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Faktor-Faktor yang Mempengaruhi Areal Perkebunan Tebu Rakyat

Factors Affecting The Smallholder Sugarcane Plantation Area

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ABSTRACT

The decrease of the smallholder sugarcane area is the major problem for the Indonesian plantation white sugar industry. This study aims to analyze factors that affecting the decrease of the smallholder sugarcane area. This study uses a panel data econometric model; using cross-sectional data from five provinces of smallholder sugarcane base area (East Java, Central Java, Lampung, West Java, and Yogyakarta) with monthly time series from 2014 to 2018. Estimates use the generalized least square (GLS) method. The results showed that the decrease of the smallholder sugarcane area was significantly affected by: (1) the decrease of sugar factories that were actively operating, (2) the increase of labor wages in the estate crops sector, (3) land competition with corn commodities, and (4) the increase of residential areas due to growth of population. The opening of new sugar factories out of Java Island is an alternative to encourages land clearing for smallholder sugarcane areas.

Keywords: *Land Competition; Land Conversion; Panel Data Regression*

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INTRODUCTION

The decrease of the smallholder sugarcane area is the major problem for the Indonesian plantation white sugar industry. Smallholder sugarcane plantations are owned and managed by sugarcane farmers, although the milling process is carried out through sugar factories owned by the state and/or private companies. Smallholder sugarcane plantations contribute 58,67 percent of sugarcane harvested area; and produced 58,01 percent of plantation white sugar production during the 2014 to 2018 periods (Pusdatin Kementan, 2019). Smallholder sugarcane plantations are the largest source of raw materials for the plantation white sugar industry (Apriawan, Irham and Mulyo, 2015).

The decrease of the smallholder sugarcane area leads to a decrease in the production of plantation white sugar. This condition will exacerbate the deficit of Indonesia's sugar. Considering the position of plantation white sugar as a basic need, Indonesia imports to meet the needs and stabilize the price of plantation white sugar. Until this present day, Indonesia has not been able to achieve sugar self-sufficiency again. Extensification should be the answer to achieve sugar self-sufficiency. However as noticed, the smallholder sugarcane plantation areas is decreasing (shown in Table 1) (Hermawan and Rasbin, 2012; Hairani, Aji and Januar, 2014; Yunitasari *et al.*, 2015; Rahman *et al.*, 2018; Rachmadhan, Kusnadi and Adhi, 2020b, 2020a).

Table 1. Smallholder sugarcane plantations area in big five province 2014–2018

Province	Smallholder sugarcane plantations area (hectare)					Average (hectare)
	2014	2015	2016	2017	2018	
East Java	182.878	172.683	181.939	177.700	176.332	178.306
Central Java	54.025	40.956	37.354	31.023	34.961	39.664
Lampung	6.530	7.807	5.123	3.704	10.421	6.717
West Java	9.676	7.309	8.113	3.227	2.650	6.195
Yogyakarta	7.500	7.272	2.230	6.845	6.805	6.130
Indonesia	262.996	238.492	239.182	227.847	235.758	

Source : BPS (2015), BPS, (2016), BPS (2017), BPS (2018), dan BPS (2019b)

Smallholder sugarcane plantations are concentrated in East Java, Central Java, West Java, Lampung, and Yogyakarta Province. There are 204 sugar factories throughout Indonesia, and 198 of them are located in East Java, Central Java, West Java, Lampung, and Yogyakarta Province; however, there are only 46 sugar factories that are still active today in the region. The number of active sugar factories also continues to decrease along with the decrease of the smallholder sugarcane area as suppliers of raw materials (BPS, 2019).

Demographically, the smallholder sugarcane plantations base area is an area with a large and dense population. The growth of population in the five regions drives to increase the residential needs, especially for the island of Java. Practically, there is a competition of land use between sugarcane plantations and residential needs.

The competition of land use also occurs between commodities. The smallholder sugarcane plantations are known to be side by side with rice and corn farming areas. Moreover, East Java, Central Java, West Java, and Lampung Province are the main provinces that produce rice and corn. Sugarcane commodities are suspected uncompetitive with rice and corn commodities to become the main choice to cultivate (Marpaung *et al.*, 2010; Hermawan and Rasbin, 2012; Zainuddin and Wibowo, 2018; Suripto, 2019).

The decrease of smallholder sugarcane plantations is also closely related to the auction price of plantation white sugar. The plantation white sugar auction price is the price received by the farmer; and directly related to the farmer's income. However, the plantation white sugar auction price is considered no longer commensurate with the growing cost of farming (Rahman, Sinaga and Susilowati, 2014; Suryana *et al.*, 2016; Tayibnapis, Wuryaningsih and Sundari, 2016)

The component of cost for sugarcane farming is dominated by the need for labor and production inputs. Labor is used more in the first month for land preparation; while the production inputs for sugarcane farming with the biggest portion is urea fertilizer, which is given in the second month (Indrawanto *et al.*, 2012; Apriawan, Irham and Mulyo, 2015; Pakpahan, 2017).

There is a change in the labor structure in the smallholder sugarcane plantation base area, both demographically and geographically; due to economic and non-economic factors. This condition drives the labor transformation from the agricultural sector to the non-agricultural sector. The decreasing number of agricultural labor causes the increase of labor wages in the estate crop sector. (Sugiarto, 2012; Utomo, 2014; Pranadji and Hardono, 2015; Tayibnapis, Wuryaningsih and Sundari, 2016; Mazwan and Masyhuri, 2019).

On the other side, the allocation of subsidized urea fertilizer for the plantation crops sector is relatively stable. The Indonesian government has budgeted about four million tons of subsidized urea fertilizer per year during the 2012–2018. However, the decrease of smallholder sugarcane plantation areas continues. This condition contradicted with the expected output of the subsidized fertilizer policy; to help the cost of fertilizer, then the capital can be diverted to another allocation, especially extensification (Indrawanto *et al.*, 2012).

Theoretically and practically, many factors are suspected of causing the decrease of smallholder sugarcane plantation areas. As previously explained, the decrease of smallholder sugarcane plantations is the

major problem for the Indonesian plantation white sugar industry, because it affects the availability of plantation white sugar in the country. Thus, the main question in this study is what factors affect the decrease of smallholder sugarcane plantations

This study aims to analyze the determinants of the smallholder sugarcane plantation areas. The novelties of this study are: (1) this study focus on the smallholder sugarcane plantation base areas in East Java, Central Java, West Java, Lampung, and Yogyakarta Province; (2) this study considers the economic factors, demographic factors, and plantation white sugar industry; and (3) using panel data with the most recent cross-sectional and monthly data available.

