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IMPACT OF INFRASTRUCTURE ON PROFIT EFFICIENCY OF VEGETABLE FARMING IN WEST JAVA, INDONESIA: STOCHASTIC FRONTIER APPROACH

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ABSTRACT

Infrastructure plays an important role in increasing farm profit, since it reduces transaction costs which affect input and output price. The vegetable farming profit is relatively high although it varies, due to different infrastructure conditions. The study was conducted to analyze the level of profit efficiency due to various infrastructure conditions and to reveal the determinants of vegetable farming profit. The research was conducted in West Java, Indonesia with 192 sample farming activities. The results indicate that vegetable farming was not yet efficient, with an efficiency level of 0.53, and around 70 percent of farming activities having an efficiency level below 0.7. Factors that influenced significantly profit were seed price, chemical fertilizers, wage, and non-land capital formation. The increase of crop diversification, land conservation technology, seed technology, number of credit, farmer's education, and market access to input market are very effective in increasing vegetable farming profit efficiency.

Key words: efficiency level, translog profit function, transaction cost, technology, credit, market access, irrigation , profit loss

INTRODUCTION

Infrastructure plays an important role on agricultural development in Indonesia, but it is still poor and decreases in condition over time. The poor infrastructure conditions of the agricultural sector are caused by a low infrastructure budget from the government. A large portion of government expenditure is allocated to agricultural subsidy. Agriculture expenditure from 2001 to 2008 has increased significantly by 25.5 percent annually, but the share on irrigation has decreased by 11.57 percent annually. On the other hand, the share of subsidy increased by 11.08 percent annually. A similar case happened in 2008, where only 15 percent of the total agricultural expenditure was spent on irrigation. Meanwhile, almost half of the total agricultural expenditure (around 55%) is on an agricultural subsidy program. More than half (52 percent) of this, was on a form of fertilizer subsidy, while the rest (48 percent) was on a seed subsidy, raskin (rice for poor), and agricultural credit. In 2009, the social donation on the agricultural sector budget was still high (42 percent). Meanwhile, the budget for capital (11 percent) decreased significantly compared to 2008, which reached 18 percent. This condition shows the phenomena of under-investment and mis-investment (Armas et al., 2012 and Daryanto, 2009).

Infrastructure has affected access to input and output market, which in turn affects input and output price (Minten 1999). In the agricultural sector, the effect of infrastructure on output price is relatively higher than that of other sectors since agricultural products are perishable and bulky. The different prices of both input and output due to different infrastructure conditions affect farming efficiency and profit . In addition to infrastructure, fixed asset is also another factor determining profit and farming efficiency. Several studies indicate that infrastructure (in the broad definition) and fixed asset affect profit and efficiency (Rahman, 2003; Bravo-Ureta et al. 2006; Kolawole, 2006; Hyuha et al. 2007; Ogunniyi, 2008; Wadud and Ar Rashid, 2011; van Hoang and Yabe, 2012).

Infrastructure has to be improved since it increases production through an increase in agricultural productivity. Forms of infrastructure included in the analysis were roads, irrigation, research and technology, and agriculture financing. Better infrastructure leads to a more conducive business environment, which can increase private capital formation at the farming level. Therefore, infrastructure can affect the agricultural sector growth directly or indirectly through farming capital formation. It is important to analyze the effect of infrastructure on agricultural development, especially on the increase of farming efficiency.

Vegetable farming is considered of high-value, since it tends to be commercialized. The main characteristic of commercial farming is that it tries to achieve the highest profit by considering resource allocation, and available internal and external resources . The internal resources refer to land, labour, and managerial skills. The external resources include various infrastructure conditions leading to varied transaction costs. This can influence both input and output prices. The price differences cause profit variation (Ridwan et al., 2010). Therefore, analyzing the reason for variation in farming profit is interesting and important. What are the determinants of farming profit? What is the vegetable farming efficiency level and the factors that affect efficiency level? The objectives of this research are (1) to analyze the determinants of vegetable farming profit, (2) to analyze the efficiency and determinants of vegetable farming profit efficiency.

THEORETICAL FRAMEWORK

Adequate infrastructure can decrease transaction cost, which can prevent maximum profit. The effect of transaction cost traced through the effect of infrastructure can be analyzed by measuring the profit efficiency.

Transaction cost is the cost bare by the institution caused by imperfect information, opportunistic behavior, and bounded rationality of actors. Transaction cost occurs because of the assymetric information causing market failure. In market failure, the price faced by market institution varies. The price paid by the consumer is not similar with the price received by the producer due to transaction costs. Transaction cost includes transportation cost, communication, search, negotiation, selection, coordination, monitoring, and implementation (Hoff and Stiglitz, 1993). Transaction costs will eventually cause an inefficient economic activity.

