# Feasibility of corn farming in Jember District, East Java

*Anggi* Sahru Romdon[1], *Afrizal* Malik[1], *Moh.* Saeri[1], *Joko* Triastono[1], *Intan* Gilang Cempaka[2], and *Munir* Eti Wulanjari[1,*]

[1] Research Center for Behavioral and Circuler Economics, National Research and Innovation Agency, Jl. Jendral Gatot Subroto, No.10 South Jakarta-12710
[2] Research Center for Horticultural and Estate Crops, National Reseach and Innovation Agency, Jl. Raya Jakarta-Bogor, Cibinong, Kabupaten Bogor-Indonesia 16915

**Abstract.** The research is focused on assessing the feasibility of corn cultivation. This research was conducted through a survey using a simple random sampling method involving 47 farmers. The survey was conducted in October 2020, and primary and secondary data were collected. Primary data included details about the respondents, characteristics of corn farming, and input-output data was taken from the third Planting Season (July-September 2020). Secondary data was sourced from relevant agencies associated with the research. Descriptive analysis was used to assess the data on the respondents and farming characteristics, while financial analysis was applied to the input-output data to evaluate the viability of the farm and determine the breakeven point for production and price. The results showed: a) corn productivity at 7,200 t/ha grain yield, b) R/C ratio of 1.58, d) BEP price at IDR 3,130/kg, and BEP production at 4,453 kg/ha. As per the criteria of >1, the research concludes that corn farming is economically viable in this case.

## 1 Introduction

The corn commodity plays a crucial role in the national economy and can act as a source of foreign exchange in the international, national, and regional markets. Corn ranks as the second most vital food crop after rice and serves as a source of food, animal feed, and industrial raw materials [1] [2][3].

As a food source, corn is consumed in the form of processed kernels and vegetables from young cobs, and in certain regions such as East Nusa Tenggara (NTT), North Sulawesi, East Java, and Central Java, corn still serves as a staple food [3]. Corn also plays a vital role in various industries, serving as a raw material for animal feed (greenery and seeds), industrial raw materials, vegetable oil, starch, and beverages[4] [5] [6].

The contribution of East Java to the national corn production was 6,131,163 tons, accounting for 31.26%, making it the largest contributor in Indonesia [7], Corn production in East Java is generally distributed in almost all city districts. Jember District is the second largest contributor with a production of 427,064 tons, following Tuban District with a

* Corresponding author: ewulanjari@yahoo.com

production of 506,966 tons [8]. The average corn productivity in Jember District is 6.19 tons/ha [9], which is higher compared to the national average of 5.14 tons per hectare. However, this figure is still lower when compared to the productivity obtained from research, which ranges from 8.5 - 11.0 tons/ha [10].

The problem in corn farming in Jember Regency lies in the less-than-optimal production pattern; many farmers cultivate corn not based on recommended practices [11]. In addition, farmers face challenges such as rising production costs for needs like fertilizers, seeds, pesticides, and labor. Given the limited capital owned by farmers, it's not easy to expand farming into large-scale operations [12]. Considering these factors, research on the performance and sustainability of corn farming in the lowland agro-ecosystem area of Jember Regency is necessary. The aim of this study is to examine the performance and feasibility of corn cultivation in Jember Regency.

# 2 Methodology

## 2.1 Location and time of research

The feasibility study of corn farming was conducted in October 2020. The research location was in Wuluhan Sub-district, with a focus on 47 respondents. These respondents were farmers who have been continuously cultivating corn for the past two years.

## 2.2 Method of collecting data

The collected data comprises both primary and secondary data. Primary data collection is conducted via surveys and field observations. Surveys are focused on gathering data and information related to respondent characteristics, cultivation activities, and and input - output data was taken from the third Planting Season (July - September 2020). Field observations are carried out to reinforce survey results. Secondary data is collected from both technical institutions and other entities related to the research and publication data. This secondary data includes regional demographic data, harvest area data, production and productivity data, and other data supporting research activities.

## 2.3 Data analysis method

The data of farmers characteristics was evaluated using descriptive analysis, while the economics data were analysis using qualitative quantitative methodologies to provide a comprehensive overview of both inputs and outputs. Qualitative analysis was employed to evaluate quantitative variables using basic statistical parameters such as percentages, maximum and minimum values, average values, and average growth, executed by the revenue and cost (R/C) balance analysis method.

