The Impact of Cropping Intensity on Maize Marketing in Rainfed Area

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ABSTRACT. Subsistence/semi commercial farmers have been slow to adopt new technologies of maize cultivation even when they make economic sense and compatible with their socio cultural values. Generally, that is because of the high cost of inputs such as seed, fertilizer and pesticides. Therefore its needed to explore the potential adoption of technology prior to dissemination to the farmers. Indonesian Cereals Research Institute had been introducing Cropping Intensity (CI) four times per year or CI 400 in order to boost total maize production. The cropping pattern introduced i.e paddy – maize – maize –maize. CI 400 provides several advantages such as enhancing maize production and cropping intensity that subsequently increase farmers' income. In addition, the CI 400 application could saves labor by 1.94%. The CI 400 had been tested at Bontonompo district, South Sulawesi Province in 2010. Upon adoption of the CI 400 model, most of farmer gained income twice to three times higher due to the high price during the period of Mei to August 2010. The price of maize during that period varied from Rp 2,000/kg to Rp 2,200/ kg. The technology shows promise in ensuring the continuity of maize farming and has the potential to be extended to other region.

Keyword: maize, CI 400, maize, cropping intensity, farmers, Income

Introduction

Maize production in Indonesia could be increased by both expansion of cultivable area and intensifying cultivation practices. Recently, expansion of area under maize is difficult due to the limited land availability. Thus, land intensification through improvement of nutrient management, adoption of improved varieties, integrated pest and disease management etc provides a better opportunity to increase maize production and enhancing farmers' income.

However, maize intensification program is not as easy as it concept, as most of semi commercial farmers have been slow to adopt new technologies of maize cultivation even when they make economic sense and compatible with their socio cultural values. Generally, that is because of the high cost of inputs such as seed, fertilizer and pesticides.In globalization era, agriculture development still faces many problems, i.e. technology, socio-economic and institutions. To overcome these problems, innovation of the appropriate technology and development system of maize production, process, and distribution/marketing of the product should be taken into consideration. Regarding this, the increasing productivity, efficiency, quality, added value and extensification to new areas are required. Although increasing the harvest areas from 2003 to 2007 is only 7.74 % (www .deptan.go.id ., 2008), the harvest areas will be continuously extended to eastern part of Indonesia. Considering that the available land in Java island and western part of Indonesia for growing maize has been limited, therefore extensification program of maize development should be done in eastern part of Indonesia (Aqil M *et al.* 2012).

In order to increase maize production, CI 400 (growing rice once and maize three times a year) or CI 300 is promoted. This cropping system provides many advantages such as enhancing maize production and cropping intensity that subsequently increase farmers' income. Adoption of CI 400 on large scale in rainfed and dryland areas is expected, in order to boost national maize production. CI 400 uses relay planting concept incorporated with "legowo" or adjusted growing system in order to fit the time cycles of four seasons.

Land Resources Availability

The total area of rainfed land in Indonesia is approximately 1.512.386 acre, and in South Sulawesi Province is approximately 214.544 acre. Potentials use of land is shown in Table 1.

Table 1 shows the type of land and cropping intensity in both Indonesia and South Sulawesi Province. In addition, the total area under irrigated system is about 2.714.938 acre, where 55,71% of the area is classified as rainfed area with cropping pattern rice –unoccupied (IC 100), rice-maize/ nut (IC 200) or rice-maize-maize (IC 300) with the use of groundwater to irrigate the area during the dry season.

The total harvest area of maize in Indonesia in 2008-2011 was about 2.083.714 acre (Table 2) or 76.75% of the total rice-fields, decreased by 0,8%/yr, especially during the period of January-April (about 1.67%/yr), product increased by 2.07%, and productivity increased by 2,83%/yr. The detail of the total harvest area in Indonesia is shown in Table 2.

The progress of harvest area, productivity and production of maize during 2008-2011 is shown in Table 2. Maize production is mainly concentrated in rainy season from January to April. Total harvest area during that period reached 2.083.714 ha or 51,58% of the total annual production. However, the growth rate of harvest area and maize production tend to decline by 0.8% and 1.44% respectively. The Government of Indonesia has stated the need to increase the farming land, or to use more intensive agricultural methods to grow sufficient maize crops to meet demand. Millions more new land will be required particularly in outer Java such as Kalimantan, Sumatera, Sulawesi and Papua provinces. It is expected that maize production has led to a positive stimulation of rural economies and helped improve conditions for the production of other crops agricultural land. In addition, the government has chosen to focus on increasing the productivity of current agricultural lands through improved irrigation and farming techniques.

