International Journal of Horticulture, Agriculture and Food Science (IJHAF)
ISSN: 2456-8635
[Vol-6, Issue-5, Sep-Oct, 2022]
Issue DOI: https://dx.doi.org/10.22161/ijhaf.6.5
Article DOI: https://dx.doi.org/10.22161/ijhaf.6.5.4

Optimization Model of Use of Production in Order to Increase Production and Eficiency of Potato Business in Kerinci District, Jambi Province

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Received: 01 Oct 2022; Received in revised form: 15 Oct 2022; Accepted: 22 Oct 2022; Available online: 30 Oct 2022

Abstract— *This research aims to; analyze the optimization model of the use of production inputs in order to increase production and the efficiency of potato farming. This study uses cross-section data from 62 farmers. Sampling was done by Simple Random Sampling. The approach taken to examine the response of production to inputs is made descriptively. The production and efficiency functions are estimated using the stochastic frontier production function and the dual cost function. The results showed that there was no optimal use of production inputs. The frontier production function was mainly determined by the input of seed production of SP-36 fertilizer, KCL fertilizer, and liquid insecticide. The determinants of optimal production are determined by the use of seeds, urea fertilizer, and the use of drugs. The optimal use of inputs can produce an optimal production of 21,768 kg, while the actual production is only 12,250 kg. The use of seeds, SP-36 fertilizer, organic fertilizers, liquid insecticides, and labor are risk-reducing productivity factors. The technical efficiency of potato farming is in the medium category (ET=0.6644). Sources of technical inefficiency mainly come from the land area, age, and distance of farming land. Meanwhile, income, farming experience education and the number of family members reduce the occurrence of technical inefficiency. Farmers' behavior in responding to productivity risks is the average risk taker.*

Keywords— ***Productivity Function, Stochastic Frontier, Efficiency and Risk Behavior.***

I. INTRODUCTION

The main potato producer in Jambi is Kerinci Regency. Jambi Province has three areas that become potato farming centers, namely Kerinci Regency, Merangin Regency, and Sungai Penuh City. In this area, the most produced horticultural commodity compared to other commodities is potato.

For Kerinci Regency, potato farming cultivation techniques still face obstacles and are cultivated conventionally. Productivity tends to decrease and fluctuate over the last 5 years, and is followed by a decrease in harvested area. Since 2016, potato farming has experienced a decline in harvested area and production. The decline in harvested area occurs annually by an average of 3.25%, namely from 2016, which was 4,682 ha in 2016 down to 4,334 ha in 2020. The decline in potato production was 9.69% from 2016, which was 91,080.5 tons, decreased to 82,251.8 tons in 2020. The productivity of potato farming has decreased from 19.5 tons/ha in 2016 to 11.5 tons/ha in 2020.

Kerinci Regency is the main potato production center in Jambi Province. This area is mostly in the highlands. Kerinci Regency is the area with the largest production and harvested area of potato commodity. In 2017, Kerinci Regency was the area with the highest production compared to other Kerinci center areas. Kerinci Regency has a production proportion of 92.98 percent or 76477.4 tons with a productivity of 17.06 tons/ha, and has the widest harvest area among other production center areas in Jambi Province, which is 4,482 ha or 92.72 percent.

Meanwhile, Merangin Regency has a land area composition of 6.37 percent and production of 6.21 percent of the total land area and production of Jambi Province. Kayu Aro Barat is an area that is included in the Kerinci Regency area. Kayu Aro Barat is one of the potato-producing districts, because it is the area that has the most production, which is 31,504 tons with a land area of 1,432 ha in 2020. Potato production in Kayu Aro Barat District fluctuates. Increasing production requires the optimal use of production inputs. The optimal use of inputs is the use of inputs appropriately and does not damage the surrounding environment. Farmers do farming with the aim of increasing their productivity and making a profit. Decrease in productivity can occur due to the contribution of the use of low production inputs so that the level of technical efficiency is low. The use of production inputs that have not been optimal will affect productivity.

