

## ELASTICITY OF CORN PRICE TRANSMISSION AND ITS IMPLICATION TO FARMERS

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### Abstract

Corn has important roles to Indonesian economy both for staple foods and for price transmission to other products. The high domestic demand for corn compared to its domestic production has made corn imports continue to grow. This research is aimed to know the elasticity of price transmission and its implication to corn's farmers. The results of analysis show that corn price transmission is inelastic. The coefficient shows that corn market is oligopsony under the imperfect competition market. To help the corn farmers, the government has to provide fertilizer subsidy and farm credit with low interest rates, as well as impose import tariff on corn.

**Keywords:** Corn, Elasticity of price transmission, oligopsony, imperfect competition market

**JEL classification numbers:** Q00, Q12, Q18

### Abstrak

Jagung memiliki posisi penting dalam perekonomian Indonesia baik sebagai makanan pokok maupun sebagai perantara aliran harga ke barang lain. Tingginya permintaan jagung dalam negeri dibandingkan dengan produksi dalam negeri telah membuat impor jagung terus tumbuh. Penelitian ini bertujuan untuk mengetahui elastisitas transmisi harga dan implikasinya kepada para petani jagung. Hasil analisis menunjukkan bahwa aliran harga jagung adalah tidak elastis. Koefisien dari model menunjukkan bahwa pasar jagung berstruktur oligopsony dalam kondisi pasar persaingan tidak sempurna. Untuk membantu para petani jagung, pemerintah harus memberikan subsidi pupuk dan kredit pertanian dengan tingkat bunga rendah, serta memberlakukan tariff impor atas jagung.

**Keywords:** Jagung, elastisitas aliran harga, oligopsony, pasar persaingan tidak sempurna

**JEL classification numbers :** Q00, Q12, Q18

### INTRODUCTION

Corn is the second most important staple diet after rice, especially in rural Central Java, Yogyakarta, East Java, South East Nusa and all provinces in Sulawesi. While in the period of 1985-2008, household consumption on corn have decreased by some 4.52 percent, there has been a growth of demand for corn for industrial sector (the animal food industry, food industry, corn flour and cooking oil) by about 22.61 percent per year. Thus, there was a net increase in consumption of corn by about 18.09 percent. Corn production has in-

creased by 5.76 percent per year (Table 1). As the consequences, the corn imports increase steadily so that now Indonesia becomes a net corn importer (Table 2).

In Indonesia, corn are traded through a long trade chains from farmers to the village traders and then to district collectors and finally to wholesalers. This causes a high price disparity between the prices at the producer level and the prices at the wholesale level. Moreover this price disparity is likely widening. According to Indonesia Central Bureau of Statistics, as of December 1985 the disparity is Rp 66 per

kg of dried corn and as of December 2008 becomes Rp 693.37 per kg. This widening gap suggests that the farmers do not enjoy

most of benefits from the increasing corn prices occurred at the wholesale level (Figure 1).

