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Abstract. Currently, maize farming in dry land has important role in line with decreasing arable land area and the increasing need for food and animal feed industry. The proper dry land management is expected to respond and meet these needs. This study aims to determine the performance of dry land maize farming with biochar and manure, which results are expected to be a recommendation for dry land management in a sustainable manner. The research location is determined purposively and the total sample is 150 respondents. Captured data includes primary data that is strengthened by the support of secondary data. This method of data analysis is using analysis of farming. The results showed that the farming maize dry land in this study showed a good performance based on indicators of revenue cost ratio > 1 , gross margin cost ratio is positive and has more than bank interest rate applicable. The use of labour is a classified productive number as well as the standard of output and revenue. The value of the break-even point is far below the average output value and selling price. Therefore, the maize farming in dry land with biochar and manure in this study is feasible to develop.

1. Introduction

1.1. Background

The area of dry land in Indonesia is 123.1 million hectares, this amount is wider than the fertile land, and 13.3 million hectares are located in East Java, Bali, Nusa Tenggara Timur and Nusa Tenggara Barat [1]. Based on data from Central Bureau of Statistics (*Badan Pusat Statistik/BPS*), in East Java, Blitar Regency has a dry land area of 44,939 hectares, wider than 34,141 hectares of paddy fields and is located in the southern part of Panggungrejo Sub-district with 7,152 hectares, which is the most widespread compared to other sub-districts [2]. At this time, dry land farming is an activity that is not less important than fertile land farming. One of the causes is that the rate of land degradation is increasing over time, especially the decrease of fertile land area.

Corn is a plant with high adaptation property because it can be cultivated in various soil types, various physical and socioeconomic environments, dry land, rice fields, lebak and tidal land [3]. In addition, corn needs water only in the early growth phase and the flowering phase [4]. Until now, corn farming in dry land still faces almost the same problems in every region: low productivity. Average yield of dryland maize based on research conducted by Agricultural, Fishery and Forestry Extension (*Balai Penyuluhan Pertanian/BPP*) office of Sungai Penuh Sub-district, Sungai Penuh District of Jambi Province is relatively low, that is 1.2 tons·ha⁻¹, while its potential can reach 5 to 7, 6 tons·ha⁻¹ for



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hybrid corn type [5]. Average productivity of maize in Panggunrejo Sub-district is based on data from Blitar Central Bureau of Statistics of 1.69 tons·ha⁻¹ or only 33.78 percent compared to the minimum potential principality and 22.22 percent of maximum potential productivity [6].

Various efforts are made by farmers to increase productivity, however, capital and input access constraints become other problems to achieve that goal. In the United States, to produce maize of 7.5 tons·ha⁻¹, farmers had to fertilize at 135 kg·ha⁻¹ of nitrogen, while for soils containing low phosphorus and potassium are required fertilization as much as 100 kg·ha⁻¹ of P₂O₅ and 170 kg·ha⁻¹ of K₂O [7]. An increase in N fertilizer to 142.7 kg·ha⁻¹ can increase yield and protein content of maize [8]. A study conducted by South Sumatera Institute of Agricultural Assessment (Balai Penelitian Teknologi Pertanian/BPTP) recommends a dose of maize fertilization in dryland with 300 kg·ha⁻¹ of nitrogen, 200 kg·ha⁻¹ phosphorus and 100 kg·ha⁻¹ of potassium with time of treatment a half the nitrogen plus all phosphorus and potassium parts when planting in the array next to the line, then two thirds of nitrogen part is given at 30 days after planting together with weeding [9].

Increased productivity of maize is influenced by cultivation technology as well as varieties. The superiority of the new superior varieties compared to the old superior ones, is on the achievement of efficiency, which shows new superior varieties are more technically, allocatively and economically efficient [10]. In achieving optimal production, there is still possibility to improve technical efficiency at the level of existing technology. Increased productivity is an urgent need to reduce the dependence of corn imports in order to meet the needs of food and feed industry in the country. It is concluded that special effort is needed to spur domestic corn production, because without that effort it is estimated that corn import will continue to increase, while in domestic market there is competition of corn demand for food and feed industry [11]. If the stock of world corn trade tends to decline, it is estimated that world corn prices will increase significantly. This will directly affect the livestock feed industry, which relies heavily on imported corn, there will be an increase of production costs and selling price of livestock feed products. Finally, it will disrupt the development of the domestic animal feed industry.