If the use of production inputs is not optimal, productivity will be low. The use of inappropriate inputs such as excessive fertilizers and pesticides can also affect productivity. For this reason, technical efficiency needs to be determined to determine the use of production inputs and their combinations to increase the productivity and efficiency of farming that is profitable for farmers. This study intends to analyze the effect of using production inputs, level of technical efficiency, sources of technical inefficiency, and optimal use of production inputs for potato farming. The measurement of technical efficiency in this study uses the Cobb-Douglass production function model method. The CD production function frontier method is a parametric approach.

Estimating technical efficiency is intended to analyze any combination of production factors that can optimize the productivity of potato farming. Barriers to farmers such as high costs for factors of production, and low and fluctuating selling prices can affect farmers' incomes. Farmers are always faced with the risk of product failure due to improper cultivation methods or the use of production factors that are not recommended. So potato farming cannot be said to be efficient. Therefore, so that farmers can manage their farming optimally, it is necessary to make an effort to determine the allocation of production inputs in an appropriate manner (designing a construction model of the technical efficiency approach of potato farming.

II. METHODOLOGY

Kerinci Regency was used as the research area, with the locus of research being Kayu Aro Barat District. The research area was determined purposively. The consideration for choosing the location is because the area has the potential to develop potato farming. The research locus was Kebun Baru Village, Giri Mulyo Village, and Sungai Asam Village.

Sources of data come from primary and secondary data. Primary data were obtained from respondent farmers using a questionnaire. Secondary data was obtained from reports from related offices, especially from BP3K. The research locus was carried out purposively, namely in Kebun Baru Village, Giri Mulyo Village, and Sungai Asam Village. The sample size uses the slovin method with a precision level of 5%. From a farmer population of 560 households, the number of samples was 62 households. The sampling method uses Simple Random Sampling.

The econometric model used refers to Tasman, A (2008) and Soekartawi (2016). The CD stochastic frontier econometric model used is:

$$\ln Pro = \beta_0 + \beta_1 \ln Pro + \beta_2 \ln BIT + \beta_3 \ln TEJA + \beta_4 \ln PU + \beta_5 \ln P\ldots$$
$$\beta_6 l\ PO + \beta_7\ 1n\ PF + \beta_8\ PI + e^{(g)} \ldots\ldots\ldots\ldots \quad (\ldots$$

Where :

Pro = Total potato production (kg/ha)

BIT = Number of potato seeds (kg)

TEJA = Labor (HOK)

PU = Urea fertilizer (kg)

PP = Phonska Fertilizer (kg)

PO = Organic fertilizer (kg)

JSP = SP36 Fertilizer (kg)

PK = Use of KCl (kg)

PI = Use of insecticides (liters)

The amount of the estimated parameter : $\beta 1, ..., \beta 7, > 0$

Technical Inefficiency Effect Analysis

The effects of technical inefficiency are significant as follows:

$Ui = \gamma 0 + \gamma 1Tan + \gamma 2LL + \gamma 3PP + \gamma 4UP + \gamma 5DIK + \gamma 6RAK + \gamma 7SU + \gamma 8SUS$

Where:

Ui = Effect of technical inefficiency

γ 0 = Constant

Tan = Total revenue(Rp million)

LL = Land area (hectare)

PP = Farmer's experience (years)

UP = Age of farmer

DIK = Farmer's formal education level (years)

RAK = Family dependency rate.