When transaction cost exists, technical efficiency may not change, but not the allocative efficiency which considers relative input and output price. Transaction cost changes the relative price (increase or decrease) that leads to change in allocative efficiency. One of the approaches in measuring farming efficiency when transaction cost exists is to utilize profit efficiency (Sadoulet and de Janvry 1995).

Profit efficiency is defined as the ability of a firm to reach the highest profit level at a certain price and fixed input usage (Kumbhakar and Lovell, 2000; Sadoulet and de Janvry, 1995).

The highest or maximum profit function that can be obtained is called the profit frontier. The stochastic frontier of profit function can measure the profit efficiency level for each farm directly, as seen in Figure 1. Meanwhile, profit inefficiency is the profit loss caused by not operating in the profit frontier. In Figure 1, if the farm is operated at point F, it has not reached the efficient profit with the inefficient ratio of the distance ratio, MF/MP. The larger the gap between profit and frontier profit curve, the more inefficient the farm. It also shows the average profit curve which does not include the profit inefficiency (Fig. 1).

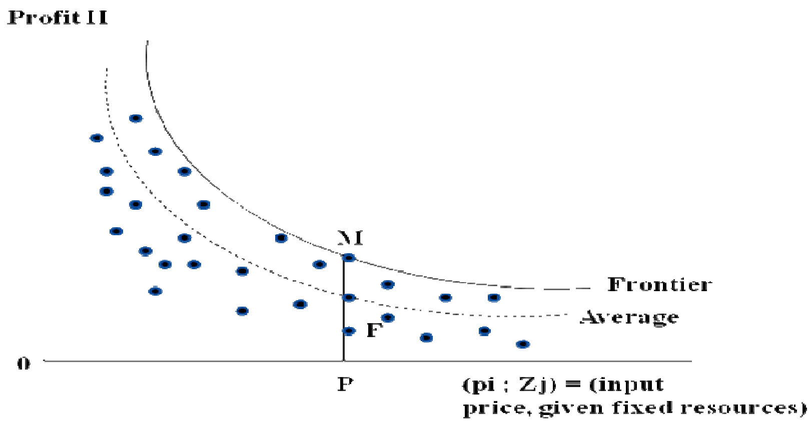

Fig. 1. Profit frontier and average function. (Sadoulet and de Janvry, 1995)

Profit function is derived from the production decision in which the farmer will allocate input to produce output at the maximum level of profit. If the producer faces the input price w and output price p, and assuming maximum profit $\pi = p.y - w.x$ using x input to produce y output, then the profit frontier illustration can be seen in Figure 1. The profit frontier function is as follows (Kumbhakar and Lovell, 2000):

$\pi (p,w) = \max_{y,x} \{ p.y - w.x; (y,x) \in GR\}$ ………..………………………......………… [01]

The profit frontier function has several assumptions, which include: (a) a non-decreasing output price p, if $p' \geq p$, (b) a non-increasing input price w, if $w' \geq w$, (c) homogenous in first order on output price p and input price w, and (d) convex on output price p and input price w.

Especially on a single output case, the profit frontier curve can be normalized by output price. Because profit function is homogenous at the first degree on (p,w), it is therefore possible to divide maximum profit with p where $p > 0$. The normalized profit frontier function with output price is as follows:

$\pi^* (w/p) = \pi (p,w)/p = \max_{y,x} \{ p.y - w.x; (y,x) \in GR\}$ …………………….....................……[02]

The normalized profit function with output price is characteristicly non-increasing, convex, and homogenous at zero degree at output price p and input price w. If there is a fixed input, the profit function is therefore called the profit variable. The frontier variable profit function is as follows:

$v\pi (p,w,z) = \max_{y,x} \{ p.y - w.x; (y,x,z) \in GR\}$ ………………………………..………………[03]

The profit variable is the total revenue minus the variable cost with output price *p*, input price *w*, and fixed input *z*.

The profit efficiency is the condition when technical, allocative (price) efficiency, and scale efficiency are achieved. Technical efficiency reflects the ability of a firm to obtain maximal output from a given set of inputs, and allocative efficiency which reflects the ability of a firm to use input for optimal proportion, given their respective prices and production technology. Scale efficiency is the condition when all firms are operating at an optimal scale (Farrel, 1957). The function of profit efficiency is:

$\pi E(y,x,p,w) = (p.y - w.x)/\pi(p,w);\ \pi(y,x) > 0$……………….………………………...…..…[04]

Profit efficiency is the ratio between actual profit (p.y-w.x) with maximum profit π(p,w). In Figure 2, the producer faces price (p^A, w^A) and profit efficiency $\pi E(y,x,p,w) = 1$ at the input output combination at point E, and $\pi E(y,x,p,w) < 1$ for the other input output combination points. The profit efficiency measurement has an upper limit and the upper limit will only be reached when the producer maximizes his profit. Profit efficieny is not limited at zero since actual profit can be negative.