Table 1. Land resources availability in Indonesia and South Sulawesi Province in 2010.

Type of land and cropping intensity	South Sulawesi	Indonesia
Irrigated land		
• 1 x rice	20.403	361.481
• 2 x rice	148.379	1.847.778
Irrigated ½ technicality		
• 1 x rice	13.961	251.624
• 2 x rice	40.842	737.095
Irrigated simple		
• 1 x rice	46.817	589.447
• 2 x rice	109.576	997.142
Rainfed		
• 1 x rice	214.544	1.512.386
• 2 x rice	32.647	503.021
Total area under:		
• 1 x rice	295.725	2.714.938
• 2 x rice	331.444	4.085.036

Source: BPS Indonesia 2010

Beside land expansion, in recent decades, Ministry of Agriculture is working to replenish the local or low productivity maize into new improved variety/hybrid. As a comparison, in 1990, the percentage area planted to hybrid maize was less than 2% of the total area. However, in 2010, the share of hybrid maize increased sharply to about 55-60% of the total area. This will be possible mainly due to the increasing wide-spread of hybrid not only in Java Island but also outside Java (Sumatera, Sulawesi, Kalimantan). In addition, better infrastructure system and well developed agro-industry enable farmers to have access to good maize seed and maize grain market. Nowadays, farmers in Indonesia grew local varieties for home consumption only, while for commercial purposes they grew hybrids or recycled hybrids. A few of them also grew improved OPVs. Most of farmers intend to make more profit using the available improved technologies in maize production.

Table 2. Harvest area, productivity and maize production, 2008-2011.

Description	2008	2009	2010	2011	Rate	Rate of growth (%)
Harvest area (acre)						
a. January – April	2.079.883	2.176.198	2.145.402	1.933.371	2.083.714	-1,67
b. May- August	1.068.455	1.166.286	1.139.190	1.111.613	1.121.386	1,1
c. September-December	853.386	818.175	847.094	819.808	834.616	-0,95
January-December	4.002.724	4.160.659	4.131.672	3.864.692	4.039.937	-0,8
Productivity (t/ha)						
a. January – April	3,96	4,13	4,23	4,19	4,13	1,44
b. May- August	4,25	4,39	4,53	4,60	4,44	2,01
c. September-December	4,15	4,29	4,84	5,41	4,67	6,99
January-December	4,08	4,24	4,44	4,56	4,33	2,83
Production (ton)						
a. January – April	8.237.885	8.995.141	9.072.681	8.094.067	8.599.944	-0,18
b. May- August	4.538.779	5.122.700	5.155.916	5.114.140	4.982.884	3,18
c. September-December	3.540.588	3.511.907	4.099.039	4.435.043	3.896.644	6,02
January-December	16.317.252	17.629.748	18.327.636	17.643.250	17.479.472	2,07

Source: BPS Indonesia 2010 dan 2012

Indonesia is also actively bred or introducing new variety to support land expansion and varietal replenishment. During 1995-2010 (Table 3), Indonesia introduced more than 160 varieties (Directorat of Food Crops, Ministry of Agriculture 2011). Out of those 160 varieties, 125 varieties (approximately 78%) were hybrids and only 34 (22%) varieties were OPVs. From 125 hybrid cultivar, about 100 cultivar (80%) varieties were bred by private/multinational companies and the remaining 25 cultivars (20%) were bred by public research institute (Indonesian Agency for Agricultural Research and Development). As the private/multinational companies invests much in maize seed industry, the role of BBI (National seed reproducement unit) which exists in each province/regency have been gradually decreased (Maamun *et al*. 2001).

Table 3. Description of national maize varieties during 1995-2010.

Type of maize	Yield potential (t/ha)	Year released
Composite		
Wisanggeni	8,0	1995
Bisma	7,0-7,5	4 September 1995
Lagaligo	7,5	8 November 1996
Gumarang	8,0	25 February 2000
Lamuru	7,6	25 February 2000
Kresna	7,0	25 February 2000
Palakka	8,0	14 February 2003
Sukmaraga	8,50	14 February 2003
Srikandi Putih-1 (QPM)	8,09	4 June 2004
Srikandi Kuning-1 (QPM)	7,92	4 June 2004
Anoman-1	6,60	2 October 2006
II. Three Way Hybrid Maize		
Semar 3	8-9	8 November 1996
Semar 4	8,5	22 June 1992
Semar 5	8-9	22 June 1999
Semar 6	8-9	22 June 1999
Semar 7	8-9	22 June 1999
Semar 8	8-9	22 June 1999
Semar 9	8,5	22 June 1999
Semar 10	8-9	22 June 1999
III. Single Cross Hybrid		
Bima 1	8-9	22 October 2001
Bima 2 Bantimurung	11,0	7 February 2007
Bima 3 Bantimurung	10,0	7 February 2007
Bima 4	11,7	31 October 2008
Bima 5	11,4	31 October 2008
Bima 6	10,59	31 October 2008
Bima 7	12,1	30 November 2010
Bima 8	11,7	30 November 2010
Bima 9	13,4	30 November 2010
Bima 10	13,1	30 November 2010
Bima 11	13,2	30 November 2010