RESEARCH METHODS

The procedure for analyzing the determinants of the smallholder sugarcane plantation areas is through the panel data econometric models estimation. The study used cross-sectional data from five provinces of smallholder sugarcane base area, consist of East Java, Central Java, Lampung, West Java, and Yogyakarta Province; with monthly time series from the 2014 to 2018 periods. The data in this study were obtained from the Statistics Indonesia (BPS), the Ministry of Agriculture of the Republic of Indonesia, and the Ministry of Trade of the Republic of Indonesia.

The estimation of the smallholder sugarcane plantation areas econometric model is carried out by panel data regression. The estimation procedure goes through several stages. The first stage is to design the specification of the econometric model equation (Gujarati and Porter, 2008; Jannah, 2019). The equation for the smallholder sugarcane plantation areas econometric model is formulated as follows:

$$SHHA_t = \beta_0 + \beta_1 ISFP_{t-12} + \beta_2 ILWP_{t-12} + \beta_3 ISFA_{t-11} + \beta_4 IASF_{t-12} + \beta_5 IPHA_t + \beta_6 ICHA_t + \beta_7 IREA_t + \mu$$

With the hypothesis of the estimated coefficient value as follows:
$\beta_2, \beta_3, \beta_5, \beta_6, \beta_7 < 0$; dan $\beta_1, \beta_4 > 0$

Where :

$SHHA_t$ = Smallholder sugarcane plantation areas (based on harvested area) in period t (hectare)

$ISFP_{t-12}$ = Real auction price of plantation white sugar in period t-12 (IDR/kg)

$ILWP_{t-12}$ = Real labor wages in the estate crops sector in period t-12 (IDR/day)

$ISFA_{t-11}$ = Allocation of subsidized urea fertilizer for plantation crops sector in period t-11 (tons)

$IASF_{t-12}$ = Number of operating (milling) sugar factories owned by the state (BUMN) and private companies in period t-12 (units)

$IPHA_t$ = Rice harvested area in period t (hectare)

$ICHA_t$ = Corn harvested area in period t (hectare)

$IREA_t$ = Residential areas, calculated based on the number of residents and floor area of residence per capita (hectare)

β_0 = Constanta

$\beta_{1,2 \ldots 7}$ = Coefficient

μ = Residual

Variables of smallholder sugarcane plantation areas, the auction price of plantation white sugar, and the number of operating sugar factories only have data availability according to the milling season schedule.

This is due to the character of the plantation white sugar industry; where the production and operation of the factory only occur during the milling season. The absence of data does not mean that the value of data is 0 (zero or null), so the model is estimated using panel data regression with unbalanced panel data.

The second stage is to determine the estimation method. The estimation of panel data regression can be done using the pooled least square (PLS), fixed effect model (FEM), or random effect model (REM) approach. The estimation method determined by tests (with = 5%) as follows: (1) Chow test (determine estimation using PLS or FEM), (2) Hausman test (determine estimation using REM or FEM), and (3) Lagrange multiplier (LM) test (determine estimation using PLS or REM).

The third stage is residual testing to determine whether there is a bias in the model. The residual value was carried out by a series of tests (with α = 5%) consist of the Chow-Denning heteroscedasticity test, the Breusch-Pagan LM (cross-section) and the Ljung Box Q-statistic (time series on lag 2) autocorrelation test, and the Jarque-bera normality test. If a residual problem is identified, then the estimation is made using the Seemingly Unrelated Regression (SUR) model which is estimated using the Generalized Least Square (GLS) method.

The fourth stage is the goodness of fit test of the model; as the model validation to represents real conditions. The validation of the model using the F-statistic test (with α = 5%) and the coefficient of determination adjusted R^2. Multicollinearity test was carried out by testing the correlation between exogenous variables; if the adjusted R^2 value is too high.

The fifth stage is hypothesis testing using t-test with maximum α = 10%; to cover more variables. The test criteria are as follows:

a. Probability (t-statistic) < α, exogenous variable have a significant effect to endogenous variable.
b. Probability (t-statistic) > α, exogenous variable have no significant effect to endogenous variable.

The result of the estimation show the effect of changes in the independent variable on the dependent variable. The value will also be displayed in the form of elasticity. The more elastic a variable, the more it shows the magnitude of the influence of exogenous variables on endogenous variables (Gujarati and Porter, 2008; Charles and Darne, 2009; Baye, 2010; Widyaningsih, Susilawati and Sumarjaya, 2014; Toor and Islam, 2019)

HASIL DAN PEMBAHASAN

Model Estimation Result. The model estimation method uses panel data regression with the pooled least square (PLS) estimation method. The estimation method was determined based on the results of the Chow test, Hausman test, and Lagrange multiplier (LM) test (shown in Table 2).

Table 2. The results of Chow test, Hausman test, and Lagrange multiplier test (LM)

Estimation method test	Stat.	Sig.	Decision
Chow test (F statistic)	0,391	0,815	Estimation use pooled least square
Hausman test (chi-sq stat.)	6,792	0,451	Estimation use random effect model
Lagrange multiplier test (Breusch-Pagan, both, based of X^2 distribution)	4,176	7 0 ,000	Estimation use pooled least square

Based on the pooled least square method estimation results, the coefficient of determination adjusted R^2 is 0,553 and the probability value of the F-test statistic is 0,000; which shows that the model is quite feasible and is indicated avoid the risk of multicollinearity. However, based on the residual test, it was found

that the model have a condition where the residual value was not normally distributed, heteroscedasticity and autocorrelation were found in the cross-sectional data (shown in Table 3).

Table 3. The results of residual tests

Residual test	Stat.	Sig.	Decision
Jarque-Bera normality test	46,621	0,000	Residual not normally distributed
Chow-Denning heteroscedasticity test	4,823	0,000	Heteroscedasticity is present
Autocorellation test			
Breusch-Pagan LM (*cross-section*)	91,802	0,000	Autocorellation is present
Ljung-Box (*time series*)	1,0038	0,605	Autocorellation is not present

Due to the condition, the estimation is carried out using the GLS method with SUR cross-section weighting. This method is used to avoid inefficient estimation results, due to heteroscedasticity and autocorrelation conditions. As for the residual problem which is not normally distributed, the estimator obtained is still BLUE and is asymptotically normally distributed based on the Gauss-Markov assumption. Through the use of a large sample (cross-section of five provinces and monthly time series 2014-2018) conclusions using t-test based on these assumptions can still be applied correctly (Gujarati and Porter, 2008; Widyaningsih, Susilawati and Sumarjaya, 2014). The results of the estimation of factors that affect the smallholder sugarcane plantation areas are shown in Table 4.