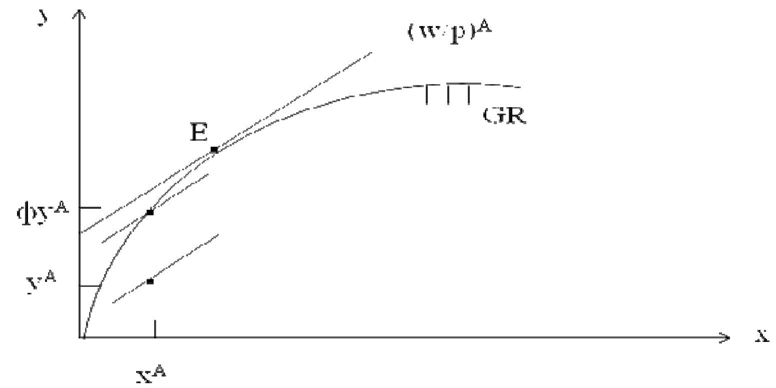

Fig. 2. Profit efficiency measurement. (Kumbhakar and Lovell, 2000)

RESEARCH METHOD

Research Area and Data

This reseach is an empirical study of vegetable farm level in central vegetable production areas at Bandung and Garut Regency, West Java. The decision of choosing sub-regency and village was based on two criteria: (1) central production and (2) infrastructure availability. Based on these criteria, the research was located at Pangalengan and Kertasari Sub-regency in Bandung Regency, and Pasirwangi and Cikajang Sub-regency in Garut Regency. The number of villages chosen was 12 villages, consisting of 8 villages in Bandung Regency and 4 villages in Garut Regency.

The data consisted of primary and secondary data. The primary data consisted of vegetable farm input-output during the planting season 2010/2011, input and output price, distance between land and economic center, road conditions, irrigation, farming technology, conservation technology, land slope, access to input and output market, farm credit, fixed assets in five years (2006-2011), and farmer's characteristics. The number of farm samples was 192, with 118 samples in Bandung Regency and 74 samples in Garut Regency. Stratified random sampling was conducted to determine samples. The stratification was based on land area, where the strata were: strata 1 (< 0.5 Ha), strata 2 (0.5-1.0 Ha), and strata 3 (> 1 Ha), wherein stata 1 consisted of 82 samples, strata 2 52 samples, and strata 3 58 samples.

Road infrastructure, seed technology, and land conservation technology index were used in this research following Iyengar and Sudarshan, as was applied by Ashok and Balasubramanian (2006) as follows:

$$Y_{id} = (X_{id} - MinX_{id}) / (MaxX_{id} - MinX_{id}) \quad \text{[05]}$$

where X_{id} = i^{th} infrastructure of d^{th} farmer. The index number range was between 0 and 1. Meanwhile, the crop diversification index used the Simpson diversification index:

$$SID = 1 - \sum (a_i/A)^2 \quad \text{[06]}$$

where SID = Diversification index, a_i = i^{th} plant area, and A = total area. The index number range was between 0 and 1.

Stochastic Frontier Profit Function Model

The profit function model used was the transcendental logarithmic (translog) profit function with stochastic frontier approach. Based on previous studies, stochastic frontier is the best and most applied in the agricultural sector. With this model, besides the predicted factors affecting vegetable farm profit and profit efficiency level, other factors affecting vegetable profit efficiency can be simultaneously predicted. The simultaneous model was carried out in one step and was introduced by Coelli et al. (1998). Maximum Likelihood Estimation (MLE) was used in estimating the parameter making the results unbiased.

The vegetable profit function was affected by output price, variable input price, and several fixed inputs. In this research, profit function was predicted to be affected by potato price (Py), seed price (Ps), chemical fertilizer price (Pf), organic fertilizer price (Po), wage (Pw), and insecticide cost (Pp). As an important component of cost structure in vegetable farming, both input and output price were affecting vegetable farming profit. The hypothesis was that input price negatively affected profit since it increased vegetable farming cost, while output price positively affected on-farm profit. . The profit and input price variable was normalized with output price based on potato price since it is the main commodity of the sample farmer. Meanwhile, the fixed input assumed to affect profit were land area (Za) and non-land capital accumulation (Zc). Land area was the indicator of farm size, the hypothesis was that the larger the land area the larger the profit was. Meanwhile, non-land capital accumulation, such as building and equipment, was believed to have a positive effect on farm profit. Non-land capital accumulation would increase farm capacity since having new assets would be more productive compared to old ones.