Source: Aqil M *et al*. 2012

Integrated Crop Management (ICM)

Use of appropriate farm inputs to increase yields is essential to increase yields. Appropriate fertilizers, containing the right blend of plant nutrients, are required to minimize the nutrient deficiency constraints, disease-tolerant high-yielding maize varieties are required to maximize crop response to nutrient inputs, and herbicides are required to control weeds whilst saving labor. The implementation of appropriate farm inputs to increase yield is called integrated crop management (ICM). The ICM concept (Table 4) had been adopted in maize production in Indonesia since 2005.

The component of technology is divide into two inputs component namely 1. Basic input and 2. Complementary input. Basic input consist of four items i.e high yielding maize variety, certified seed, maize population is about 66,000 to 75,000 plant/ha and the last is appropriate fertilizer use. In addition to the complementary inputs consist of land preparation either minimum or no tillage, draining the excess water, organic fertilizer, ridging/row making, weed control, pest and disease control and appropriate harvest and post harvest handling.

Table 4. Component of maize Integrated Crop Management (ICM), 2005.

1. High yielding varieties; either hybrid maize or composite
2. The seed quality; germination is higher than 90%, seed treatment with ridomil or saromil 2,5-3,0 g/kg of seed
3. Land Preparation: No tillage or minimum tillage
4. Drainage of excess water
5. Plant population is about 66.000 plant/ha
6. Fertilizer:
   a. Organic fertilizer by manure or compost. Fertilizer requirement is about 1.5 to 2 t/ha
   b. Chemical fertilizer

Type of fertilizer	Rate (kg/ha)*		
	7-10 dap	25-30 dap	40-45 dap
Urea	-	200	150
ZA	100	-	-
SP-35	100**	-	-
KCl	100**	-	-

*) dap = days after planting

**) Changeable according to the content nutrient of the land (data analysis of the land)

7. Consumptive use of rain, and groundwater
8. Planting with seeder
9. Weeding with herbicides and/or by hand
10. OPT control

Source: Subandi *et al*. 2005

Economic Evaluation of CI 400

Indonesian Cereals Research Institute had been introducing Cropping Intensity (CI) four times per year or CI 400 in order to boost total maize production. The cropping pattern introduced i.e paddy – maize – maize – maize. CI 400 (Table 5) provides several advantages such as enhancing maize production and cropping intensity that subsequently increase farmers‘ income. In order to meet the planting diurnal, we introduce a relay planting system as follows: About a week before harvesting the first season, we grow the second season so when the harvesting date reached, the second crop was already emergence. The similar treatment is done for the third season so totally it saves time to about 21 days. Land preparation is done by no tillage system and weed was controlled by chemical herbicide.

In addition, the CI 400, application could saves labor by 1.94%. The CI 400 had been tested at Bontonompo district, South Sulawesi Province in 2010. Upon adoption of the CI 400 model, most of farmer gained income of about Rp. 7.47 for each additional cost of Rp. 1. Table 5 also shows that the extensive use of land from CI 300 into CI 400 would increase the cost production of Rp. 134. However, the income gained was also increased by 224% due to the higher yields and maize price during the period from June to September. Changes production and maize price that showed in picture 1.

Figure 1 shows the trend of production and price of maize grain at Bontonompo Subdistrict, Gowa Regency. As indicated in the figure, the highest grain price was Rp 2,200/kg with maize yield of about 7,600 kg/ha. Meanwhile, the lowest price was Rp 2,000/kg with maize yield of about 7,470 kg/ha. The equilibrium was reached at two points i.e Eq. 1 at price Rp 2090/kg with yield 7,480 kg/ha and Eq. 2 at price Rp 2030/kg with yield 8040 kg/ha. This phenomenon indicated that the grain price at the second and third season were lower than the second season. Among the reasons for the low grain price was due to the coincided harvest time and oversupply occurred during season I and III. Margaretha SL and Zubachtirodin (2010b) mentioned that in order to accelerate the adoption of ICM, the minimum production is 4.1 t/ha with grain price of Rp. 1.255/kg.