**Table 1:** Development of Harvested Area, Production and Yield Per Ha Corn in Indonesia, 1990-2008

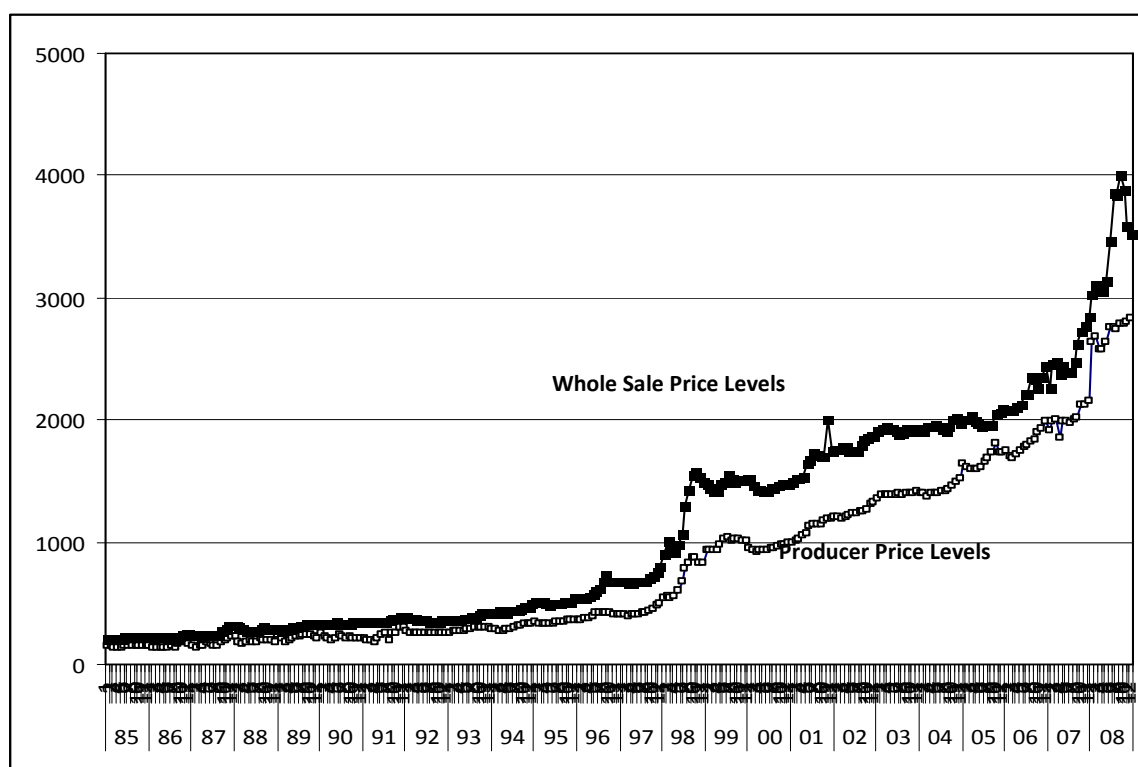
Year	Harvested Area (000Ha)	Production (000 Ton)	Yield (Ton/Ha)
1990	3158	6734	2.13
1991	2909	6256	2.15
1992	3629	7995	2.20
1993	2940	6460	2.20
1994	3109	6869	2.21
1995	3652	8246	2.26
1996	3744	9307	2.49
1997	3335	8771	2.61
1998	3848	10169	2.64
1999	3456	9204	2.66
2000	3459	9345	2.70
2001	3286	9347	2.85
2002	3127	9654	3.09
2003	3359	10886	3.24
2004	3357	11225	3.34
2005	3625	12524	3.45
2006	3346	11609	3.47
2007	3630	13288	3.66
2008	4002	16317	4.08
Growth	1.92%	5.76%	3.73%

Sources: Indonesia Central Bureau of Statistics (BPS), several years.

**Table 2:** Volume of Indonesia Imports and Exports of Corn, 1990-2008 (Tonnes)

Year	Import (ton)	Export (ton)	Balance (ton)
1990	9000	145000	136000
1991	322176	33000	-289176
1992	55498	150000	94502
1993	494446	61000	-433446
1994	1109253	37000	-1072253
1995	969145	79000	-890145
1996	616887	26830	-590057
1997	1098012	18957	-1079055
1998	313460	624942	311482
1999	618060	90647	-527413
2000	1284419	29562	-1254857
2001	1075185	90538	-984647
2002	1197401	29015	-1168386
2003	1371126	34172	-1336954
2004	1115094	51479	-1063615
2005	234706	62748	-171958
2006	1842957	29165	-1813792
2007	701953	101739	-600214
2008	264665	107001	-157664

Sources: Indonesia Central Bureau of Statistics (BPS), several years.



Source: Calculated from Indonesia Central Bureau of Statistics.