Meanwhile, variables predicted to affect vegetable farm profit inefficiency were irrigation infrastructure, crop diversification, land conservation, seed technology, credit, farmers' formal and non-formal education, and access to input market. All variables were predicted to have a negative effect on vegetable farm profit inefficiency. Those variables affected vegetable farm production efficiency and at a constant price, increased production efficiency would increase profit efficiency. The access to input market could influence input and output relative price which affected profit efficiency. The vegetable farm translog profit function model specification could be formulated as follows:

$$\ln \pi' = \alpha_0 + \sum_{i=1}^{5} \alpha_i \ln p_i' + \frac{1}{2} \sum_{i=1}^{5} \sum_{j=1}^{5} \tau_{ij} \ln p_i' \ln p_j' + \sum_{i=1}^{5} \sum_{k=1}^{2} \emptyset_{ik} \ln p_i' \ln z_k +$$

$$\sum_{k=1}^{2} \beta_k \ln z_k + \frac{1}{2} \sum_{k=1}^{2} \sum_{l=1}^{2} \mu_{kl} \ln z_k \ln z_t + v - u \quad \text{[07]}$$

Meanwhile, the vegetable farm profit inefficeincy function could be written as follows:

$$u = \delta_0 + \sum_{i=1}^{8} \delta_i w_i + \omega \quad \text{[08]}$$

where:

π' = Normalized profit with output price (Py)

$p_i{}'$ = Normalized input price with output price (Py), which is:

$i_1 = P_s$, seed price (Rp/kg); $i_2 = P_f$, chemical fertilizer price (Rp/kg); $i_3 = P_o$, organic fertilizer price (Rp/kg) ; $i_4 = P_w$, wage (Rp/HOK); $i_5 = P_p$, insecticide cost (Rp)

z_k = Fixed input, consists of:

$k_1 = z_a$, farm area land (Ha); $k_2 = z_c$, non-land capital accumulation (Rp)

v = Random variable related to external factor

u = Random variable related to internal factor which influenced profit efficiency level

δ_i = Estimated parameter coefficient

w_i = Variable influencing inefficiency, consists of:

w_1 = irrigation index[1]; w_2 = crop divesification index; w_3 = land conservation index; w_4 = seed technology index; w_5 = credit (Rp); w_6 = farmers' formal education level (1 = not graduate elementary school; 2 = graduate elementary school; 3 = graduate junior high school; 4 = graduate senior high school; 5 = diploma; and 6 = undergraduate/post-graduate); w_7 = *dummy* farmers' non-formal education (1 = attended; 0 = not attended); w_8 = input market access index

The stochastic frontier profit efficiency model could be calculated using this formula:

$$PE_i = E\left[\mathrm{Exp}(-u_i)|e_i\right] = E\left[\mathrm{Exp}\left(-\delta_0 - \sum_{i=1}^{n} \delta_i w_i\right)|e_i\right] \quad \text{[09]}$$

Where PE was the i^th^ farm profit efficiency with values between 0 and 1, and had a negative relation with profit inefficiency level. After farm profit efficiency level was known, the profit loss could be calculated using the following formula:

PL = maximum profit (1 – PE) ....[10]

Where PL was the profit loss and PE was the profit efficiency. The maximum profit per hectare could be calculated by dividing the actual profit per hectare with the efficiency level.

Hypothesis on the effect of inefficiency was conducted to test the goodness of fit of the model by looking at the variance σ^2, where $\sigma^2 = \sigma_v^2 + \sigma_u^2$, with the null hypothesis or Ho; $\sigma^2 = 0$, and H_1; $\sigma^2 > 0$. The other hypothesis tested was the value of gamma (γ), where $\gamma = \sigma_u^2/\sigma^2$, Ho : $\gamma = \delta_1 = \delta_2 = \delta_n = 0$ stating that profit inefficiency effects do not exist in the frontier profit function model. The better test used to test for the existence of inefficiency was using the one side generalized likelihood-ratio test using the following formula:

$$LR = -2\{\ln[L(H_0)/L(H_1)]\} = -2\{\ln[L(H_0)] - \ln[L(H_1)]\} \quad \text{[11]}$$

[1] Irrigation index was constructed by land distance multiplied by type of irrigation in score (technical irrigation, semi-technical irrigation, and non irrigated land)

Where L (H_0) and L (H_1) were the value of likelihood function from the null and alternative hypotheses. Ho was rejected if LR > $\chi 2$ restricted, and accepted if LR < $\chi 2$ restricted.

RESULTS AND DISCUSSION

A vegetable farm profit varied with an average of 101.8 million rupiah per hectare per year. A large variation also occurred on insecticide cost (Rp), land area (Za), and non-land capital accumulation (Zc) (Table 1). These variations may be due to the large gap in land holding causing a larger gap in other variables related to land area, directly or indirectly.