Analysis of corn farming is computed using formulas [13] [14] [15]:

$$Revenue = QPq - (\Sigma XiPXi + \Sigma YiPYi) \quad (1)$$

Where:
Q = Total corn production (kg/ha)
Pq = Corn production price (IDR/kg)
Xi = Variable input type for corn farming Xi (i = 1,2,3,…,x)
PXi = Variable input prices for Xi's corn farming (i = 1,2,3,…,p)

Yi = Type of fixed input on corn farming Yi (i = 1,2,3,…,y)
Pyi = Fixed input prices on corn farming Yi (i = 1,2,3,…,p)

Moreover, analyses of both breakeven price (TIH) and breakeven production (TIP) were performed. The purpose of the analysis in corn farming is to establish the correlation between production costs and sales volume as well as revenue, thereby enabling the understanding of profit levels and the viability of the business [13] [16] :

$$TIP = \sum Bi/HP \; dan \; TIH = \sum Bi/P \quad (2)$$

Where:
TIP = Production Break-Even Point,
TIH = Price Break Even Point,
B = Farming costs,
P = Production,
HP = Price of output and
i = Cost component index.

# 3 Result and discussions

## 3.1 Overview of the research site

Geographically, Jember Regency is situated between 113°15'47"–114°02'35" East Longitude and 7°58'06"–8°33'44" South Latitude. The regency is comprised of 31 sub-districts, spanning an area of 3,293.34 Km2, and is home to a population of 2,450,668 people (1,204,675 males and 1,245,993 females).

Wuluhan Sub-district, part of Jember Regency, has a population of 120,494 people and covers an area of 88.99 km2. The majority of Wuluhan's inhabitants are farmers or farm laborers. Predominantly, farmers cultivate food crops like rice, corn, and soybeans. Wuluhan Sub-district is recognized as a significant hub for corn cultivation in Jember Regency. In 2022, it had a recorded corn planting area of 7,424 ha with a productivity level of 6.62 tons/ha [17]

## 3.2 Characteristics of corn farmers

Differences in terms of age and level of education characterize farmer identity. The age of the respondent farmers at the study sites ranged from 25-62 years. If disaggregated into productive and less/unproductive age groups, most respondents (80%) are at a productive age (20–55 years). This condition is quite supportive in corn commodity farming activities. According to [18], the age of the productive category is 25-50 years.

The formal education levels of the respondents were as follows: junior high school (46.80%), high school (31.90%), elementary school (14.9%), and university/diploma (6.4%). Theoretically, the level of education can affect the adoption of technology, with the assumption being that higher levels of education will lead to greater technology adoption. However, there are often many other influencing factors [19] [20]. Furthermore, [21] stated that training in agriculture also enhances the efficiency of technology adoption.

Experience in farming plays a significant role in determining the success of agricultural activities, as with experience, farmers become more skilled in handling potential challenges and obstacles [22]. The farmers' experience in corn farming ranged from 5-27 years, with an average of 16 years. Given their experience, these farmers are generally considered quite adept at adopting corn technology, although this heavily depends on their capacity to

implement such technological innovations [22][23] [24].

Farmers learn corn cultivation from various sources, including field agricultural extension officers and electronic media information. Their motivations to cultivate corn vary and can be categorized into technical and economic reasons. The technical reasons include the feasibility of intercropping corn with other crops, the relatively low risk of pest attacks, and the ease of maintenance. The economic reason is that corn provides a quick cash source as it can be sold by slashing the land and grown during the dry season (PS-III).

In terms of individual corn plantation development, three trends are observed. Some farmers steadily increase their corn plantation area each year, while others experience a decline in the area. Yet, some farmers maintain a stable corn plantation area, as it is primarily used for rice cultivation. Those expanding their corn plantation area generally do so for reasons such as increasing production and income, fulfilling orders, and optimizing available land during the dry season, especially when marketing the commodity is not a challenge.

### 3.3 Corn Farming performance

Farmers in Wuluhan Sub-district typically cultivate their land three times a year. In the third Planting Season (PS III), they typically grow crops or vegetables. The most common cropping patterns observed are rice-rice-corn, rice-rice-peanuts, rice-rice-vegetables (like cabbage), and rice-rice-watermelon.

Farmers tend to use inputs based on their own capabilities and often do not adhere to recommended fertilization dosages, which is evident from the discrepancies with the recommended guidelines (Table 1). According to the Agricultural Research and Development Agency [25], the recommended fertilization for corn commodities in lowland rice areas such as the Wuluhan Sub-district are 300 kg Urea + 100 kg ZA + 100 kg SP-36 + 50 kg KCl per hectare or NPK (15:10:12) which includes 300 kg of NPK + 200 kg of Urea + 100 kg of ZA; or NPK 15-15-15, which includes 250 kg of NPK + 225 kg of Urea + 100 kg of ZA. The underuse of inputs, especially fertilizers, in corn farming in the research area can be attributed to a shortage of capital required for fertilization and insufficient dissemination of fertilization recommendations.