**Figure 1:** Monthly Corn Price, Wholesale Levels & Manufacturers, 1985-2008 (USD/ kg)

During the political reform era in 1997, the agriculture sector gained a momentum to move the national economy out of the economic crisis. Before the crisis, the agriculture sector was considered as a supporting sector for other sectors. At the time of crisis, unemployment rose sharply, so that growth in sectors outside of agriculture sector has declined. The growth of agriculture sector was positive and able to accommodate unemployed people. Along with the political reform era in 1998 the corn production and exports increased sharply so that the trade balance was surplus more than 300 thousand tons. However, in later years, Indonesia experienced a trade deficit which continued to be a net importer of corn (Table 2).

Along with the growing importance of the agricultural sector on the Indonesian economy, the government gives greater attention to the agricultural sector especially the sub-sector of food crops including corn. In 1990 corn production only reached 6.73

million tons, then in 2008 it has reached 16.32 million tons. Productivity of corn also increased sharply starting from 2.13 tonnes/ha in 1990 to 4.08 tonnes/ha in 2008 (Table 1). However, the increasing demand has not been accompanied by rising prices of corn at farmer level while the rising prices only occurred at the wholesale levels. This is due to the price of corn at farmer level is much lower than that of wholesale level.

Sahari and Musyafak (2002) explains that corn agribusiness system includes four subsystems i.e. subsystem of production procurement, production subsystem, post harvest subsystem and marketing subsystem. Marketing system is one of the important subsystems agribusiness. This system affects farmers' income because it is directly related to the level of prices received by farmers. Inefficient trading system, a less competitive market, the longer chain of trade, inadequate transportation infrastructure, unhealthy institutional

system are problems that influence the level of prices received by farmers.

Inefficient trade system and less competitive market is a kind of market failures. Corn farming is one example of imperfect competitive market where the farmers are price-takers dealing with a price maker. Weak bargaining position of farmers has made the price of corn at the producer level is determined by manufacturers and wholesalers. Some important characteristic of agricultural commodities is the lower price transmission and monopsonist market structure. The lower price transmission indicates that the increasing price in consumer or wholesale level does not automatically increase prices at the producer level. By contrast, decreasing price in consumer or wholesale level would be more quickly transmitted to the producer price at farm level. Meanwhile the imperfect market structure leads to peasant producers facing the powerful traders and wholesalers as the price makers. This creates a market failure (More on agricultural product characteristics, please refer to Liefert (2008); Hassouneh et al., 2010; and Sun, 2010).

Mubyarto (1995) suggests the oligopolistic or monopsonistic market structure potentially occur in physically and socioeconomic isolated area. This condition is what happened in the agricultural sector because this sector is generally located in rural areas which are far from the trade center (see also Habtu, 2004; and Ahn and Lee, 2010).

Meanwhile, Chechura and Sobrova (2008) say that the market structure of food crops is oligopoly or oligopsoni. However, only few economists pay attention to this market structure. Yet this is very important in agricultural commodities including corn. Lloyd et al. (2004) states that monopsony or oligopsony market structure has less than 1 elasticity of price transmission or not elastic. While a competitive market struc-

ture is called if and only if the elasticity of price transmission is equal to 1.

According to Corrison et al. (2001) the price fluctuations of agricultural commodity are high. In a perfectly competitive market the changes in price will be perfectly transmitted through all the market chains up to the final consumers. Furthermore, Corrison et al. (2001) states that one approach to analyze the price transmission is the inter market price transmission. The coefficient of the price transmission elasticity (EPT) shows the relationship between the prices of a commodity at two different market levels. The coefficient of EPT can be used to identify the price change effect at the farm level to corn prices at the wholesale level, or vice versa. Lag-variables can also be incorporated into the formula because the corn can be stored for a long time. Given that the economic crisis and the era of political reform have a positive impact on the prices of agricultural commodities in the country including the price of corn. Then, including the dummy variable of reformation era is relevant

Because of market failures occur in the corn market, it would disturb the transmission of corn prices from the farmers to the wholesale levels, and vice versa. Thus the increase in corn prices at the wholesale level is not transmitted perfectly to the price of corn at the farm level producers and vice versa. Meanwhile the era of reform in mid-1997 is estimated having a positive effect on corn prices both at the farm level and wholesalers.