Table 1. Statistical description of variables in the translog profit funtion in vegetable farms in West Java, 2010/2011

Variable	Mean	Std. Dev.	Minimum	Maximum
Profit (π)	101,843,578.16	95,983,248.60	0.00	523,747,619.05
Output price (Py)	4,342.81	1,016.85	2,000.00	8,000.00
Seed price (Ps)	11,937.68	3,240.28	2,550.00	20,100.00
Chemical fertilizer price (Pf)	2,211.79	341.33	1,492.65	3,080.12
Organic fertilizer price (Po)	362.75	86.98	160.00	600.00
Wage (Pw)	16,518.67	3,697.02	9,042.25	29,772.20
Insecticide cost (Pp)	1,974,068.45	2,979,969.72	60,000.00	18,082,150.00
Land area (Za)	0.81	1.90	0.04	18.00
Non-land capital (Zc)	16,969,313.37	47,228,973.66	0.00	533,000,000.00

Factors Affecting Vegetable Farm Profit

According to estimation results (Table 2), the value of generalized-likehood (LR) frontier stochastic profit function is 225.15, with significance at α = 1%. The parameter estimated coefficient sigma squared (σ^2) and gamma (γ) are statistically significant at α = 1%. Parameter gamma coefficient (γ) is 0.9939, which can be interpreted that 99 percent profit variation is caused by efficiency difference and the rest is caused by external factors which are not included in the model. The value of γ is significant and close to one, indicating that the factor affecting profit inefficiency is important.

The estimation result in Table 2 indicates that all the coefficient signs and significance support the hypothesis. These variables include seed price, chemical fertilizer price, and non-land fixed assets which indicate that these variables are important parameters influencing vegetable farm profit. If seed price and chemical fertilizer price increase (decrease), farm profit will decrease (increase), ceteris paribus. Therefore, a policy which can causes a decrease in seed price and chemical fertilizer will effectively increase farm profit.

Meanwhile, organic fertilizer price, despite support of the hypothesis having a negative coefficient, the effect is less significant. Interestingly, wage has a positive sign which does not support the hypothesis and significance (α < 1%). It means that an increase in wage will increase farm profit. This indicates that wage is an important variable in vegetable farming and is still relatively low. The wage variable analyzed is the composite wage consisting of male and female wage. The average composite wage is Rp 16,519 per day work or Rp 3,300 per hour with five hours work per day.

The increase in productive non-land asset utilization will cause an increase in farm profit. This indicates that capital formation is important in farm management since it increases profit. Although farm land has a positive relation with profit, the influence is not significant. In relation to land function, this result must be carefully explained. It does not necessarily mean that land area is not important in increasing farm profit, but there are other variables that have more influence than land area. Insecticide cost is not significant even though the sign is not as predicted. Pesticides are needed in vegetable farming, but the proportion to total cost is relatively small, around 13 percent.

Table 2. Estimation result of vegetable farming profit function parameter in West Java at 2010/2011 using MLE

Variable	Coefficient	Standard Error	t ratio
Constant	-3.7771	3.3483	-1.1281
LPs	-1.9449**	1.0609	-1.8332
LPf	-10.7952***	1.2433	-8.6829
LPo	-0.5209	1.1968	-0.4352
LPw	9.8882***	1.1910	8.3025
LPp	0.5065	1.1380	0.4451
1/2LnPs*LnPs	-0.3538	0.7796	-0.4539
1/2LnPf*LnPf	-7.6612***	1.0570	-7.2483
1/2LnPo*LnPo	0.0752*	0.0475	1.5834
1/2LnPw*LnPw	-1.3235*	0.9462	-1.3988
1/2LnPp*LnPp	0.0304	0.3026	0.1005
LPs*LPf	2.1996***	0.8647	2.5436
LPs*LPo	0.1372	0.4935	0.2781
LPs*LPw	-1.1580*	0.8522	-1.3589
LPs*LPp	1.8335***	0.4167	4.4002
LPf*LP0	0.2455	0.5631	0.4360
LPf*LPw	4.0405***	0.9740	4.1482
LPf*LPp	-0.4298	0.5128	-0.8380
LPo*LPw	-0.3460	0.6082	-0.5690
LPo*LPp	0.0905	0.2500	0.3621
LPw*LPp	-1.5577***	0.4813	-3.2365
LPs*LZa	-0.0638	0.2549	-0.2504
LPs*LZc	-0.1123**	0.0584	-1.9217
LPf*LZa	0.5188*	0.3629	1.4299
LPf*LZc	0.0811	0.0786	1.0315
LPo*LZa	-0.0197	0.1789	-0.1102
LPo*LZc	0.0698*	0.0436	1.6011
LPw*LZa	-0.1734	0.2899	-0.5980
LPw*LZc	0.0142	0.0354	0.3997
LPp*LZa	-0.0127	0.1356	-0.0936

Variable	Coefficient	Standard Error	t ratio
LPp*LZc	-0.0215	0.0341	-0.6307
LZa	0.0200	0.8696	0.0230
LZc	0.4509*	0.2945	1.5311
1/2LnZa*LnZa	-0.0248	0.0772	-0.3211
1/2LnZc*LnZc	0.0027	0.0032	0.8301
LZa*LZc	0.0106	0.0094	1.1203
Parameter Variance:			
Sigma squared (σ^2)	22.5693***	2.0753	10.8751
Gamma (γ)	0.9930***	0.0024	410.9335
Log Likelihood	-239.79	LR	225.1469***

***significant at α = 1% **significant at α = 5% *significant at α = 10%

Vegetable Farming Profit Efficiency Level

Profit efficiency is derived from the translog profit function using a stochastic frontier approach. The vegetable farm profit efficiency level estimated using MLE is shown in Table 3.