The land used to grow corn is privately owned ranging from 0.2 to 1.2 ha (average of 0.38 ha). During the study period, the rental price for this land was IDR 12,000,000/ha/MT, a value calculated in this study. Tillage is carried out with minimal tillage after planting lowland rice (PS-II), and the distance between the first and second tillage ranges from 7-15 days. This minimal tillage method after lowland rice cultivation can reduce labor input [26].

The intensification of corn cultivation can be seen using superior seeds and fertilization. With proper management, yield gaps can be reduced, thereby enabling potential outcomes to be achieved. Availability of seeds is not a major problem, as they can be obtained easily at the nearest kiosks in the village. However, seed prices are relatively high because farmers use hybrid corn seeds from brands such as NK-Perkasa, Bisi-2, Bisi-18, and NASA-29.

Farmers in the study area generally plant maize with varying spacing configurations, but the dominant ones are 75x20cm, 75x20cm, 60x30cm, and 65x25cm, with 1-2 seeds per hole. The fertilizers used are Phonska and Urea, while organic fertilizers such as compost or manure are usually not used. Corn croppings are used by farmers as cattle feed. Fertilization is done in two ways, namely (1) watering between plants, and (2) applying fertilizer near the base of the plant with 5-10 cm. Fertilizer is given twice: (1) 15-25 days after planting (DAP), and (2) 40-50 DAP. In terms of postharvest handling, farmers generally dry corn. Corn is dried like cobs in yards or on village roads using mats or tarpaulins which are minimal means of drying. After drying, the corn is threshed using a threshing machine.

Farmers in this region have been cultivating maize for a long time, and their motivation goes beyond purely economic reasons. They are attracted to maize farming because of its low maintenance nature, the relatively lower risk of pest attack, and the ability to control the use of inputs. These factors contributed to the steady, albeit slow, development of maize cultivation, especially in the third planting season (PS-III). The area of corn farming planted by farmers from year to year only shows a slight increase. This can be attributed to several challenges, including a shortage of family labor to manage the farm, uncertainty over crop prices, high costs of production inputs, and capital constraints.

### 3.4 Economic Feasibility

The productivity of husked ears of corn was 7.2 tons/ha (15% KA) at a price of IDR 4,950/kg during the period of research. This productivity is higher than the data from [27], which reported a yield of 6.19 tons/ha. However, this result is still lower than the potential productivity as per the research of [28], which produced 9.1 ton/ha. The productivity of corn is influenced by the varieties and the type and quantity of fertilizers used.

The smallest expense incurred by farmers in corn farming is the cost of purchasing fertilizers and pesticides, followed by the cost of purchasing seeds. Labor contributes to 24.95% of the total costs, with the most significant expense in corn farming at the research location being land rent, which accounts for 53.26% of total expenses. One of the production factors that significantly contribute to farming is land [29]. In this case, the size of farm production is related to the narrow area of land used in farming, particularly corn. Other factors include the use of high-yielding varieties and balanced fertilization with optimal labor use [30].

**Table 1.** Analysis of Corn Farming in Wuluhan District, Jember Regency PS-III 2020 (per hectare).

| | Discription | Physical | Value (IDR) | Percentace |
|---|---|---|---|---|
| **A** | **Production costs** | | | |
| | Seed (kg) | 22 | 1,870,000 | **8.29** |
| | Fertilizer | | 1,495,200 | **6.63** |
| | **-Phonska** | 415 | 996,000 | |
| | -Urea | 208 | 1,495,000 | |
| | Pesticide | | **1,550,000** | 6.87 |
| | - Buldox (bottle) | 4.5 | 1,125,000 | |
| | - Spontan (bottle) | 5 | 425,000 | |
| **B** | **Labor cost** | | **5,625,000** | 24.95 |
| | - Tillage (hand tractor) | | 1,200,000 | |
| | - Planting (person per day) | 15 | 525,000 | |
| | - Weeding (person per day) | 20 | 700,000 | |
| | - **Harvest** | | 2,400,000 | |
| | - Threshing | | 800,000 | |
| | Land lease | | 12,000,000 | **53.26** |
| | **Total Cost** | | **22,540,200** | |
| **C** | Revenue (Production (kg) x(Price IDR 4,950/kg) | 7.200 | 35,640,000 | |
| | Profit (revenue-Total cost) | | 13,099,800 | |
| **D** | **R/C (Revenue/total cost)** | | **1.58** | |

Based on the provided data, the farmer's income is estimated to be IDR 13,099,800 per season, which implies a monthly income of IDR 3,274,950 for the farmers. This finding aligns with a study conducted by Kune (2017), which revealed that the average income of corn farmers in the Miomaffo Timur sub-district, TTU Regency, was IDR 13,546,630.43

per season.