Table 4. Hasil estimasi faktor yang memengaruhi luas lahan perkebunan tebu rakyat

Variable		Estimated coefficient	Elasticity	t-*stat.*	Prob.
Notation	Description				
$ISFP_{t-12}$	Real auction price of plantation white sugar $_{t-12}$	-1,925	-1,915	-1,058	0,292
$ILWP_{t-12}$	Real labor wages in the estate crops sector $_{t-12}$	-3,432	-5,536	-2,027	0,045**
$ISFA_{t-11}$	Allocation of subsidized urea fertilizer for plantation crops sector $_{t-11}$	-0,775	-0,652	-3,580	0,000**
$IASF_t$	Number of operating sugar factories $_t$	1.182,890	1,841	6,680	0,000**
$IPHA_t$	Rice harvested area in period $_t$	-0,004	-0,057	-0,181	0,857
$ICHA_t$	Corn harvested area in period $_t$	-0,110	-0,649	-1,935	0,057*
$IREA_t$	Residential areas $_t$	-0,072	-1,374	-1,791	0,076*
Constanta		77672,670		2,111	0,037
Adjusted R^2	0,448	Prob (F-*statistic*)			0,000**

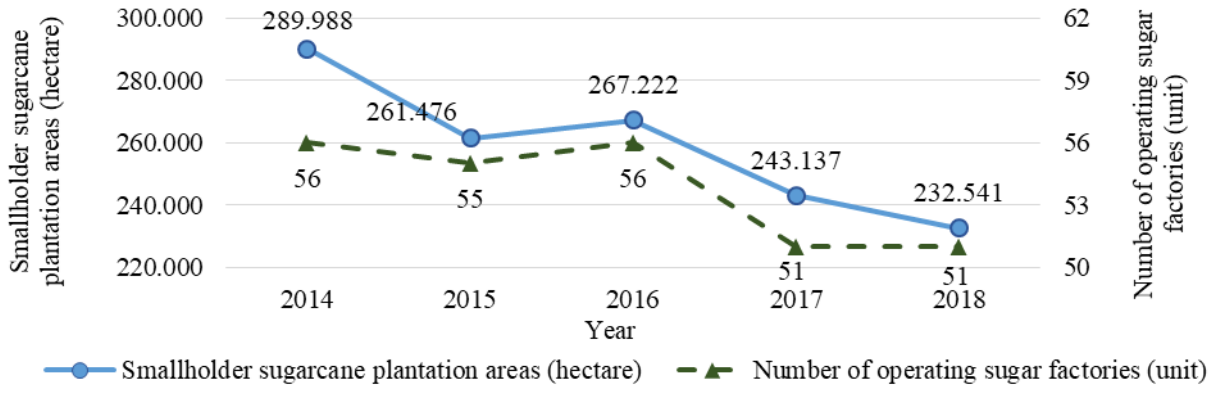
Note : ** based on t-test, significantly identified at α = 5%
* based on t-test, significantly identified at α = 5%
- the notation "t" denotes the current time period
- the notation "t-11" denotes the previous eleven month time period
- the notation "t-12" denotes the previous twelve month (one year) time period

The goodness of fit test results of the model by the F-statistical test shows that all exogenous variables significantly (at α = 5%) together had an effect on endogenous variables. Meanwhile, the adjusted R2 value indicates that the variance of the exogenous variables has not been able to describe the overall variance of the endogenous variables in the model. However, corrections and revisions to the model are not easy. This condition leads to a simplification step, which are prioritizing the substance and relevance of the model. This method still inspects the data and observes the results carefully without confounding the significance of the results with the substance (Gujarati and Porter, 2008).

The factor that has a significant positive effect on the smallholder sugarcane plantation areas is the number of operating sugar factories in that period (IASFt). While the factors that have a significant negative effect on the smallholder sugarcane plantation areas are: (1) the labor wages in the estate crops sector in the previous one year period (ILWPt-12), (2) the allocation of subsidized urea fertilizer for the plantation crops sector in the previous eleven months (ISFAt-11), (3) corn harvested area in that period (ICHAt), and (4) the area of the residential area in that period (IREAt). The factors that do not significantly affect the area of smallholder sugarcane plantations are: (1) the auction price of plantation white sugar in the previous one year period (ISFPt-12), and (2) the area of rice harvested in that period (ICHAt). Furthermore, discussions and analyses of the factors that influence the smallholder sugarcane plantation areas are presented.

The Number of Operating Sugar Factories. The plantation white sugar industry cannot be separated from the key role of sugar factories (Rachmadhan, 2021). The number of operating (milling) sugar factories ($IASF_t$) is the only variable that has a significant positive effect (at α = 5%) on the smallholder sugarcane plantation areas; with an elasticity classified as positive elastic (1,841). Thus, the number of operating sugar factories is the only factor that can stimulate the growth of the smallholder sugarcane plantation areas.

Sugar factories and sugarcane farmers are inseparable partners. Smallholder farmers' sugarcanes milling process is carried out through sugar factories owned by the state (BUMN) and/or private companies. The amount of smallholder sugarcane that can be milled depends on the number of operating sugar factories and their milling capacity. On the other side, the operational of sugar factories also depends on the amount of sugarcane from smallholder plantations as raw material. However, the number of sugar factories continues to decrease along with the decrease of the smallholder sugarcane plantation areas as suppliers of raw materials (shown in Figure 1).