Table 3. The range of vegetable farm profit efficiency according to land area in West Java, 2010/2011

Efficiency Level	Strata 1		Strata 2		Strata3		TOTAL	
	n	%	n	%	n	%	n	%
<0.1	5	2.60	1	0.52	1	0.52	7	3.65
0.1-<0.2	14	7.29	3	1.56	1	0.52	18	9.38
0.2-<0.3	9	4.69	3	1.56	2	1.04	14	7.29
0.3-<0.4	13	6.77	3	1.56	5	2.60	21	10.94
0.4-<0.5	13	6.77	5	2.60	3	1.56	21	10.94
0.5-<0.6	5	2.60	9	4.69	8	4.17	22	11.46
0.6-<0.7	10	5.21	8	4.17	13	6.77	31	16.15
0.7-<0.8	9	4.69	11	5.73	19	9.90	39	20.31
0.8-<0.9	4	2.08	9	4.69	6	3.13	19	9.90
Total	82	42.71	52	27.08	58	30.21	192	100.00
Average	0.4175		0.5874		0.6243		0.5260	
Min	0.0000		0.0338		0.0861		0.0000	
Max	0.8858		0.8946		0.8660		0.8946	
Std. Dev.	0.2325		0.2202		0.1810		0.2338	

The average profit efficiency of vegetable farming is low (0.53). Kumbakar and Lovell (2002) have set efficiency criterion at 0.7, it can be concluded that with this rate of efficiency, the vegetable farming in West Java is still inefficient. The range of efficiency index is relatively large from 0 - 0.89. The average vegetable farm profit efficiency level is 0.53, with a tendency to increase with larger land area. The average profit of vegatable farming is relatively high, reaching up to 101.8 million rupiah per hectare per year.

Using the efficiency index criterion of 0.7, only 30.21 percent from all farms is efficient, with a larger portion belonging to strata 3 (13.02 percent) while strata 1 had 10.42 percent and strata 2 only 6.77 percent (Fig. 3). According to the land classification, 22 percent is from the total farms, wherein profit is efficient at strata 1 (small land are). This shows that on small land area there is a possibility to reach a higher efficiency level (small but efficient).

Farms with a 0.5-0.7 efficiency level range are at 27.60 percent, which spreads on every strata and the highest on the large land area (strata 3). Strata 1 (small land area) comprises 7.81 percent while strata 2 and 3 are at 8.85 percent and 10.94, respectively. Overall, farms with less than a 0.5 efficiency level are dominant at 42.19 percent, and the highest percentage belonging to strata 1 (small land area) at 28.13 percent, while strata 2 is at 7.81 percent and strata 3 6.25 percent. Based on the profit efficiency level, it can be concluded that most vegetable farms are not efficient. Most of the inefficient farms belong to strata 1 (small land area). The larger the land farmers own, the higher the profit efficiency level.

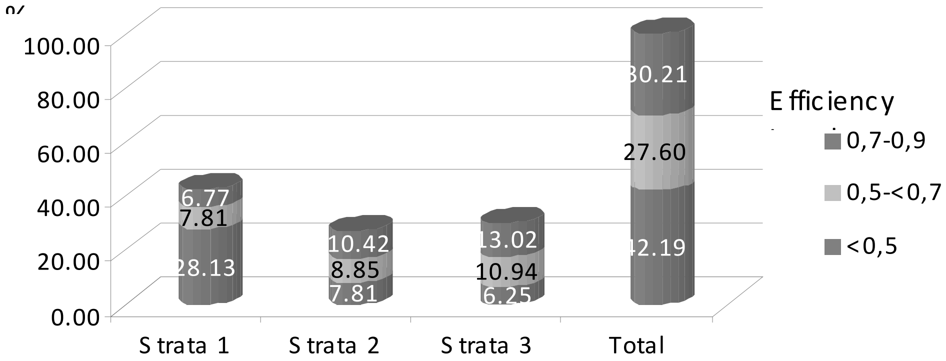

Fig. 3. Farms profit efficiency according to strata in vegetable farms in West Java, 2010/2011

The low profit efficiency level indicates two things: (1) a relatively high profit loss, and (2) big opportunities to increase profit efficiency by analyzing the source of inefficiency.