Based on the background above, the research question is whether the price of corn at the farm level is perfectly transmitted to the wholesaler level and vice versa, and whether the era of reforms affects the price of corn at the farm level and at the wholesaler. This study aims to determine the effect of changes in producer price of corn to the changes in corn prices at the wholesaler level and vice versa, as well as investigate the effect of the reform era to

the price of corn at the farm levels and wholesalers.

## METHODS

The method of analysis used in this study is multiple linear regressions. The data is a secondary monthly data of corn prices during at the farmer levels and at wholesalers for a period of January 1985 to December 2008. This data is obtained from various year of Indonesia Central Bureau of Statistics. Besides this study also includes the reform era as Dummy variable i.e.  $D = 0$  for the period before the era of reform and  $D = 1$  for the aftermath of the reform era that began in September 1997.

To determine the effect of the change of corn prices at the farm level to the wholesaler level it use elasticity of price transmission as proposed by Corrison et al. (2001). Asche et al. (2005) state that economists are interested in studying the relationship between both prices because of its easiness in finding the data. In the research time-lag data is included into the model. Based on the model of Corrison et al. (2001), this study also applies a model that describes the relationship between the two price levels.

Subandi et al. (1998) state that the corn can be stored up to 6 months when the water content in the seeds are around 11 percent. This study applies this 6 month time lags into the model. The transmission model from the farmers to the wholesale is

$$H_G = \alpha H_P^{\beta_0} \prod_{i=1}^6 H_{P-i}^{\beta_i} \prod_{i=1}^6 H_{G-i}^{\gamma_i} e^{\eta D} e^{\epsilon} \quad (1)$$

in double log form is

$$\begin{aligned} \ln H_G &= \ln \alpha + \beta_0 \ln H_P + \beta_1 \ln H_{P-1} \\ &+ \dots + \beta_6 \ln H_{P-6} + \gamma_1 \ln H_{G-1} \\ &+ \dots + \gamma_6 \ln H_{G-6} + \eta D + \epsilon \end{aligned} \quad (2)$$

or

$$\begin{aligned} \ln H_G &= \alpha + \beta_0 \ln H_P + \sum_{i=1}^6 \beta_i \ln H_{P-i} + \sum_{i=1}^6 \gamma_i \ln H_{G-i} \\ &+ \eta D + \epsilon \end{aligned} \quad (3)$$

where

$H_G$  is the price at the wholesaler.

$H_P$  is the price at producer level.

$H_{G-i}$  is the price at  $i$  time lag at the wholesaler.

$H_{P-i}$  is the price at  $i$  time lags at peasant producers.

$L$  is the time Lag.

$D$  is a dummy variable where  $D$  is 0 if it is before the era of political reform and  $D$  is 1 otherwise if it is after the reform era.

$\epsilon$  is Error

While the transmission model from the wholesalers to the producers is

$$H_P = \alpha H_G^{b_0} \prod_{i=1}^6 H_{G-i}^{b_i} \prod_{i=1}^6 H_{P-i}^{c_i} e^{dD} e^{\epsilon} \quad (4)$$

Taking the log form, Equation (4) becomes

$$\begin{aligned} \ln H_P &= \ln a + b_0 \ln H_G + b_1 \ln H_{G-1} \\ &+ \dots + b_6 \ln H_{G-6} + dD + \epsilon \end{aligned} \quad (5)$$

or

$$\begin{aligned} \ln H_P &= \ln a + b_0 \ln H_G + \sum_{i=1}^6 b_i \ln H_{G-i} \\ &+ \sum_{i=1}^6 c_i \ln H_{P-i} + dD + \epsilon \end{aligned} \quad (6)$$

By using log model as mentioned above, the results of the regression coefficients express the price elasticity.

## RESULTS DISCUSSION

Based on the results of the testing parameters, it is obtained that a good model is an equation that includes 2 time-lag due to poor corn storage systems in Indonesia.