Source: Pusdatin Kementan (2019)

Figure 1. The growth of the smallholder sugarcane plantation areas and the number of operating sugar factories

The role of the sugar factories is not only as the smallholder sugarcane milling factory. Sugar factories also play a role in providing farm credit. The presence of credit is needed by smallholder farmers to support their farming activities, as well as to support their daily needs. The smallholder farmers access to credit through partnerships with sugar factories (Zainuddin and Wibowo, 2018)

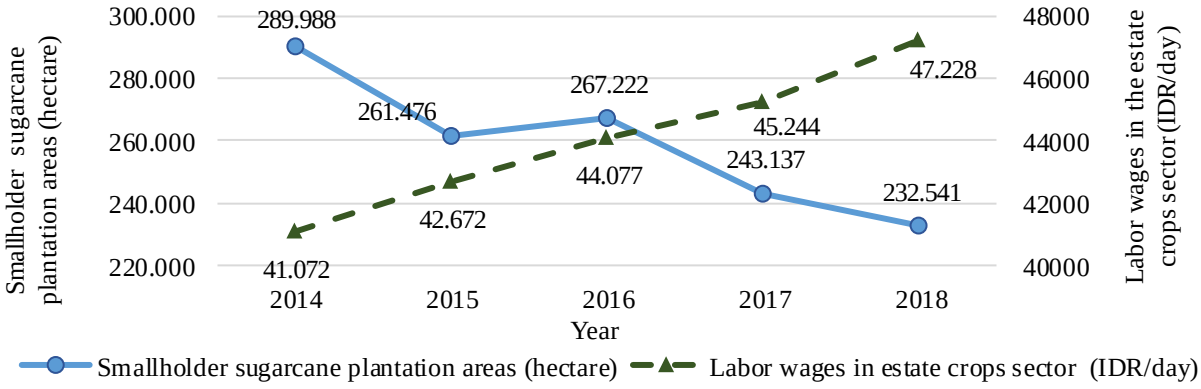
The opening (activating) of a sugar factory is an alternative to stimulate the extensification nor land clearing for the smallholder sugarcane plantation areas. The result shows, it is estimated that the opening of a new sugar factory stimulates the smallholder sugarcane plantation areas to grow up to 1.182,890 hectares. However, re-activating a sugar factory that has stopped operating is considered ineffective; because the old sugar factory is no longer efficient. Moreover, the location of the old sugar factories is concentrated in Java Island with limited land availability for sugarcane plantations; This causes competition to get sugarcanes as

raw material. So that the opening of new sugar factories is an alternative to stimulate the growth of smallholder sugarcane plantation areas and the sugar production if it is carried out outside Java Island.

Labor Wages in The Estate Crops Sector. The cost for labor is the largest component in the production cost of sugarcane farming; it is reached 57,80 percent of the total cost. Labor is mostly used in the first month (one year before harvest time) for land preparation activities. This causes the labor wages in the estate crops sector to affect the smallholder sugarcane plantation areas.

The labor wages in the estate crops sector in the previous one year period ($ILWP_{t-12}$) had a significant negative effect (at α = 5%) on the smallholder sugarcane plantation areas; with elasticity classified as negative elastic (-5,536). The value of the elasticity in absolute terms is the highest compared to other variables. The labor wages in the estate crops sector is the most influential factor in the decrease of smallholder sugarcane plantation areas (shown in Figure 2).

The use of labor as inputs is still under the control of farmers; however, the demand to increasing the labor wages in the estate crops sector is beyond the control of farmers. The averages labor wages in the estate crops sector (nominal value) all over the country have increased by 3,55 percent annually (shown in Figure 3). The increases of the labor wages in the estate crops sector are common and normal; due to inflation factors, minimum wage policies, and the labor transformation from the agricultural sector to the non-agricultural sector (Pranadji and Hardono, 2015; Syauqy and Pratomo, 2018).



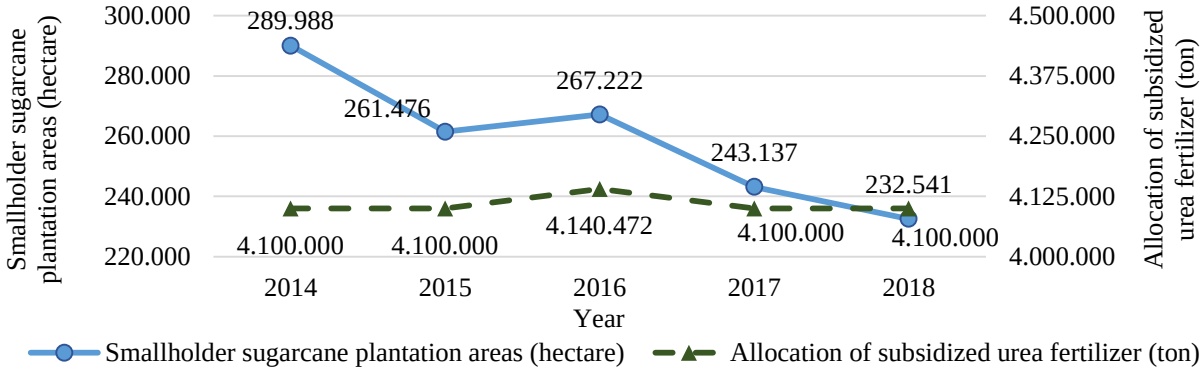
Source: Pusdatin Kementan (2019) dan BPS (2019c)

Figure 2. The growth of the smallholder sugarcane plantation areas and labor wages in the estate crops sector

The impact of the increased labor wages in the estate crops sector is unavoidable. The production of plantation white sugar cannot be increased by lowering labor wages; because it is related to the welfare of two million workers who are directly involved in the plantation white sugar industry (Rachmadhan, 2021). Because of the condition, other alternatives are needed on-farm and off-farm to increase the smallholder sugarcane plantation areas; including input policies, price policies, and extensification of the plantation white sugar industry by the opening of new sugar factories.

Urea Fertilizer Subsidy. Urea fertilizer is a fundamental input in sugarcane farming. Urea is the biggest portion of fertilizer in sugarcane cultivation, which is given in the second month of cultivation (eleven months before harvest) (Indrawanto *et al.*, 2012). The government allocates subsidies for urea fertilizer to support the smallholder farmers; it aims to that farmers can buy fertilizer as the recommended dose, so the production and farm profits increase. Thus, the capital can be diverted to another allocation, especially extensification. This causes the allocation of subsidized urea fertilizer for the plantation crops sector to be a factor that affects the smallholder sugarcane plantation areas.

The allocation of subsidized urea fertilizer for the plantation crops sector in the previous eleven months ($ISFA_{t-11}$) had a significant negative effect (at $\alpha = 5\%$) on the smallholder sugarcane plantation areas; with elasticity classified as negative inelastic (-0,652). This indicates that the allocation of subsidized urea fertilizer for the plantation crops sector is not in line with the growth of the smallholder sugarcane plantation areas (shown in Figure 3).