E = Error term

III. RESULTS AND DISCUSSION

Use of Production Inputs in Potato Farming

The production response of a farm is determined by the dose of production input used. The combination of appropriate and optimal use of production inputs has an effect on productivity, production risk, and technical efficiency. The use of production inputs is generally not in accordance with cultivation techniques and the application of fertilizer use. The average area of potato farming is 0.65 ha, with a range of 0.25-1.45 ha, and the coefficient of variation is 0.35 (CV=35%). The average use of seeds was 1,250kg/ha, range 850-1,400kg/ha, with a coefficient of variation of 28.7% (CV=0.287%). The use of urea fertilizer is 120.3 kg/ha, range 95.2-145kg/ha, with a coefficient of variation of 31.5% (CV=0.315%). The average use of SP36 fertilizer was 85.6kg/ha, range 45.8-110.4kg/ha, with a coefficient of variation of 29.3% (CV=0.293%). The dose of KCL fertilizer was 63.5kg/ha, range from 42-88.7kg/ha, with a coefficient of variation of 34.7% (CV = 0.347%). The use of labor is 82.3Hok/ha, and the range is 65.1-93.6Hok/ha, with a coefficient of variation of 19.4% (CV=0.194%). The average dose of organic fertilizer is 975kg/ha, range 820-1,200 kg/ha, with a coefficient of variation of 35.2% (CV=0.352%). The average use of pest control is 7,680ml/ha, range 5,000-11,500ml/ha, with a coefficient of variation of 36.3% (CV=0.363%). The productivity of potato farming is 12,250kg/ha.

Estimation of Frontier Productivity Functions Using the MLE Method

In this section, the input variables used in farming will be described and analyzed in the productivity function model. The estimation results of the frontier productivity function using the maximum likelihood estimation method can be seen in Table 1.

Table 1. Estimation Results of Frontier Productivity Functions with the MLE Method in Potato Farming in the Research Area, 2022

Variable	Coeffisien	Standar Error	T-distribution
Productivity Function			
Constanta	2,1435	0,1674	12,8046
BIT-Seeds	0,3865	0,0875	4,4164
PU- Urea Fertilizer	0,8447	0,3041	2,7777
JSP- SP 36 Fertilizer	0,5111	0,1412	3,6196
PK- KCl Fertilizer	0,3152	0,0742	4,2479
PO- Organik Fertilizer	0,1514	0,1123	1,3481
PI- Liquid insecticide	0,2112	0,0233	9,0643
TEJA-Labor	0,0943	0,5144	0,1833
LR	28,43		

Note: a, b and c are significant at the level of α = 0.01, 0.05, 0.15

Table 1 shows that the coefficient of determination (R2) is 0.8152, this is a lot of 81.52% of the variation of potato productivity can be explained by variations of the independent variables in the model, in other words, 81.52% of the independent variables jointly affect productivity and the remaining 18, 48% is influenced by other variables that are not included in the model. Partially, the variables of seed, KCl fertilizer, and liquid insecticide had a significant effect at the level of α = 0.01, and the variable urea fertilizer and SP 36 fertilizer had a significant effect at the level of α = 0.05 on productivity. The elasticity value of frontier productivity from the variables of seed, labor, urea fertilizer, SP 36 fertilizer, organic fertilizer, KCl fertilizer, and liquid insecticide was 0.3865, 0.8447, 0.5111, 0.3152, 0.1514, 0.2112, and 0.0943. if seeds, labor, urea fertilizer, SP 36 fertilizer, organic fertilizer, KCl fertilizer, and liquid insecticide are added by 10% with the assumption of ceteris paribus it can increase productivity by 3.86%, 8.44%, 5.11%, respectively. , 3.15%, 1.51%, 2.11%, and 0.94%. The variables that had a significant effect on production at the level of α = 0.01 were seeds, urea fertilizer, SP36 fertilizer, KCl fertilizer, and liquid insecticide. Meanwhile, organic fertilizer and labor have a significant effect on production at α = 0.15. The addition of seeds can still increase productivity. Conditions in the study area showed that the use of seeds was not optimal. The addition of urea fertilizer could still increase potato productivity.

Estimated Productivity Risk Function with MLE Method

The results of the estimation of the frontier productivity function are then used as the basis for estimating the productivity risk function. The estimation results of the production risk function can be seen in Table 2.