The full estimation results are the following:

$$\begin{aligned} \ln hg = & 0.0991 + 0.2077 \ln hp \\ & (2.68) ** \quad (6.63) *** \\ & - 0.0537 \ln hp - 1 - 0.0941 \ln hp - 2 \\ & \quad (-1.28) \quad \quad (-2.78) ** \\ & + 1.1108 \\ & (19.11) *** \end{aligned} \quad (7)$$

$$\begin{aligned} \ln hg - 1 = & 0.1828 \ln hg - 2 + 0.0173 \ln dreform \\ & (-3.21) ** \quad (1.79) * \end{aligned} \quad (8)$$

where \*\*\*, \*\*, and \* indicate significant at almost 0%, 0.1-0.8%, and 7.5% level, respectively.

The results above indicate that the signs of the elasticity of price transmission coefficient are in accordance with the theory. Generally all the independent variables significantly affect the dependent variable except  $\ln Hp - 1$ . The  $\ln Hp$  coefficient is 0.21 indicating that for every 1% increase in corn prices at the producer level led to rising corn prices at the wholesaler level by 0.21% which is smaller than one, ceteris paribus. This shows that the price of corn at farm level is not transmitted perfectly to the wholesaler level. So the corn market is not perfect competition.

Lloyd et al. (2004) states that less than 1 elasticity of price transmission indicates the presence of oligopsoni market. This is in line with Mubyarto (1995) that mentions the role of the brokers in the formation of prices at farm level. They are also as lender to farmers as well as provider for farmers' basic needs. Therefore, the farmers have a strong attachment to the middlemen. This led to farmers receiving the lower price from the middleman because they act as single buyer (monopsony) or oligopsoni. Therefore, the market faced by the farmers or producers is a monopsony market or oligopsoni. As a comparison, Chechura and Sobrova (2008) found that the elasticity of price transmission for pork in Chechnia Republic at the farm level to the

price at the wholesale level was 0.668. It means inelastic. This demonstrated that the pork market in the country are also not perfect or oligopsoni.

While  $\ln Hp - 1$  coefficient is negative but the effect is not significant. The influence of corn prices two months ago ( $\ln Hp - 2$ ) is significant and negatively marked by -0.09. It shows that for every 1% increase in corn prices at farm level at two months ago led to a significant decline in currently corn prices at the wholesaler level of 0.09%. It because the farmers begin to plant corns to respond to price increases which is in line with Cobweb Theorem (Mubyarto 1995). Wholesale traders expect there will be increased supply of corn from farmers within a few months, so they buy less corn to reduce the storage burden. At the end the price of corn at farm level go down.

Furthermore, a 1 percent increase of corn prices at the wholesaler level a month ago will increase 1.11 percent current corn price at the wholesale. This coefficient indicates that the elasticity of price transmission is larger than 1 or elastic. Lloyd et al. (2004) indicates this elasticity oligopsoni market structure dealing with an oligopoly market. Thus the structure of the corn market at the level of wholesalers in Indonesia is oligopsoni or oligopoly. This finding is further strengthened by Erwidodo et al. (2003). Buyers of corn such as Charoen Pokphan and Japfa Comfeed are the two large-scale plants which control about 50-60 percent of the total animal food production in Indonesia. Some of the buyers are from other companies using corn flour for industrial raw materials, food industry and cooking oil industry. While the raw material suppliers for Charoen Pokphan and Japfa Comfeed and other industries is a wholesalers that are oligopoly. It can be concluded that the structure of the corn market in a big city or the wholesaler is an oligopoly market which is dealing with oligopsoni market.

The rising corn prices at the wholesale level at two months ago ( $t-2$ ) causes the current corn prices at the wholesale level fall to 0.18 percent. This price decrease occurs because consumers have enough time to respond to rising prices by making imports. While the economic reform variables have a significant effect 7.5% level of significance. It means that the era of reform served to increase the price of corn at the wholesaler level.