Source: Pusdatin Kementan (2019) dan Kementan (2014a; 2014b; 2016; 2017a; 2017b)

Figure 3. The growth of the smallholder sugarcane plantation areas and the allocation of subsidized urea fertilizer

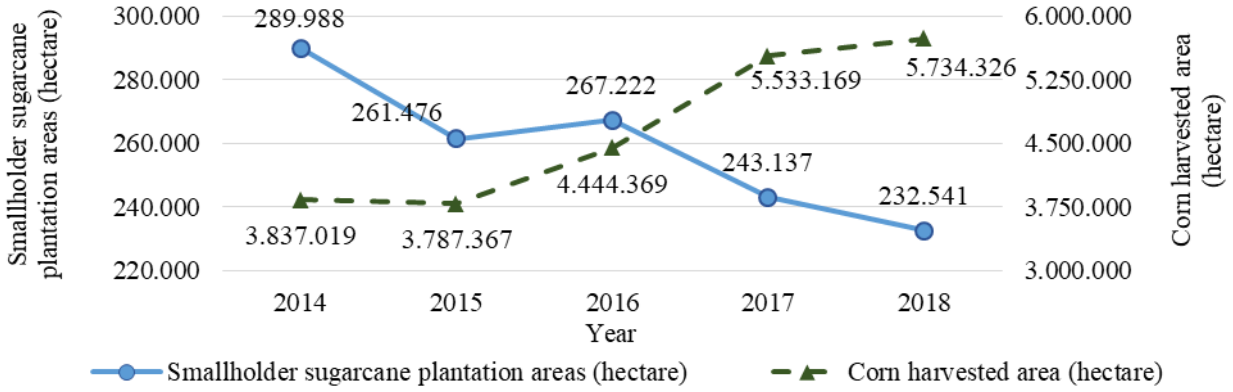
The significant relationship do not conclude that the decrease the smallholder sugarcane plantation areas is due to an increase in the allocation of subsidized urea fertilizer. The statistically significant relationship between them can be due to the similarity in the pattern of the allocation of subsidized urea fertilizer for the plantation crops sector which is determined by the government, by follows the pattern of the needs of urea fertilizer for the plantation crops sector.

Subsidized fertilizers procurement and distribution are subsidized and controlled by the government. The government determines the subsidized fertilizer, the amount, the allocation, and the highest retail price of subsidized fertilizer. The subsidized fertilizers are urea, SP-36, ZA, NPK, and organic fertilizers. Through fertilizer subsidies, smallholder farmers can allocate some of the capital to other production inputs; including the provision of land (Rachmadhan, Kusnadi and Adhi, 2020b).

The subsidized fertilizer policy is considered ineffective. During the 2013 to 2018 periods, the government has increased the allocation of subsidized urea fertilizer; with the hope to boost the performance of the plantation white sugar industry. However, the increase in the allocation of subsidized urea fertilizer is not in line with the growth of the smallholder sugarcane plantation areas (shown in Figure 4). Nevertheless, the fertilizer subsidy policy still needs to be implemented. It is because the fertilizer subsidy policy covers various agricultural sub-sectors and commodities, as well as the importance of input subsidies for agriculture.

Corn Harvested Area. The smallholder sugarcane plantation areas are known to be side by side with maize farming areas. Moreover, East Java, Central Java, West Java, and Lampung Province are the smallholder sugarcane base area, and also for corn commodities. Limited land in the sugar industry area causes land competition between sugarcane and corn commodities.

Corn harvested areas ($ICHA_t$) had a significant negative effect (at $\alpha = 10\%$) on the smallholder sugarcane plantation areas; with elasticity classified as negative inelastic (-0,649). This shows that the growth of the corn harvested area is significantly not in line with the growth of smallholder sugarcane plantation areas in Indonesia (shown in Figure 4). So it can be concluded that there is land competition between the smallholder sugarcane plantation and corn commodities.



Source: Pusdatin Kementan (2019) dan Kementan (2014a; 2014b; 2016; 2017a; 2017b)

Figure 4. The growth of the smallholder sugarcane plantation areas and the corn harvested areas

Smallholder sugarcane farming cannot compete with maize farming. The corn production cost is relatively cheaper and had faster cash flow; these are the reasons why maize farming is more in demand. In addition, maize farming income is also higher than sugarcane farming (Marpaung *et al.*, 2010; Pratiwi, Wibowo and Wibowo, 2018; Zainuddin and Wibowo, 2018). This is the reason farmers switch to growing corn instead of sugarcane.

The result shows that the coefficient between the corn harvested area and the smallholder sugarcane plantation areas is -0,110; it shows that the decrease of the smallholder sugarcane plantation areas is smaller than the increase of the corn harvested area. This also indicates that eleven percent of the land conversion for corn commodities comes from the smallholder sugarcane plantation areas.

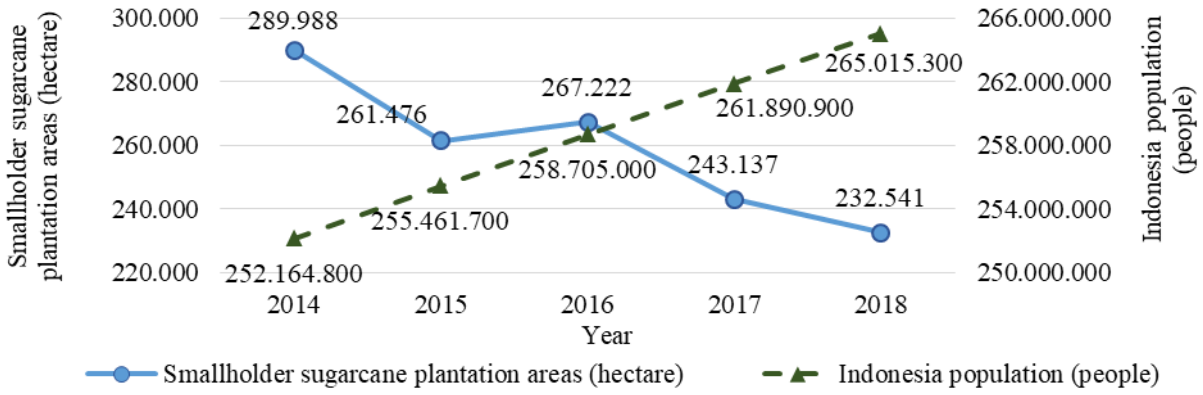
Residential Area. East Java, Central Java, West Java, and Yogyakarta Province are areas with large and dense populations. This condition causes the need for the residential areas going to increase, especially on Java Island. Practically, there is competition for land use between the smallholder sugarcane plantation areas and the needs for the residential areas (Hermawan and Rasbin, 2012).