The increasing productivity can be performed by cultured-technology, such as organic fertilizer application, included of manure and biochar as soil ameliorant which is able to improve the structure, physically and biologically soil characteristics. The benefit of biochar application that soil quality improvement can be accomplished by soil acid (pH), cation exchange capacity (CEC), physically soil characteristics, and field capacity through biochar application of 50 tons·ha⁻¹ [12, 13]. Biochar application as ameliorant can be utilized on production enhancement in addition to physical, chemical, and biological characteristics of tropical soil [14, 15, 16].

1.2. Formulation of the problem

Based on the results of previous studies and studies as mentioned above, the efforts to increase the productivity of maize, especially in the research of dry land location, faced many obstacles, including the internal constraints of farmers related to capital limitations and willingness of farmers to innovate. From the external side, there is a scarcity of inputs and the lack of stakeholder support to farmers related to the smooth distribution of inputs and attention to the increase of dry land productivity. In order to fulfill the goal, it is needed the breakthrough of cultured-technology, such as biochar and manure application. The other difficulties have been headed by farmers are fluctuating selling price of output also contributes to the pessimistic attitude of farmers in dryland maize farm, where the selling price of output at harvest time tends to be low. These factors either directly or indirectly become a limiting factor for the success of corn farming in dry land. Therefore, it is necessary to research whether the performance of dried maize farming by biochar and manure applications by farmers in Kalitengah Village, Panggunrejo District, Blitar Regency is feasible to cultivate? This research will provide information on the performance of dryland maize farming.

2. Research Method

The location of this research was conducted in Kalitengah Village, Panggungrejo Sub-district, Blitar Regency, in a purposively determined way [17, 18]. The study time is from January to April 2017. Research samples are determined as disproportionally random sampling from a farmers' group of members and official of 150 [17, 19]. The data in this research is primary data obtained by interview method using questionnaire instrument and supported by secondary data from related institution. The collected data were analyzed by farming analysis method, as follows [20, 21]:

- a. Production cost

$$TC = TVC \text{ explicit} + TVC \text{ implicit}$$

- b. Revenue

$$TR = Y \cdot P_y$$

- c. Income

$$I = TR - TVC \text{ explicit}$$

- d. Gross Margin

$$GM = TR - (TVC \text{ explicit} + TVC \text{ implicit})$$

- e. Revenue Cost Ratio

$$RCR = TR / TC$$

- f. Gross Margin Cost Ratio

$$GMCR = GM / TC$$

- g. Labor productivity

$$\text{Based on the output (kg/HOK)} = Y / \text{HOK}$$

$$\text{By revenue (Rp/HOK)} = TR / \text{HOK}$$

- h. Break Even Point (BEP)

$$\text{Based on output (kg)} = TC / P_y$$

$$\text{By price (Rp/kg)} = TC / Y$$

Analysis of farm sensitivity Comparison of BEP value with inflation and/or CPI

Note:

TC : Total production cost (Rp)

TVC_{explicit} : Total cost of real variable (Rp)

TVC_{implicit}: Total variable cost calculated (Rp)

TR : Total revenue (Rp)

Y : Number of Output (kg)

P_y : Output Price (Rp/kg)

I : Income (Rp)

GM : Gross margin (Rp)

HOK : The amount of labor that is calculated based on the number of working days

(HOK = Hari Orang Kerja = Working People Days)

CPI : Consumer Price Index

3. Results and Discussion

3.1. Use of inputs and production costs

The use of inputs in farming has an important role to achieve high productivity and will be related to production costs. The high cost of farming is influenced, not only by land space, but also by input prices and the amount of inputs used by farmers. High-income farming is not necessarily a successful farm if the performance analysis does not take into the implicit inputs as well as the explicit inputs. In this study, the implicit input is including manure and biochar with the average use each of 82.09 kg·ha⁻¹ and 1,127.14 kg·ha⁻¹ and use of labor in the family of 11.81 working days (HOK). The implicit input is calculated the same as taking into account the explicit input. The economic costs of farming consist of fixed costs and variable costs. Fixed costs include depreciation of equipment and buildings used in farming, capital interest, regular repairs, taxes, land rent and insurance if any. Furthermore, variable costs consist of costs for purchasing inputs such as seeds, fertilizers, pesticides and labor wages. In this study, fixed costs are not taken into consideration because farmers do not pay land rent, interest on capital, insurance, land tax and depreciation of tools which is quite very small value, which can be ignored. In addition, some equipment is an inventory of farmer groups and can be used interchangeably. Production costs in dryland maize farming are presented in table 1.