From the estimation results above, there is empirical evidence that the price of corn at the farm level is imperfectly transmitted to corn prices at the wholesaler level. It is because the regression coefficients of  $\ln hp$ ,  $\ln hp-1$  and  $\ln hp-2$  are less than one. Meanwhile, estimation of the elasticity of price transmission from wholesaler to the farmer is as follows:

$$\begin{aligned} \ln hp = & -0,1073 + 0,6508 \ln hg \\ & (-1,63) \quad (6,63)^{***} \\ & - 0,4052 \ln hg-1 - 0,0819 \ln hg-2 \\ & (12,13)^{***} \quad (-2,63)^{**} \\ & + 0,7315 \quad (9) \\ & (-0,80) \end{aligned}$$

$$\begin{aligned} \ln hp-1 = & 0,11130 \ln hp-2 + 0,0004 dreform \\ & (1,88)^* \quad (0,03) \quad (10) \end{aligned}$$

where \*\*\*, \*\*, and \* indicate significant at 0%, 0,1-0,8%, and 5% level, respectively.

The results yield coefficient signs that are in accordance with the theory. Independent variables are significant at 0 is  $\ln Hg$  with the coefficient of 0.65. This means that any 1 percent price increase occurs at the wholesale level will cause a 0.65 percent rise in corn prices at the farm level, *ceteris paribus*. Furthermore  $\ln hg-1$  coefficient is - 0.41, the  $\ln hp-1$  coefficient is 0.73 and the  $\ln hp-2$  coefficient is 0.18. These can be concluded that corn prices at the wholesale level and at farm level are absolutely less than one. This shows that the corn market in Indonesia is not perfect or

not elastic. Thus the increase in the price level at wholesalers are not all transmitted to the producers. This shows that the corn market at the wholesale level have oligopsoni structured because the elasticity of price of transmission is less than 1. The underlying argument is corn market inefficiency in which the wholesaler has a stronger bargaining position than that of the farmers.

From the estimation results above, it is empirically proved that the price of corn at the wholesalers are not perfectly transmitted to the price of corn at the farm level. While the economic reform variables does not significantly affect the price of corn in the producer market due to inefficiency and fundamentally the trade system corn-producing areas have not changed at all.

Based on the above results, it can be concluded that the corn market in Indonesia at the wholesaler is monopsony or oligopsoni. To protect farmers, the government should be able to assist farmers in improving farmers' income to their increasing welfare. The policies that can be achieved is through fertilizer subsidies, limited import tariffs, floor price, credit provision and encourage strong farmer groups.

Fertilizer subsidies can reduce the cost thereby increasing farmers' income. Manti and Hendayana (2005) mention that the cost of production of corn is Rp 1.0435 million per hectare. It is around Rp 638.500 or 61.19 percent of it used for purchasing fertilizers and pesticide. Therefore, provision of subsidized fertilizers and pesticide would significantly reduce the farmers' burden.

Import tariff may improve the welfare of farmers so that domestic production increases. So far the government has never imposed tariffs policy on corn. Erwidodo et. al (2003) suggest that optimal corn import tariff is around 50-10 percent. This rates are adequate to ensure the profit of

farmers by 30 percent. It also estimate that the elasticity of price transmission of corn import tariff is 0.75 which is imperfect.

Floor price policy is intended to protect farmers from falling prices because of excess supply in the harvest season. The policy objective is to ensure the minimum price of farmers willing to plant. This policy has been applied to rice commodity. However, this policy has not been applied in Indonesia except for Gorontalo.

Lower capital of corn farmers lead to weak bargaining position so that the farmers are forced to borrow money to the middlemen and eventually the farmers must sell their product to them with cheaper prices. Therefore, the government should provide cheaper credit facilities for the farmers. So far these credit facilities are only distributed among rice farmers, cattle ranchers and so forth. These loans can be used to purchase seeds and pay labour costs.

## CONCLUSION

Corn is one of the important staple food after rice. It is also consumed for animal food industry, food industries, flour and cooking oil. However the disparity between the corn price at producers and wholesalers is increasing. This study aims to determine

the elasticity of price transmission of corn from the wholesaler to the farmer and vice versa. It also identifies the effect of the reform era to the price of corn.