The income analysis reveals that the Revenue-to-Cost (R/C) ratio is greater than 1, specifically 1.58. This indicates that corn farming is profitable for farmers at the research location, suggesting its feasibility and suitability given the land conditions and sufficient water availability. The R/C ratio value could be even higher if land rental costs were not included.

This finding aligns with several other studies on corn farming, which have demonstrated the feasibility and profitability of this type of agriculture. For instance, [31] found that corn farming in Pattilanggio District had an R/C value exceeding 2, signifying its profitability and feasibility. Similarly, [32] demonstrated in his research in East Lombok Regency that corn farming was financially profitable, boasting an R/C ratio of 1.22. [33] reported that corn farming in Bumi Harjo Village, Kumai District, West Waringin Regency, was feasible, with an R/C ratio of 7.1. Furthermore, [34] study showed that Bima URI2 corn farming in East Nusa Tenggara was viable, with an R/C ratio greater than 1.

**Table 2.** Analysis of TIH and TIP of corn farming in Wuluhan District, Jember Regency (PS-III 2020).

| No | Discription | Value |
|---|---|---|
| 1 | Total Cost (IDR) | **22,540,200** |
| 2 | Production (kg/ha) | **7,200** |
| 3 | Actual price (IDR/kg) | 4,950 |
| 4 | Production breakeven point (TIP) | 4,553 |
| 5 | Price breakeven point (TIH) | 3,130 |

The breakeven points for both price (TIH) and production (TIP) of corn are lower than the current market price (as seen in Table 2). This suggests that, provided the cost structure remains stable, corn farming can be effectively managed and profitable. The price of corn during the study was IDR 4,950/kg, and the breakeven price was IDR 3,130/kg, indicating that the minimum selling price to cover costs is IDR 3,130/kg. This finding contrasts with [35] study on corn farming in Pancur Batu District, Deli Serdang Regency, which showed a production breakeven point of 2,130.53 kg and a breakeven price of IDR 1,069.95. This discrepancy is likely due to differences in the total costs.

### 3.5 Corn marketing/ Sales of crops

Corn is typically sold in bulk, and the sale is closely linked to the relationship between the farmers and potential buyers. As stated by 99% of the respondent farmers, they sell corn mainly to fulfil orders. The remaining 1% sell their corn produce directly to avoid high transportation costs. Payment methods from buyers to farmers are generally conducted in cash. If there is any deferred payment, it typically does not exceed a period of 7 days. The location for receiving payments varies, but most often, it is done at the farmers' premises.

There exist three possible relationships between farmers and buyers: (a) farmers solely act as sellers, (b) farmers receive financial assistance from buyers, and (c) buyers act as customers without any obligations to the farmers. Based on farmer interviews, condition (a) appears to be the most common. However, corn sales by farmers are typically executed per the buyers' orders. This suggests that a collaborative relationship exists between the farmers and buyers. The nature of this relationship is still under investigation, as farmers may feel indebted due to receiving financial assistance from potential buyers, or due to other factors.

## 4 Conclusion

The average size of corn farms in Jember Regency is 0.38 ha per farmer. The farmers use minimum tillage soil management practices and high-yielding varieties of corn. The

fertilization practice involves the usage of Phonska fertilizer (415 kg/ha) and Urea (208 kg/ha). The productivity of husked corn ears is 7,200 tons per hectare, and the Revenue-Cost (R/C) ratio is greater than 1, indicating profitability.

However, the break-even price point (TIH) is IDR 3,130 per kg, and the production break-even point (TIP) is 4,453 kg per hectare. This implies that farmers need to produce at least 4,453 kg per hectare and sell it at a minimum price of IDR 3,130 per kg to cover their costs. Productivity, although significant, is not at an optimal level because farmers have not yet fully mastered the technology to increase productivity. As a result, it is necessary to promote innovations to boost productivity among farmers. It is also worth noting that traders mainly determine the price of corn at harvest time. It is crucial to provide farmers with tools and knowledge to negotiate better prices and improve their overall income from corn farming.

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