Table 2. The Result of Estimating the Productivity Risk Function of Potato Farming with the MLE Method in the Research Area, 2022

Variable		Coefficien	Standar Error	T distribution
Productivity Function				
Constanta		132,821	83,762	1,5855
BIT-Seeds		=8,765	2,433	=3,6025
PU- urea Fertilizer		-1,964	2,322	0,8458
JSP- SP 36 Fertilizer		-3,672	2,434	=1,5086
PK- KCl Fertilizer		3,347	2,224	1,5049
PO- OF		-13,455	7,541	-1.7842
PI- Liquidinsecticide		-0,443	0,541	-0,8188
TEJA-Labor		-13,774	5,431	-2,5361
LR	27.56			

Note: a, b and c are significant at the level of α = 0.01, 0.05, 0.10, 0.15

Table 2 shows that the magnitude of the coefficient of determination [R2] is 0.7482, this means that as much as 74.82% of potato productivity can be explained by variations in the independent variables in the model, with 74.82% of the independent variables simultaneously influencing productivity. and the remaining 25.18% is influenced by other variables that are not included in the model. The results of the analysis of the productivity risk function show that seeds, labor, and organic fertilizers have a significant effect on productivity risk at the level of α = 0.05 and α = 0.10 in farming. urea fertilizer, SP36, and liquid insecticide are risk-reducing factors but have no significant effect

The results of the estimation of the productivity risk function (Table 3) show that the addition of seeds has a significant effect on increasing the productivity risk. On the other hand, the results of the analysis of the frontier productivity function showed that the addition of seeds had a significant effect on increasing productivity. However, the addition of seeds can also affect variations in potato productivity. The addition of seeds will increase the risk of potato productivity, presumably because farmers use seeds purchased from traders and are no longer superior. Consistent with Qamaria (2011) seeds have an effect on increasing the risk of taro productivity in Bogor Regency.

The estimation result of the productivity risk function shows that KCl fertilizer is a risk-decreasing factor but has no significant effect. The addition of organic fertilizer has a significant effect on reducing the risk of productivity. These results indicate that organic fertilizer is a risk-decreasing factor. The average farmer using organic fertilizer is still below the recommended dose of 850 kg per hectare. The recommended medium is 5000 – 7000 kg per hectare. Consistent with Fauziyah (2010) which shows that the addition of organic fertilizer has a significant effect on reducing the risk of tobacco productivity on dry land with a self-help system in Larangan District, Pamekasan Regency.

The addition of organic fertilizers can reduce productivity but has no significant effect. It is consistent with Qamaria (2011) that the use of organic fertilizers has a negative and insignificant effect on reducing productivity in taro farming in Bogor Regency. Consistent with Nainggolan (2011) that limited capital causes most farmers to use organic fertilizers below the recommended dose in potato farming.

The addition of labor is a risk-decreasing factor. This can happen because, with sufficient labor supply, farming activities will be able to run better so that the risk of failure caused by a shortage of labor can be avoided. Fauziyah (2010) that the addition of labor has a significant effect on reducing productivity risk in mountain tobacco farming with a self-help system in Pakong District, Pamekasan Regency. With the information about risk-increasing factors and risk-decreasing factors, it will help farmers in managing their farming.

Farming Technical Efficiency

Technical efficiency is a reflection of the farmer's ability to achieve maximum production from a given set of inputs. The estimated parameter is the ratio of the technical efficiency variance (u1) to the total production variance (∑i). The value of y is 0.4138 which means that 41.38% of the total variation in potato production is caused by differences in technical efficiency and the remaining 59.62% is caused by stochastic frontier effects.

The value of the generalized likelihood ratio (LR) of the stochastic frontier production function has a greater value than the value of the y2 distribution table providing information that there is an influence of farmers' technical efficiency in the production process. The distribution of the technical efficiency of the model used is presented in Table 4.