The results show that the elasticity of corn price transmission from the farm level to wholesaler level is inelastic. The elasticity of price transmission of corn from wholesaler level to farm producers is also inelastic. This means that the market structure of corn is imperfect market. The reformation era affects the price of corn only at the wholesaler, but the effect is not apparent to the producer price at farm level. Meanwhile, the elasticity of price transmission rate at the wholesaler is oligopsoni because its magnitude is more than one.

Considering that the corn market structure is oligopsoni, then the government should intervene in protecting farmers from being harmed by this market system. Farmers' bargaining position is weak and must face the buyers who have a strong bargaining position. Government policy that can be taken including fertilizer subsidy, limited import tariffs, floor price policy as well as the provision of credit facility. Through government policy, corn farmers are no longer rely on the middlemen so that their welfare will increase.

## REFERENCES

- Ahn, B.I. and H. Lee (2010), "An Equilibrium Displacement Approach to Oligopoly Market Analysis: An Application to Trade in the Korean Infant Formula Market," *Agricultural Economics*, 41(2), 101-109.
- Asche, F., S. Jaffry and H. Hartmann (2005), "Price Transmission and Market Integration: Vertical and Horizontal Price Linkages for Salmon," CEMARE Working Paper No. 1, pp. 1-17.
- Cechura, L. and L. Sobrova (2008), "The Price Transmission in Pork Meat Agri-Food Chain," *Czech University of Life Sciences*, 54, 77-84.
- Corrison, S., C.W. Morgan and A.J. Rayner (2001), "Price Transmission: The Interaction between Market Power and Return to Scale," *European Review of Agricultural Economics*, 28(2), 143-159.



- Erwidodo, E., H. Hermanto and H. Pudjihastuti (2003), "Impor Jagung: Perlukah Tarif Impor Diberlakukan? Jawaban Analisis Simulasi," *Jurnal Agro Ekonomi*, 21(2), 175-195.
- Habtu, T.W. (2004), "[Imperfect Price Transmission: Is Market Power Really to Blame?](#)" *Journal of Agricultural Economics*, 55(1), 101-114.
- Hassouneh, I., T. Serra, and J.M. Gil (2010), "Price transmission in the Spanish bovine sector: the BSE effect," *Agricultural Economics*, 41(1), 33-42.
- Liefert, W.M. (2008), "Decomposing Changes in Agricultural Price Gaps: An Application to Russia," *Agricultural Economics*, 40(1), 15-28.
- Lloyd, T., S. Corriston, W. Morgan, and T. Rayner (2004), "Price Transmission in Imperfectly Competitive Vertical Markets," Discussion Papers in Economics, No. 04/09, pp. 1-19.
- Manti, I. and R. Hendayana (2005), "Kajian Kelayakan Ekonomi Rakitan Teknologi Usaha Tani Jagung di Lahan Gambut," *Jurnal Pengkajian dan Pengembangan Teknologi Pertanian*, 8(1), 55-66.
- Mubyarto (1995), *Pengantar Ekonomi Pertanian*, Lembaga Penelitian, Pendidikan dan Penerangan Ekonomi dan Sosial (LP3ES), Jakarta.
- Sahari, D. and A. Musyafak (2002), "Analisis Kelembagaan Pemasaran Menunjang Pengembangan Agribisnis Jagung di Kawasan Sentra Produksi Sanggau Ledo Kalimantan Barat," *Jurnal Pengkajian dan Pengembangan Teknologi Pertanian*, 5(2), 26-43.
- Subandi, S., I.G. Ismail, and H. Hermanto (1998), *Jagung, Teknologi Produksi dan Pascapanen*, Unpublished Paper, Pusat Penelitian dan Pengembangan Tanaman Pangan Badan Penelitian dan Pengembangan Pertanian, Jakarta.
- Sun, C.H. (2010), "The Impact of Auction Characteristics on Prices of Agricultural Products Traded Online: Evidence from Cherries," *Agricultural Economics*, 41(6), 587-594.