Table 1. Average production cost of dryland corn farming.

Type of Input	Implicit (Rp)	Explicit (Rp)	Price/Unit (Rp/unit)	Total Cost (Rp)	Total Cost/ha (Rp/ha)
Seed (kg)	0	478,417.33	47,500.00	478,417.33	1,112,598.44
Nitrogen fertilizer (kg)	0	601,895.00	3,811.00	601,895.00	1,399,755.81
Phosphor fertilizer (kg)	0	42,602.16	3,600.00	42,602.16	99,074.79
Kalium fertilizer (kg)	0	54,712.32	3,900.00	54,712.32	127,237.95
Manure (kg)	6,620.88	0	121.67	6,620.88	15,397.39
Pesticides (kg)	0	53,102.00	53,666.67	53,102.00	123,493.02
Biochar (kg)	48,691.50	0	109.00	48,691.50	113,236.05
Labor (HOK)	371,766.67	375,766.67	31,833.33	747,533.33	1,738,449.60
Total					4,729,243.10

Source: Research Result (2016)

Factors contribute to the cost of production is the price of inputs used by farmers. In this study, the average price of seed is Rp47,000/kg with the lowest price range Rp 20,000/kg and the highest Rp 80,000/kg with the use of seeds average 23.05 kg·ha⁻¹. The average price of chemical fertilizers covering Nitrogen, Phosphor and Potassium fertilizers is almost the same and ranges from Rp3,000/kg (average of Nitrogen Rp 3,811/kg, Phosphor Rp 3,600/kg and Rp 3,900/kg of Potassium), while the average price of Pesticides is Rp 53,102/kg. The average use of Nitrogen is 367.44 kg·ha⁻¹, Phosphor is 11.83 kg·ha⁻¹, Potassium is 32.63 kg·ha⁻¹ and Pesticide is 1.14 kg·ha⁻¹. The average price of manure is Rp 121.67/kg, where the price is the only calculated price, because the manure used by some farmers is an input that is not purchased in real terms by farmers. On the other hand, the level of wages of labor applicable and issued by farmers in the research location is quite low, on average of Rp 31,833.33/HOK with the lowest wage of Rp 30,000/HOK and the highest is Rp 35,000/HOK. Based on the average price and the amount of input used by farmers, the result of this study indicates that the largest components of production costs in dryland maize farm is labor cost, then the cost of Nitrogen fertilizer, so that the average cost incurred by farmers for maize farming in dry land is Rp 2,033,574.53/season or Rp 4,729,243.10/ha/season.

3.2. Output, revenue, income and gross margin of dryland corn farm

The output of farming is product/commodity as the result of final output obtained by farmers from a series of production processes in managed farming. High low output is strongly influenced by natural factors, the ability of managers and inputs used. Some indicators that can be used to see the success of farming and have linkages with indicators of farming performance include: the amount of revenue (revenue), farmers income and gross margin.

From the results of this study, it was found that the production (output) and productivity of dryland maize in the research location of Kalitengah Village, Panggungrejo Sub-district, Blitar Regency is still relatively low compared to the expected potential, although the productivity is still higher than the productivity of dryland maize in other areas, especially the productivity at the Panggungrejo Sub-district in general.

Compared with productivity in other similar areas, for example at Sungai Penuh District Kerinci Regency Jambi Province, the productivity of dryland maize at the research location without biochar application is higher 51.23 percent, while at the Panggungrejo District level is higher 31.36 percent. Average output and productivity of maize in Kalitengah Village is 1,058.13 kg or 2,460.77 kg·ha⁻¹, while productivity at Panggungrejo Sub-district is 1,689 kg·ha⁻¹, and productivity in other area is Sungai Penuh District Kerinci Province of Jambi is 1,200 kg·ha⁻¹. On the other hand, dry land potential based on research from BPTP South Sumatra (2017) is in the range of 5 to 7.6 tons·ha⁻¹. Thus, the productivity of dryland maize produced by farmers from the study sites is still far below the minimum standard of potential dry land expected productivity. After the application of biochar as ameriolant, the average of maize production increases as 1,156.83 kg or 2,690.30 kg·ha⁻¹, it increased of 8.53 percent.