Table 3. Distribution of Potato Farming Technical Efficiency in the Research Area, 2022

Hose Efficiency	Efisiency Index		
	Amount (n)	Percentage (%)	Average
0,4-<0.5	6	9,67	0,4334
0.5-<0.6	11	17,74	0,5667
0.6-<0,7	25	40,32	0,6558
0.7-<0.8	10	16,67	0,7546
0.8-<0.9	8	12,90	0,8463
0.9-<1.0	2	3,22	0,9281
Total	62	100	
Average	0,6464		
Minimum	0,4333		
Maximum	0,9423		

Table 4 shows that the average level of technical efficiency achieved by farmers in potato farming is 0.6218, meaning that the average productivity achieved is around 93% of the frontier, namely the maximum productivity that can be achieved with the best management system (the best practice). This level of efficiency is categorized as low because it does not approach the frontier (TE-1). This level of technical efficiency reflects that the managerial skills of farmers are not yet high enough. But the moderate level of efficiency also illustrates that the opportunity to increase productivity is getting bigger because the productivity gap that has been achieved with the maximum productivity level that can be achieved with the best management system is quite large. Potato farming still has the opportunity to increase productivity in the short term by 35.36% by optimizing farming inputs with technological innovation and improving farm management.

The results of the technical efficiency analysis also show that the lowest level of technical efficiency is 0.5 –< 0.6 with an average efficiency level of 0.6464 with a number of farmers as much as 6.81% and the highest is 0.6 - 0.7. as many as 1.70% of farmers who achieved an average technical efficiency of 0.9281, as many as 40.32% farmers who achieved an average technical efficiency of 0.5667 and the remaining 23.86% farmers who achieved technical efficiency between 0.70-0.89 with an average technical efficiency 0.7546. Policies to increase productivity through technical efficiency can be carried out in certain groups through a participatory extension system so that farmers quickly adopt new technologies, especially in the use of inputs in accordance with the recommendations.

Sources of Farming Technical Inefficiency

Deviation from the Isoquant frontier is called technical inefficiency. There are many factors that lead to the achievement of technical inefficiencies in the production process. Determination of sources of inefficiency provides information about potential sources of inefficiency and provides suggestions for policies that should be implemented or eliminated to achieve a total level of efficiency. The results of the estimation of factors that affect technical inefficiency can be seen in Table 5.

Table 4. Result of Estimation of Sources of Technical Inefficiency in Potato Farming in Research Area, 2022

Variable	Coefficient	Standar Error	T distribution
Effect of technical inefficiency[1]			
Constanta	3,412	1,041	3,2776
Land Area (Z_1)	0,372	0,0362	10,2762
TotalRevenue(Z_2)	-0,532	0,0241	-22,0746
Age (Z_3)	0,034	0,041	0,8292
Education (Z_4)	-0,077	0,152	-0,5065
F.experience (Z_5)	-0,375	0,134	-2,7985
Number of family members (Z_6)			
Land-house distance (Z_7)	-0,623	0,412	-1,5121
	0,006	0,002	3

Note: a, b, c and d are significant at the level of α = 0.01, 0.05, 0.10 and 0.15

Table 5 shows the land area (Z1). positive and very significant effect on technical inefficiency. The positive sign on the land variable indicates that farmers who have narrow land are relatively more efficient than farmers who have large lands, Ogundari and Ojo (2006) obtained results that are in line with this study. Small to medium-scale farming is technically more efficient than large-land farming.

Total income (Z2) has a negative and very significant effect on the technical inefficiency of potato farming. The research of Villano and Fleming (2004) found something different, namely income from outside the farm concerned would actually cause the farm to become inefficient due to the activities of members of the farming family who are mostly outside the farm.

The age variable (Z3) has a positive and significant effect on technical inefficiency. This means that the older the farmer, the more technical inefficiency, or in other words, the younger farmer is more technically efficient than the old farmer. Muslimin (2012) which

shows that age has a negative and significant effect on the technical inefficiency of potato farming in South Sulawesi Province.