The residential area ($IREA_t$) had a significant negative effect (at α = 10%) on the smallholder sugarcane plantation areas; with elasticity classified as negative elastic (-1,374). This shows that the growth of residential areas is significantly not in line with the growth in the smallholder sugarcane plantation areas in Indonesia.

Practically, the need for residential areas increases with the increase in population. It is shown in Figure 5, that Indonesia population is increasing; on the other side, the smallholder sugarcane plantation area is decrease. It concluded that there is land competition between the need of residential areas and the smallholder sugarcane plantation areas.

The results show that the coefficient between the residential area and the smallholder sugarcane plantation areas is -0,072; it shows that the decrease of the smallholder sugarcane plantation areas is smaller than the residential area. This also indicates that 7,2 percent of the land conversion area for the residential area comes from the smallholder sugarcane plantation areas.

The coefficient of the residential area (-0,072) is smaller than the corn harvested area (-0,110); this shows that the increase of corn harvested area had a greater effect on the decline in the smallholder sugarcane plantation areas. However, it cannot be concluded that the decreased of the smallholder sugarcane plantation areas is more due to commodity transformation, compared to the land conversion for infrastructure. This requires further study.



Source: Pusdatin Kementan (2019) dan BPS (2019a)

Figure 5. The growth of the smallholder sugarcane plantation areas and Indonesia population

The Auction Price of Plantation White Sugar. The auction price of plantation white sugar is the price received by the farmer; it is the prevailing and agreed price in the sugar auction (Pusat Kebijakan Perdagangan Dalam Negeri, 2015). The auction price of plantation white sugar is directly related to the farmer's income, which drives the sugarcane farmer's motivation. The auction price of plantation white sugar fluctuated; but tends to increase.

The results show that the auction price of plantation white sugar in the previous one year period ($ISFP_{t-12}$) had no significant effect on the smallholder sugarcane plantation areas. Furthermore, the negative coefficient indicates that the increase of the auction price is not in line with the growth of the smallholder sugarcane plantation areas in Indonesia. However, it cannot be concluded that the increase in the auction price of plantation white sugar causes a decrease in the smallholder sugarcane plantation areas.

Rice Harvested Area. The smallholder sugarcane plantation areas in East Java, Central Java, West Java, and Lampung Province are also known to often side by side with rice farming areas. The smallholder sugarcane plantation base areas are also the rice major producer in the country. However, the ideal land conditions for rice farming are different from sugarcane farming. Ideally, rice farming is carried out in fields with good irrigation; while sugarcane farming is carried out on dry land although the irrigation is still needed (Indrawanto *et al.*, 2012).

The results show that the rice harvested area ($IPHA_t$) had no significant effect on the smallholder sugarcane plantation areas. Furthermore, the negative coefficient indicates that there is land competition between smallholder sugarcane and rice commodities; but the coefficient is very small.

CONCLUSION AND RECOMMENDATION

The decrease of the smallholder sugarcane area was significantly affected by: (1) the decrease of sugar factories that were actively operating, (2) the increase of labor wages in the estate crops sector, (3) land competition with corn commodities, and (4) the increase of residential areas due to growth of population.

The opening of new sugar factories out of Java Island is an alternative to stimulate the growth of smallholder sugarcane plantation areas. The location of sugar factories is currently concentrated in Java Island; with limited land availability and an increasing population. This causes competition for land and raw materials, and land transformation to other sectors.

DAFTAR PUSTAKA

[BPS] Badan Pusat Statistik (ID) (2015) *Statistik Tebu Indonesia 2014*. Jakarta (ID): Badan Pusat Statistik. Available at: https://www.bps.go.id/publication/2015/07/30/6b48be9594d58e0fbc62275f/statistik-tebu-indonesia-2014.

[BPS] Badan Pusat Statistik (ID) (2016) *Statistik Tebu Indonesia 2015*. Jakarta (ID): Badan Pusat Statistik. Available at: https://www.bps.go.id/publication/2016/09/01/3c6a33a29d68f1f5d82f32a9/statistik-tebu-indonesia-2015.

[BPS] Badan Pusat Statistik (ID) (2017) *Statistik Tebu Indonesia 2016*. Jakarta (ID): Badan Pusat Statistik. Available at: https://www.bps.go.id/publication/2017/11/10/d1ade8b3b28b2f118c3968d7/statistik-tebu-indonesia-2016.

[BPS] Badan Pusat Statistik (ID) (2018) *Statistik Tebu Indonesia 2017*. Jakarta (ID): Badan Pusat Statistik. Available at: https://www.bps.go.id/publication/2018/11/13/5202a47197d21c1d9c0b3b2e/statistik-tebu-indonesia-2017.

[BPS] Badan Pusat Statistik (ID) (2019a) *Statistik Indonesia 2019*. Jakarta (ID): Badan Pusat Statistik. Available at: https://www.bps.go.id/publication/2019/07/04/daac1ba18cae1e90706ee58a/statistik-indonesia-2019.html.

[BPS] Badan Pusat Statistik (ID) (2019b) *Statistik Tebu Indonesia 2018*. Jakarta (ID): Badan Pusat Statistik. Available at: https://www.bps.go.id/publication/2019/11/22/9d2b03409986c2dcfcd43ae4/statistik-tebu-indonesia-2018.html.

[BPS] Badan Pusat Statistik (ID) (2019c) *Statistik Upah Buruh Tani di Perdesaan 2018*. Jakarta (ID): Badan Pusat Statistik. Available at: https://www.bps.go.id/publication/2019/04/05/531eaeab4e3ee5b1c3926b5a/statistik-upah-buruh-tani-di-perdesaan-2018.html.