Source of Profit Inefficiency in Vegetable Farms

Descriptive statistics of every variable affecting profit inefficiency is shown in Table 4. Most of the observed infrastructure indices are less than 0.5, even conservation technology indices and access to input market are less than 0.1.

An estimation of results of factors affecting vegetable farm profit inefficiency are shown in Table 5. All predicted parameters have an expected sign according to the hypothesis, which is negatively affecting inefficiency. The significance level of all parameters, except for irrigation index, is relatively high with a value of less than 1 percent. This indicates that all variables, except for irrigation infrastructure, are very important and affect profit efficiency. In other words, these variables can diminish the inefficiency effect on vegatable farm profit.

Table 4. Descriptive statistics of profit inefficiency parameter in vegetable farms in West Java, 2010/2011

Variable	Mean	Std. Dev.	Minimum	Maximum
Irrigation index (IRIG1)	0.2333	0.2989	0.0000	1.0000
Crop diversification index (SID)	0.5185	0.1050	0.4444	0.6667
Land conservation index (IKON)	0.0431	0.0976	0.0003	1.0000
Seed technology index (ITEKB)	0.3139	0.2861	0.0000	1.0000
Credit[2] (CRED)	4,080,000.00	8,330,000.00	100,000.00	50,000,000.00
Formal education level (EDF)	2.5625	1.0316	1.0000	6.0000
Non-formal education index (EDNF)	0.3802	0.4867	0.0000	1.0000
Access to input market index[3] (AKSIIn)	0.0322	0.1021	0.0000	1.0000

Table 5. Estimation result of vegetable farm profit inefficiency effect in West Java, 2010/2011

InefficiencyVariables	Coefficient	Standard Error	t ratio
Constant	-3.0022***	1.0384	-2.8911
Irrigation Index (IRIG1)	-0.4097	1.0717	-0.3823
Diversification Index (SID)	-7.5507***	1.7594	-4.2916
Conservation Index (IKON)	-5.2317***	1.4532	-3.6001
Seed Tech. Index (ITEKB)	-6.9832***	0.9905	-7.0503
Credit (CRED)	-2.17E-07***	2.01E-08	-10.7853
Formal Education Level (EDF)	-3.9869***	0.2429	-16.4152
Non Formal Education Dummy (EDNF)	-4.0227***	0.8672	-4.6384
Access to Input Market (AKSIIn)	-9.7499***	0.8794	-11.0865

Note : *** significant at α = 1%

Irrigation infrastructure has a negative effect on inefficiency, but the effect is insignificant, different from Rahman (2003), Wadud and Ar Rashid (2011), and van Hoang and Yabe (2012), which show that irrigation infrastructure significantly affect profit efficiency. The average irrigation index is relatively small (0.23) with a high standard deviation of 0.3.

Crop diversification in vegetable farming is already high with a value of 0.52 and farmers in average have planted two crops annually. Crop diversification will impact vegetable productivity, therefore crop diversification will impact farming efficiency. The same was also observed in studies by Rahman (2003), Kolawole (2006), and van Hoang and Yable (2012) which

[2] The credit was measured with the value of loan occupied by the farmer

[3] Market access was measured by an index that is constructed from the input market distance (km) multiplied by the time needed to reach input market (minutes)

emphasized soil fertility. In related to crop diversification, one of the objectives of diversification is to improve and maintain soil fertility. Bravo-Ureta et al. (2006) showed that output diversification can increase a farmer's income. Contrarily, Hyuha et al. (2007) indicated that in the case of paddy farming, profit efficiency is higher for specialized farmers.

The objective of land conservation activity is to maintain and increase land fertility which is important in farming activity. Land fertility will have an impact on input utilization productivity, which will eventually affect farming profit. This research shows that land conservation has a negative and significant effect on profit inefficiency. Bravo-Ureta et al (2006) also found that land conservation can increase a farmer's income. This is result also supported by research conducted by Rahman (2003), Kolawole (2006), and van Hoang and Yabe (2012) which showed that land fertility affects profit efficiency. Ogunniyi (2008) also found that the usage of tillage is one factor which can increae profit efficiency.

The average land conservation index in vegetable farming is relative low with a value of 0.04, with the index ranging from 0 to 1. Therefore, efforts in increasing land conservation must be conducted more extensively. Besides land conservation in the form of terracing, other conservation methods can be conducted by farmers, with the assistance of facilitators and motivation from the government through extension workers.

Seeds are an important input factor and determine producitivity and farming production. The need of seeds does not only concern the quantity, but more importantly the quality. Seed quality is produced through hybrid technology. Accessability to seed technology and affordable prices can allow farmers the incentive to adopt good technology. The adoption of good technology, such as the application of certified seeds, can influence the cost per output which affects farming profit. Therefore, seed technology will impact profit efficiency.