The final part of the farming process is the achievement of the goal of a good farming performance and encouraging, that farmers do not get losses even highly expected is the achievement of high income and profits. The reason is, with the income and profits, the farmer will be able to finance his farming in the next period. This is the primarily expectation in the research sites that farmers get less favorable of natural problems. Because fixed cost does not take into account, then the margin is as gross margin, not profit. Analysis of revenue, income and gross margin of dryland maize farming is presented in table 2.

Table 2. Average revenue, income and gross margin of dryland corn farm.

Description	Total (Rp/ha)
Average Revenue	9,432,600.77
Average Income	5,696,564.77
Average of Gross Margin	4,703,357.69

Source: Research Result (2016)

At the average of output selling price of Rp 3,561.66/kg, the average revenue of farmers is Rp 9,432,600.77/ha. Subsequently, at an average cost of Rp 4,729,243.10/ha, farmers received a difference between revenue and costs on dryland maize farms on average of Rp 5,696,564.77/ha as an income. To evaluate whether managed farming can compete with similar farms in other areas, a gross margin analysis of farming can prove it and on average gross margin received by farmers amounted to Rp 4,703,357.69/ha. Revenue and gross margin compared to the regional minimum wage in Blitar Regency of Rp 1,520,920/month is still relatively small. If the income is divided into 4 months according to the maize farming period, the farmer will only earn Rp 1,424,141.19/month and receive the gross margin of Rp 1,175,839.42/month, which is lower than the regional minimum wage applicable in the research location. However, the revenue, income and gross margin are higher or there is improvement after biochar application as the last achievement before biochar application: the revenue, income, and gross margin average were Rp 8,065,713.19/ha, Rp 4,329,677.19/ha, and Rp 3,449,706.14/ha. Therefore, the application of biochar and manure are the alternative solutions as they are implicit input and can be produced by farmers independently for the productivity improvement and

farming sustainability in dry land. The application of biochar and manure as ameliorant has positively impact for farming as there is input efficiency as well as economically improvement of maize performance in dry land. This poses a challenge for the government and other stakeholders to improve the competitiveness of dryland farming to be more productive in order to avoid land conversion and the transfer of professions for farmers who may be able to encourage other problems.

3.3. Labor productivity, revenue and cost ratio, gross margin and cost ratio, breakeven point analysis of dryland corn farming

The results of analysis of dryland maize farm performance with labor productivity indicator, revenue cost ratio, gross margin cost ratio and break even point, which is an integral part of the previous analysis is presented in table 3.

Table 3. Performance analysis of dryland corn farm.

Description	Total
Average of Revenue Cost Ratio (R/C)	1.99
Average of Gross Margin Cost Ratio (GM/C)	0.99
Labor Productivity based on Revenue (Rp/HOK)	172,600.19
Labor productivity based on Output (kg/HOK)	49.23
Break Even Point (BEP) of Price (Rp/kg)	1,757.89
Break Even Point (BEP) of Output (kg·ha ⁻¹)	1,327.82

Source: Research results (2016)

The result of dryland maize farming analysis with biochar and manure application has performance by showing a good revenue cost ratio, indicates that corn farming is feasible to be developed. Based on the result, showing that every Rp 1 cost incurred by farmers to manage the farm will be obtained revenue of Rp 1.99. There is improvement of RCR value as percentage of 14.57 while the achievement before biochar application was 1.70. The indicator is still reinforced by the next indicator of the gross margin cost ratio of 0.99 which means that 99 percent of gross margin will be received by farmers from the expenditure of 100 percent of costs on dryland maize farming with biochar and manure. There is improvement of 24.24 percent comparing before biochar application was 0.75.

In this study, the average production cost is Rp 4,729,243.10/ha while the average gross margin received by farmers is Rp 4,703,357.69/ha. In order to ensure if this business is feasible to do is a comparison and reference that can strengthen the reason for dryland maize farming is the interest rate from *Bank Rakyat Indonesia* (BRI) which is the only government commercial bank operating up to the research location. At the time of the study conducted, interest rates savings rural savings (*Simpedes BRI*) is 1 percent per month. If the farmer keeps the money held as a savings in the bank, then with the deposit and balance in the farmer's account of Rp 4,729,243.10 farmers will receive a monthly savings of Rp 47,292.43. For 4 months saving the farmers will get accumulated interest of savings amounting to Rp 189,169.72 before deducting administrative costs. If the money is used for dryland maize farming, then for 4 months will produce gross margin of Rp 4,703,357.69 and the amount is much larger and more useful than just saved as savings. The benefits obtained in addition to greater gross margin, are farmers working and avoiding unemployment, owned land remains productive and there is a guarantee of the main source of livelihood for the farmer's family, while the long-term benefits are broader to support the attainment of self-sufficiency in food from government programs in order to improve people's welfare. If the gross margin obtained by farmers from dry land farming that will continue to grow, it will be able to motivate farmers to gain profits, and some of the profits received can be saved as a savings without having to leave the farm as the main source of family livelihood.

