marketing of any agricultural product. Even they do not provide credit for their members. In the past, cooperatives were providing inputs (in terms credit) for farmers. Now, it is not done anymore. Thus, farmers generally borrowed cash from traders at a high interest rate.

CONCLUSION AND RECOMMENDATION

Conclusion

Based on the above results and discussions, we can draw some following conclusions.

(1) Maize is mostly cultivated in dry-land, especially during wet season, and in rain-fed and irrigated lowland during dry season.

(2) The most profitable maize production in the study area of East Java is "maize production system in irrigated lowland using pure hybrids".

(3) Since there is a big gap between average yield of hybrids, especially in rain-fed, with its potential, then there is a possibility to increase actual yield at farmers level, to get closer to its potential, by promotion of proper hybrids technology.

(4) Some constraints faced by farmers to increase maize production are: (i) low price of maize grain during harvesting season; (ii) high price of inputs; (iii) long distance between maize production areas and feed mill as well as seed industries; (iv) less promotion of OPVs and hybrids produced by governments research centers; and (v) lack of capital.

Recommendation

In order to encourage farmers to increase their maize yield, there should be some policy efforts implemented by the government of Indonesia. First, government should encourages researchers in the research centers to do mutual collaboration with private companies, in terms of maize breeding and promotion of the new HYVs resulted from this collaboration.

Second, encourages private companies to do investment in feed mills, closer to maize production centers. Third, provide farmers with Rural Bank or Agricultural Bank, where farmers can access them directly, with a simple administrative procedure. Fourth, provide the law enforcement on Intellectual Property Right. So that, there is an incentive for the breeders to produce more new high yielding varieties (HYVs).

REFERENCES

Bastara, T., 1988. The Development Program of Corn in Indonesia in Corn. Central Research Institute for Food Crops (CRIFC). Bogor.

CBS (Central Bureau of Statistics), 1985 – 2000. Indonesian Statistical Year Book

Hairunsyah, 1993. The Research Program of Corn in Banjarbaru Research Institute for Food Crops (BARIF) in Proceeding on Corn Research Seminar. BARIF. Banjarbaru.

Maamun, M.Y., O. Suherman, Dj. Baco, M. Dahlan and Subandi 1999. Research Report presented in the Second Annual Workshop on Asian Maize Sosioeconomics Working Group, in Chiang Mai, Thailand, 25-28 May 1999.

Malian, H., and A. Djauhari. 1988. The Farm Budget Analysis of Corn in Corn. Central Research Institute for Food Crops (CRIFC). Bogor.

Subandi, Ibraim,M, A. Blumenschein. 1988. National Coordinated Research Program on Corn. Central Research Institute for Food Crops. Agency for Agricultural Research and Development.

Subandi, and I. Manwan, 1990. The Research and Technology to Improve Corn Production in Indonesia. Central Research Institute for Food Crops (CRIFC). Bogor.

Subandi, 1998. Corn Varietal Improvement in Indonesia: Progress and Future Strategies. IARD Journal, 20 (1). Agency for Agricultural Research and Development. Jakarta.

Suhariyanto, K. 2000. Maize Production and Cost Structure in Indonesia. Paper presented in the Third Annual Workshop of the Asian Maize Sosioeconomics Working Group, in Ho Chi Minh City, Vietnam, 26-29 June 2000.