This research shows that seeds have a negative and significant effect on vegetable profit inefficiency, meaning that vegetable profit efficiency is affected by hybrid seed technology utilization. The utilization level of hybrid seeds in vegetable farming is still relatively low as indicated by the average of seed technology index of 0.3, with a scale of 0 to 1. The low seed technology index is caused by the limited availability of good seeds and unaffordable prices. Therefore, steps must be taken to increase seed availability so it can be accessed by farmers at an affordable price.

Agricultural credit is important since it increases input utilization efficiency, influencing farming productivity. At a certain input and output price, increase in productivity caused by credit support can increase farming profit. This research shows that agricultural credit has a negative and significant effect on profit inefficiency. The increase in credit amount can increase farming profit efficiency. Other research also supporting our result include Hyuha et al. (2007), Kolawole (2006), Abu and Asember (2011), and Ogunniyi (2008). The difference is that this research utilized the amount of credit, meanwhile the other four studies used credor access variable using dummy variable. But it generated similar results that indicate credit can increase profit efficiency.

A farmer's formal education level is related to the ability of a farmer to manage his farm. Therefore, formal education level is predicted to affect profit efficiency. This research prooves that a farmer's education level has a significant effect and increases farming profit efficiency.

Other research also generated similar results, such as Nganga et al. (2010), Hyuha et al. (2007), Rahman (2003), Kolawole (2006), Ogunniyi (2011), and Abu and Asember (2011). Therefore, an effort to improve farmer education is a must. One way is to increase investment on education through allocating a larger budget for education.

The ability of a farmer to manage his farm not only depends on formal education level, but also on non-formal education. Non-formal education includes involvement in extension activities, communication with extension workers, training, and others. Those forms of non-formal education deliver practical and specific knowledge, and skills according to the farmer's needs. Therefore, farmers with non-formal education have higher managerial skills, so they manage their farms more efficiently. Previous research has also proved that non-formal education, with various terms, significantly increase profit efficiently (Hyuha et al. 2007; Kolawole, 2006; Karafillis and Papanagiotou, 2009; Ogunniyi, 2011; Abu and Asember, 2011).

Access to input markets tend to help farmers purchase input at the right quantity, time, and price. Purchasing input correctly leads to an increase in input utilization efficiency. Therefore, an access to input market is predicted to affect farming profit efficiency. This research prooves that access to input market has a significant effect on profit efficiency. Other studies support this conclusion, such as Wadud and Ar Rashid (2011).

Vegetable Farming Profit Loss

The low vegetable farming profit efficiency level indicates the existence of a relatively large profit loss. The indication of profit loss is also a chance to improveme by looking for the source of profit loss. Generally, profit loss is higher at a lower efficiency level (Table 6) and profit loss is also negatively related to farming actual profit.

Table 6. Profit loss according to profit efficiency level on vegetable farming in West Java, 2010/2011.

Efficiency Level	n	%	Actual Profit (Rp/Ha/Year)	Profit Loss (Rp/Ha/Year)
<0.1	7	3.65	10,973,365	146,635,834
0.1 - <0.2	18	9.38	25,666,096	146,641,626
0.2 - <0.3	14	7.29	40,138,364	113,035,468
0.3 - <0.4	21	10.94	51,589,350	91,588,715
0.4 - <0.5	21	10.94	62,476,794	74,449,413
0.5 - <0.6	22	11.46	80,698,188	68,860,682
0.6 - <0.7	31	16.15	126,079,224	67,795,358
0.7 - <0.8	39	20.31	144,485,179	47,553,307
0.8 - <0.9	19	9.90	249,426,292	45,654,842
Total	192	100.00		
Mean			101,843,578	78,509,945
Min			0	18,983
Max			523,747,619	455,246,803
Std. Dev.			95,983,249	62,246,926

The average vegetable farming profit loss is relatively high reaching up to 78.5 million rupiah per hectare annually. This shows that there is still a relatively high profit potential to be obtained by farmers if vegetable farming is conducted technically and allocated efficiently. The increase in infrastructure is one of the methods needed to increase profit efficiency. Therefore, an important implication of this research is the need for gradual and continuous infrastructure improvement.

CONCLUSION

Factors affecting vegetable farming profit are seed price, chemical fertilizer price, wage, and non-land capital accumulation. Wage has a positive effect on profit, indicating the importance of labor (labor intensive) and can be substituted with other input, including machinery. Vegetable farming has not reach efficient profit. Profit efficiency increases with increase in land area. The low level of vegetable farming profit efficiency (0.53) causes high profit loss. An increase in crop diversification, land conservation, seed technology adoption, credit, formal and non-formal education, and an access to input market are very effective in increasing vegetable farming profit efficiency.

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