The formal education variable (Z4) has a negative but not significant effect on technical inefficiency. The research of Kebede (2001) and Sumaryanto, et al (2003), found that education had a positive effect on the technical efficiency of potato farmers, but it was different from the research of Tanjung (2003) which found that education had a negative effect on the technical efficiency of potato farming.

The farming experience variable (Z5) has a negative but not significant effect on technical inefficiency. This means that the more experienced farmers are, the more efficient they are in producing, especially in the use of production inputs. Consistent with Kalirajan (1984), Kalirajan, and Shand (1986) in Bravo-Ureta and Pinheiro (1993) in the Philippines and India, experience has a positive effect on technical inefficiency in potato production.

The variable number of family members (Z7) has a negative effect on the technical inefficiency of farming. This shows that the number of family members who are sources of labor in the family can replace paid workers outside the family. Saptana's research (2011), that the ratio of the number of working-age household members to the total household members has a negative but not significant effect on the technical inefficiency of curly red chili farming in Central Java Province.

The distance between the land and the farmer's house (Z8) has a positive and significant effect on technical inefficiency. The closer the distance between the farmland and the farmer's house, the more technical efficiency will increase. While the research of Muslimin (2012), that the distance between the farm and the farmer's house has a negative and significant effect on the technical inefficiency of potato farming in South Sulawesi Province.

Farmer Productivity Risk Behavior

In farming, the decision to allocate production inputs is influenced by the behavior of farmers toward the risks they face. According to Ellis (1988), farmers' behavior toward risk is grouped into three, namely: (1) risk-averse farmers, (2) risk-neutral farmers, and (3) risk-averse farmers. The risk behavior of farmers' productivity can be seen in Table 6.

Table 6. Farmer's Behavior in Responding to Production Risks

Production Input	Average θ	Average λ	Productivity Risk Behavior
Constanta	-0,214	0,853	Risk Averse
Seeds	0,085	1,334	Risk taker
Urea Fertilizer	2,347	0,665	Risk Taker
SP_{36} Fertilizer	-0,912	0,484	Risk Averse
KCl Fertilizer	0,052	2,551	Risk Taker
Organic Fertilizer	0,091	0,764	Risk Taker
Liquid Insecticide	-0,614	-0,732	Risk Averse
Labor	0,462	0,926	Risk Taker
Average	0,6518	0,856	Risk Taker

Table 6 shows that the risk behavior of farmers' productivity on seed input is risk taker, while SP36 fertilizer and liquid insecticide are risks averse. Farmer productivity risk behavior towards urea fertilizer input is a risk taker towards productivity risk. . Consistent with Fariyanti (2008), potato and cabbage farmers in Pangalengan District, Bandung Regency behave as risk takers towards urea fertilizer. While Fauziyah (2010), that the behavior of farmers to urea fertilizer is risk averse in tobacco farming on dry land with a partnership system in Larangan District, Pamekasan Regency.

The risk behavior of farmers' productivity on organic fertilizers is risk averse. . Whereas the results of the estimation of productivity, and risk show that organic fertilizer has a significant effect on reducing the risk of potato productivity. Faryanti (2008) the use of organic fertilizers is very necessary because it can reduce the risk of productivity.

Farmers' productivity risk behavior towards KCl fertilizer is a risk taker. The use of more KCl fertilizer aims to prevent or reduce pest and disease attacks so that the risk of crop failure can be reduced. . Farmers' risk behavior on chemical insecticides is risk averse, and their use depends on farmers' perceptions of risk.

Farmer productivity risk behavior on labor input is also a risk taker. This means that farmers have the courage to allocate more labor inputs to their farms. . Consistent with Fauziyah's research (2010) that the risk behavior of tobacco production productivity of farmers in paddy fields with a self-help system in Pademawu District, Pamengkasan Regency towards labor is a risk taker Fariyanti (2008) that potato and cabbage farmers in Pengalengan District, Bandung Regency behave risk averse to labor input.