[Kementan] Kementerian Pertanian Republik Indonesia (ID) (2014a) *Peraturan Menteri Pertanian Republik Indonesia Nomor 103/Permentan/SR.130/8/2014 Tentang Perubahan Atas Peraturan Menteri Pertanian Nomor 122/Permentan/SR.130/11/2013 Tentang Kebutuhan dan Harga Eceran Tertinggi (HET) Pupuk Bersubsidi untuk Sektor Pertani*. Indonesia.

[Kementan] Kementerian Pertanian Republik Indonesia (ID) (2014b) *Peraturan Menteri Pertanian Republik Indonesia Nomor 130/Permentan/SR.130/11/2014 Tentang Kebutuhan dan Harga Eceran Tertinggi (HET) Pupuk Bersubsidi untuk Sektor Pertanian Tahun Anggaran 2015*. Indonesia.

[Kementan] Kementerian Pertanian Republik Indonesia (ID) (2016) *Peraturan Menteri Pertanian Republik Indonesia Nomor 59/Permentan/SR.310/12/2016 Tentang Perubahan Atas Peraturan Menteri Pertanian Nomor 60/Permentan/SR.310/12/2015 Tentang Kebutuhan dan Harga Eceran Tertinggi Pupuk Bersubsidi untuk Sektor Pertanian Tahu*. Indonesia.

[Kementan] Kementerian Pertanian Republik Indonesia (ID) (2017a) *Peraturan Menteri Pertanian Republik Indonesia Nomor: 47/Permentan/SR.2310/12/2017 Tentang Alokasi dan Harga Eceran Tertinggi Pupuk Bersubsidi untuk Sektor Pertanian Tahun Anggaran 2018*. Indonesia. Available at: https://psp.pertanian.go.id/wp-content/uploads/2020/04/Permentan_47_Tahun_2017_AlokasiHET_Puber_TA2018.pdf.

[Kementan] Kementerian Pertanian Republik Indonesia (ID) (2017b) *Peraturan Menteri Pertanian Republik Indonesia Nomor 04/Permentan/SR.310/3/2017 Tentang Perubahan Atas Peraturan Menteri Pertanian Nomor 69/Permentan/SR.310/12/2016 Tentang Kebutuhan dan Harga Eceran Tertinggi Pupuk Bersubsidi untuk Sektor Pertanian Tahun*. Indonesia.

[Pusdatin Kementan] Pusat Data dan Sistem Informasi Pertanian Sekretariat Jenderal Kementerian Pertanian (ID) (2019) *Outlook Tebu 2019*. Edited by A. A. Susanti and Akbar. Jakarta (ID): Pusat Data dan Sistem Informasi Pertanian Sekretariat Jenderal Kementerian Pertanian. Available at: http://epublikasi.setjen.pertanian.go.id/arsip-outlook/75-outlook-perkebunan/697-outlook-tebu-2019.

Apriawan, D. C., Irham and Mulyo, J. H. (2015) 'Analisis Produksi Tebu dan Gula di PT. Perkebunan

Nusantara VII (Persero)', *Agro Ekonomi*, 26(2), pp. 159–167. Available at: https://jurnal.ugm.ac.id/jae/article/view/17268.

Barades, E., Alimuddin, A. and Sudrajat, A. O. (2013) 'Elektroporasi dan transplantasi sel testikular dengan label GFP pada ikan nila Electroporation and GFP-labelled transplantation of testicular cells in Nile tilapia', *Jurnal Akuakultur Indonesia*, 12(2), pp. 186–192. doi: 10.19027/jai.12.186-192.

Baye, M. R. (2010) *Managerial Economics and Business Strategy Seventh Edition*. Seventh. New York: McGraw-Hill/Irwin.

Charles, A. and Darne, O. (2009) 'Variance-Ratio Tests of Random Walk: An Overview', *Journal of Economic Surveys*, 23(3), pp. 503–527. doi: https://doi.org/10.1111/j.1467-6419.2008.00570.x.

Graber, A. and Junge, R. (2009) 'Aquaponic Systems: Nutrient recycling from fish wastewater by vegetable production', *Desalination*. Elsevier B.V., 246(1–3), pp. 147–156. doi: 10.1016/j.desal.2008.03.048.

Gujarati, D. N. and Porter, D. C. (2008) *Basic Econometric, Fifth Edition*. New York: McGraw-Hill.

Hairani, R. I., Aji, J. M. M. and Januar, J. (2014) 'Analisis trend produksi dan impor gula serta faktor-faktor yang mempengaruhi impor gula Indonesia', *Berkala Ilmiah PERTANIAN*, 1(4), pp. 77–85. Available at: https://jurnal.unej.ac.id/index.php/BIP/article/view/616.

Hermawan, I. and Rasbin (2012) 'Analisis Penggunaan Luas Lahan Tebu dan Padi Terkait dengan Pencapaian Swasembada Gula di Indonesia', *Jurnal Ekonomi & Kebijakan Publik*, 3(1). doi: 10.22212/jekp.v3i1.173.

Indrawanto, C. *et al.* (2012) *Budidaya dan Pascapanen Tebu*. 1st edn. Edited by I. M. Trisawa, Mukhasim, and A. Budiharto. Jakarta: IAARD Press. Available at: http://perkebunan.litbang.pertanian.go.id/?p=20549.

Jannah, E. M. (2019) *Daya Saing dan Aliran Perdagangan Lada Indonesia di Pasar Internasional*. Institut Pertanian Bogor.

Marpaung, Y. T. *et al.* (2010) 'Perkembangan industri gula indonesia dan urgensi swasembada gula nasional', *Indonesian Journal of Agricultural (IJAE)*, 2(1), pp. 97–119. Available at: https://ejournal.unri.ac.id/index.php/IJAE/article/view/1500/1475.

Mazwan, M. Z. and Masyhuri (2019) 'Alokasi Penggunaan Input Produksi Tebu Perkebunan Rakyat di Jawa Timur (Studi Kasus Petani Tebu Plasma Ptpn XI)', *Jurnal Ekonomi Pertanian dan Agribisnis (JEPA)*, 3(1), pp. 138–151. doi: https://doi.org/10.21776/ub.jepa.2019.003.01.14.

Pakpahan, F. P. M. (2017) *Pengelolaan Tanaman Tebu (Saccharum Officinarum L.) di Wilayah Kerja PG Madukismo, PT Madubaru, Yogyakarta dengan Aspek Khusus Korelasi Pemupukan dengan Produktivitas*. Institut Pertanian Bogor. Available at: https://repository.ipb.ac.id/handle/123456789/89804.