The result of labor productivity analysis based on the revenue and output shows that the use of labor in dry land maize is classified as productive. This is evidenced by the productivity value of Rp 172,600.19/HOK based on revenue and 49.23 kg/HOK based on output. This value means that the

contribution of income from each labor usage is Rp 172,600.19/HOK where the average labor usage is 23.5 HOK/ha, so that the total contribution of revenue from the use of labor is Rp 4,056,104.46/ha. This is reinforced by the value of labor productivity based on output of 49.23 kg /HOK which if multiplied by the average output price of Rp 3,561.66/kg will produce the same revenue. The use of labor is said to be productive because labor contributions to output and farm revenues are greater than labor costs incurred by farmers to pay wages. This reinforces the importance of the role and function of labor in every business. There is a progress of labor productivity, based on increased revenue of 14.49 percent of Rp 147,588.53/day of labors, and the increased output of 8.53 percent, comparing before biochar application was 45.03 kg/day of labors.

Breakeven point of dry land maize farm based on result of analysis when output price equal to Rp 1,757.89/kg and output equal to 1,327.82 kg·ha⁻¹. The actual output generated an average of 2,690.30 kg·ha⁻¹, while the average output price is Rp3,561.66/kg. Based on the break even point value will be generated average production cost of Rp 4,729,243.10/ha which is equal to the average revenue of Rp 4,729,243.10/ha. In the previous discussion it is said that the average farm income of dryland maize farm at the research location is Rp 9,432,600.77/ha. Therefore, based on the above indicators, the dry land maize farming in the study sites is feasible to develop. There is improvement of BEP price and output: 6.29 percent and 5.71 percent, since before biochar application were Rp 1,875.84/kg and 1,408.29 kg·ha⁻¹. The analysis this result empowers the importance of biochar as ameliorant in order to support the productivity and the farming in dry land sustainably.

In the long run, whether corn farming in dry land can still be developed or not, it can be analyzed by using sensitivity analysis, based on the inflation rate or the consumer price index (CPI) at the national level, as well as in each region level. National inflation rates contributed by food commodities during 2014, 2015 and 2016 are 10.57; 4.93; and 5.69, respectively. In the other hand, the size of the consumer price index fluctuates and differs over time in each region. By using the results of the above farm performance analysis and it compares with the highest inflation of 10.57 occurring in 2014 and the assumption of *ceteris paribus*, dryland maize farming at the study site can be maintained and feasible to develop. This is based on the break even point value of the price at which the BEP value of the output price is Rp 1,757.89/kg or 49.36 percent of the average output price at the farm level, which means that if the output price falls more than 49.36 percent, dryland maize farming at the new research sites has reached a break-even point and farmers have not suffered losses. The farms will suffer losses if output prices fall by more than 49.36 percent. With the same assumption that the price of output rises with an increase equal to the amount of inflation, then the farmer will actually gain the benefit. The similar thing will be happened if production costs increase by 49.36 percent (*ceteris paribus*), then the farmer will get break even point where the total revenue will be equal to the total cost. The farmers will suffer losses if production costs rise more than 49.36 percent. However, if production costs only increase by the number of rate of inflation, then farmers still gain the gross margin.

4. Conclusion

The application of biochar and manure as ameliorant on farming land has technically benefit as well as technically benefit of pH soil improvement, cation exchange capacity, physic, chemist, and biological soil characteristics, meanwhile it increases economically yield and it gives better economically performance. Dryland maize farms with biochar and manure in this research showed a good performance based on several indicators, including revenue cost ratio which is greater than 1 (it is equal to 1.99). The value of the gross margin cost ratio is positive (0.99) and greater than the prevailing bank interest rate, the use of labor is productive with the value of productivity based on output of 49.23 kg/HOK and based on revenue of Rp172,600.19/HOK. The value of labor use productivity is greater than the real wages incurred by farmers to pay for labor. Thus, dry land corn farming with biochar and manure is feasible to be developed.

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