Conclusion

Indonesian Cereals Research Institute had been introducing Cropping Intensity (CI) four times per year or CI 400 in order to boost total maize production. The cropping pattern introduced i.e paddy – maize – maize – maize. CI 400 provides several advantages such as enhancing maize production and cropping intensity that subsequently increase farmers‘ income. In addition, the CI 400 application could saves labor by 1.94%. The CI 400 had been tested at Bontonompo district, South Sulawesi Province in 2010. Upon adoption of the CI 400 model, most of farmer gained income of about Rp 7.47 for each additional cost of Rp 1. In addition, the extensive use of land from CI 300 into CI 400 would increase the cost production of Rp 134. However, the income gained was

Table 5. A comparative analysis of cost-benefit of CI 300 and CI 400 implementation in Bontonompo. District, Gowa Regency, South Sulawesi. 2010

CI 300	Production (t/ha)	Value (Rp/ha)	Cost (Rp/ha)	Benefit		
				Input	Labor	Amount
Rice	4,900	12,250,000	1,205,000	975,000	2,180,000	10,070,000
Maize I	3,100	5,425,000	1,587,700	1,055,000	2,642,700	2,782,300
Maize II	3,100	3,720,000	1,587,700	1,155,000	2,742,700	977,300
Amount	11,100	21,395,000	4,380,400	3,185,000	7,565,400	13,829,600
Input value		4,16				
Wage value		5,34				
CI 400						
Rice	2,20	5.500.000	1.900.000	485.000	2.385.000	7.955.000
Maize I	7,47	14.933.333	2.785.000	884.300	3.669.300	11.264.033
Maize II	7,60	16.714.500	2.785.000	998.125	3.783.125	12.931.375
Maize III	8,11	16.233.333	2.785.000	755.625	3.540.625	12.692.708
Amount	25,38	53.381.166	10.255.000	3.123.050	13.378.050	44.843.116
Input value		4,90				
Wage value		13,81				
Rate of growth (%)	129	149	134	-1,94	76,83	224

Source: Margaretha *et al*. 2010a.

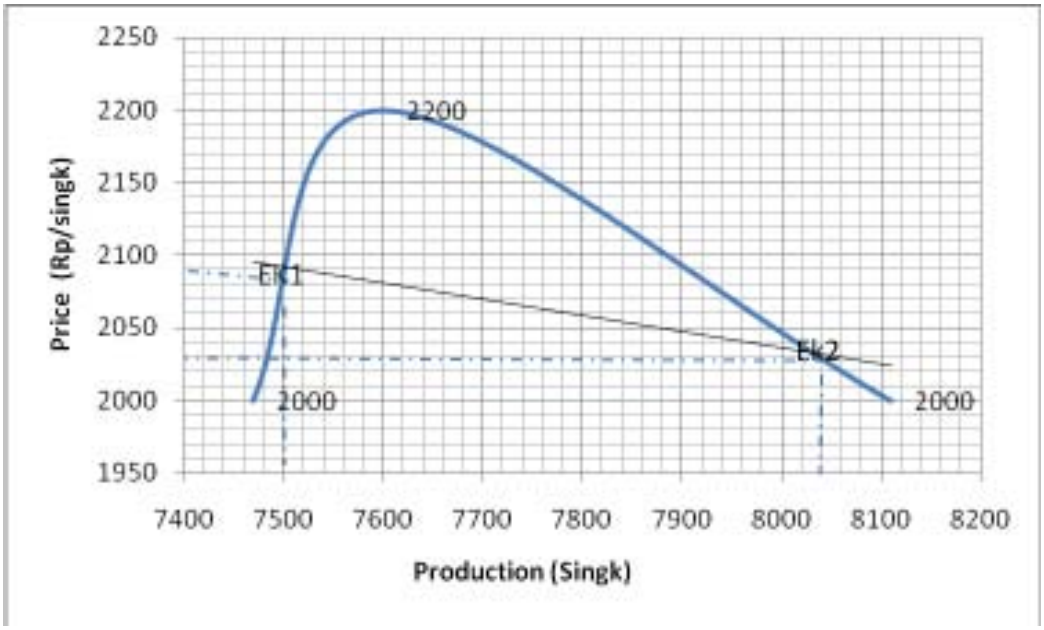

Figure 1. Trend of production and price of maize at Bontonompo Subdistrict Gowa Regency. South Sulawesi Province, 2010.

also increased by 224% due to the higher yields and maize price during the period from June to September. The technology shows promise in ensuring the continuity of maize farming and has the potential to be extended to other region.

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