Pranadji, T. and Hardono, G. S. (2015) 'Dinamika Penyerapan Tenaga Kerja Pertanian', in Rusastra, I. W. and Irawan, B. (eds) *Panel Petani Nasional: Mobilisasi Sumber Daya dan Penguatan Kelembagaan Pertanian*. Jakarta (ID): IAARD Press, pp. 209–221.

Pratiwi, T. D., Wibowo, E. P. and Wibowo, H. (2018) 'Daya Saing Usahatani Tebu terhadap Komoditas Eksisting di Wilayah Kerja Pabrik Gula Wonolangan Kabupaten Probolinggo Tahun 2018', *Caraka Tani: Journal of Sustainable Agriculture*, 33(1), pp. 57–67. doi: https://doi.org/10.20961/carakatani.v33i1.19562.

Pusat Kebijakan Perdagangan Dalam Negeri (2015) *Laporan Akhir Analisis Lelang Gula PTPN/Petani*

dalam Rangka Stabilisasi Harga. Jakarta.

Rachmadhan, A. A. (2021) *Dampak HPP Terhadap Kinerja Industri Gula Kristal Putih Indonesia*. Institut Pertanian Bogor. Available at: https://repository.ipb.ac.id/handle/123456789/106360.

Rachmadhan, A. A., Kusnadi, N. and Adhi, A. K. (2020a) 'Analisis Harga Eceran Gula Kristal Putih Indonesia', *Buletin Ilmiah Litbang Perdagangan*, 14(1), pp. 1–20. doi: https://doi.org/10.30908/bilp.v14i1.433.

Rachmadhan, A. A., Kusnadi, N. and Adhi, A. K. (2020b) 'Pengaruh Kebijakan Subsidi Pupuk terhadap Produksi Gula Kristal Putih Indonesia', *Jurnal Agro Industri Perkebunan*, 8(1), pp. 9–19. doi: https://doi.org/10.25181/jaip.v8i1.1266.

Rahman, M. E. *et al.* (2018) 'Kebijakan Dukungan Domestik untuk Menetralisir Dampak Negatif Penurunan Tarif Impor Terhadap Industri Gula Indonesia', *Jurnal Agro Ekonomi*, 36(2), pp. 91–112. doi: http://dx.doi.org/10.21082/jae.v36n2.2018.91-112.

Rahman, R. Y., Sinaga, B. M. and Susilowati, S. H. (2014) 'Model Ekonomi dan Dampak Implementasi Perjanjian Perdagangan Bebas ASEAN-Cina Bagi Perdagangan Gula Indonesia', *Jurnal Agro Ekonomi*, 32(2), pp. 127–145. doi: http://dx.doi.org/10.21082/jae.v32n2.2014.127-145.

Sugiarto (2012) 'Distribusi Tenaga Kerja Sektor Pertania pada Berbagai Tipe Agroekosistem di Perdesaan Patanas', in Suradisastra, K. et al. (eds) *Petani dan Pembangunan Pertanian*. Bogor (ID): Pusat Sosial Ekonomi dan Kebijakan Pertanian Kementerian Pertanian, pp. 258–275. Available at: http://pse.litbang.pertanian.go.id/ind/index.php/layanan-publik/publikasi/prosiding/128-prosiding-seminar-nasional-petani-dan-pembangunan-pertanian-2012.

Suripto (2019) *Rancang Bangun Model Manajemen Risiko Agroindustri Gula Tebu*. Institut Pertanian Bogor. Available at: https://repository.ipb.ac.id/handle/123456789/98234.

Suryana, A. *et al.* (2016) *Idenifikasi Permasalahan dan Solusi untuk Pemenuhan Kebutuhan Gula Nasional*. Bogor (ID). Available at: http://pse.litbang.pertanian.go.id/ind/pdffiles/anjak_2016_01.pdf.

Syauqy, M. F. and Pratomo, D. S. (2018) 'Analisis Terhadap Berkurangnya Tenaga Kerja pada Sektor Pertanian di Pedesaan di Indonesia', *Jurnal Ilmiah Mahasiswa FEB Universitas Brawijaya*, 7(1). Available at: https://jimfeb.ub.ac.id/index.php/jimfeb/article/view/5193.

Tayibnapis, A. Z., Wuryaningsih, L. E. and Sundari, M. S. (2016) 'Efforts to Achieve Beyond Sugar in Indonesia', *International Journal of Management & Bisuness Studies*, 6(4), pp. 14–22. Available at: www.ijmbs.com/Vol6/4/2-ahmad-zafrullah-tayibnapis.pdf.

Toor, E. and Islam, T. U. (2019) 'Power Comparison of Autocorrelation Tests in Dynamic Models', *International Econometric Review*, 11(2), pp. 58–69. doi: 10.33818/ier.447133.

Utomo, S. J. (2014) 'Transformasi Tenaga Kerja Wanita dari Sektor Pertanian ke Sektor Industri di Kabupaten Mojokerto', *Media Trend*, 9(2), pp. 126–135. doi: https://doi.org/10.21107/mediatrend.v9i2.773.

Widyaningsih, A., Susilawati, M. and Sumarjaya, I. W. (2014) 'Estimasi Model Seemingly Unrelated Regression (SUR) dengan Metode Generalized Least Square (GLS)', *Jurnal Matematika*, 4(2), pp. 102–110. doi: https://doi.org/10.24843/JMAT.2014.v04.i02.p49.

Yokoyama, H. (2013) 'Growth and food source of the sea cucumber Apostichopus japonicus cultured below fish cages - Potential for integrated multi-trophic aquaculture', *Aquaculture*. Elsevier B.V., 372–375, pp. 28–38. doi: 10.1016/j.aquaculture.2012.10.022.

Yunitasari, D. *et al.* (2015) 'Menuju Swasembada Gula Nasional: Model Kebijakan untuk Meningkatkan Produksi Gula dan Pendapatan Petani Tebu di Jawa Timur', *Jurnal Ekonomi & Kebijakan Publik*, 6(1), pp. 1–15. doi: 10.22212/jekp.v6i1.160.

Zainuddin, A. and Wibowo, R. (2018) 'Analisis Potensi Produksi Tebu dengan Pendekatan Fungsi Produksi Frontir di PT Perkebunan Nusantara X', *Jurnal Pangan*, 27(1), pp. 33–42. doi: 10.33964/jp.v27i1.404.