Production Input Usage Optimization Model

In order to increase the production and efficiency of potato farming, it is necessary to have an optimization model for the use of production inputs. The objective of the optimization model is to increase productivity (technical efficiency) by determining the optimal combination of input use, minimizing production risk due to low productivity because the use of production inputs is not in accordance with recommendations or the use of production inputs is not optimal and minimizes technical inefficiency. The optimization model can be expressed as follows:

$$F_{opt(X)} = F_{(ET)} - F_{(R)} - F_{(IET)}$$

Information:

X = Optimal production function of potato farming

F_((ET))= Productivity function (technical efficiency) of potato farming

F_((R))= Risk function of potato farming production

F_((IET))= Function in technical efficiency of potato farming

$$F_{(ET)} = 2,1435 + 0,3865 \ln BIT^* + 0,8447 \ln UREA^* + 0,5111 \ln PP^* + 0,3152 ln \; PK^* + 0,1514 \ln \; PO^* + 0,2112 l \; PI^* + 0,0943 \ln TEJA^*$$

$$F_{(R)} = 132{,}821 + 8{,}765 \ln BIT^{**} + 1{,}964 \ln UREA^{**} + 3{,}672 \ln PP^{**} + 3{,}347 \ln PK^{**} - 13{,}455 \ln PO^{**} - 0.443 \ln PI^{**} - 13{,}774 \ln TEJA^{**}$$

$$F_{(IET)} = 3{,}412 - 0{,}532\ Tan + 0{,}034\ LL - 0{,}077\ DIK - 0{,}375\ PP - 0{,}623\ RAK + 0{,}006\ JUT$$

If the size of the farmer's profit is related to the estimation of the frontier productivity function, then the optimal input use allocation can be obtained. The comparison of actual and optimal input use can be seen in Table 6.1.

Table 6.1. Comparison of the actual and optimal use of inputs in potato farming in Jambi province.

Input Type	Input Usage		
	X_{Actual}	$X_{Recommendation}$	$X_{Optimal}$
Land Area (Ha)	0,65	165	1,46
Seeds(Kg)	1,250	880	1,100
Urea (Kg)	120,50	160	175,60
SP_{36} (Kg)	85,6	125	120,35
KCl (Kg)	75,5	85	110,75
Labor (HOK)	82,3	90	105,35
Organic Fertilizer (Kg)	975,0	1,350	1750,60
Chemical Insecticide (ml)	7680	10,000	8,750
Production (Ton)	12,250	18,650	21,768

Table 6.3 shows that the actual use of inputs is below the recommended inputs and optimal inputs, therefore, to achieve optimal production, farmers need to allocate as much input use as Xrecommendations or XOptimal. The actual production obtained is 12,250 kg/ha and the optimal production is 18,850 – 21,768kg/ha or an increase in production of 40,12 - 47,65%. This means that if farmers want to get maximum profit, farmers must allocate inputs with the optimal combination of quantities so that production is close to frontier production. Siska, Y et.al (2022), that in order to increase the competitiveness of potato farming, it is necessary to increase productivity by adopting new technology, subsidizing seeds and fertilizers as well as credit assistance.

IV. CONCLUSION

Farmers working on potato commodities are still relatively traditional. Adoption of technology with production input innovation is not recommended. There is no optimal use of production inputs. The frontier production function is mainly determined by the input of seed production of urea fertilizer, SP-36, KCL fertilizer, and liquid insecticide. The determinants of optimal production are determined by the use of seeds, urea fertilizer, and the use of drugs. The optimal use of inputs can produce an optimal production of 21,768 kg, while the actual production is only 12,250 kg. The use of seeds, SP-36 fertilizer, organic fertilizers, liquid insecticides, and labor are risk-reducing productivity factors. The technical efficiency of potato farming is in the medium category (ET=0.6644). Opportunities to increase productivity are still available at 0.3636%. Sources of technical inefficiency mainly come from the land area, age, and distance of farming land. Meanwhile, income, farming experience education, and the number of family members reduce the occurrence of technical inefficiency. Farmers' behavior in responding to productivity risks is the average risk taker.

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