



UNDERSTANDING THE DRIVES OF CONTRACT FARMING PARTICIPATION AND ITS INCOME EFFECTS ON TRADITIONAL FARMERS IN MADURA, INDONESIA

MARDIYAH HAYATI^{1*}, MOHAMMAD WAHYU FIRDAUS², TAUFIK RIZAL DWI ADI NUGROHO¹, DIAN ESWIN WIJAYANTI¹, DESI RAMADHANI² AND RAVITA NILA ASWAR², SYAUQI AGUNG FIRMANDA², HENDRA HENDRA³ AND NI PUTU RIZKY ARNANI⁴

¹Agribusiness Study Program, Faculty of Agriculture, Universitas Trunojoyo Madura, Bangkalan, Indonesia

²Agriculture Socio-Economic Department, Faculty of Forestry and Agriculture Bio-Industry, Universitas Brawijaya, Malang, Indonesia

³Postgraduate School, Universitas Brawijaya, Malang, Indonesia

⁴Department of Psychology, Universitas Trunojoyo Madura, Bangkalan, Indonesia

*Corresponding author: mardiyah@trunojoyo.ac.id

ARTICLE INFO	ABSTRACT
Article History: <i>Received: 28 November 2024</i> <i>Revised: 19 September 2025</i> <i>Accepted: 30 June 2026</i> <i>Published: 15 August 2026</i> Keywords: <i>Contract farming, impact evaluation, traditional farmers</i>	The issue of market access in maize farming has persisted for a long time, particularly due to limited information and market channels, especially for small-scale farmers in rural areas. These limitations often force farmers to sell at lower prices to middlemen and direct markets. The contract farming scheme has emerged as a solution to address these market access challenges. This study aims to estimate the factors influencing farmers' decisions to join contract farming schemes and to compare their farm incomes. The research involved 100 small-scale maize farmers in Pamekasan and Sumenep Regencies on Madura Island. Probit regression analysis revealed that farmers' participation in contract farming was positively influenced by socioeconomic factors such as family size, farming experience, social activity, access to loans, and bank accounts. In contrast, off-farm income had a significant negative impact on the likelihood of farmers joining contract farming. Propensity Score Matching (PSM) analysis indicated that contract farming had a positive effect on farmers' income, with an Average Treatment Effect on the Treated (ATT) value of 196.636 USD per planting season using the Nearest Neighbour Matching (NNM) method and 182.201 USD per planting season using the Kernel-based Matching (KBM) method. Overall, these findings indicate that contract farming provides significant benefits by offering farming inputs, training, cultivation monitoring, and purchasing outputs, ultimately increasing the incomes of traditional maize farmers on Madura Island. Therefore, promoting contract farming is crucial for enhancing the economic well-being of small-scale maize farmers in rural areas.

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Introduction

The limited market access faced by small-scale and traditional farming in rural areas has become a significant challenge (Otegunrin *et al.*, 2019; Ritter *et al.*, 2019). Maize, one of the key agricultural commodities, plays a crucial role in the rural economy. In many cases, farmers rely solely on agriculture as their main livelihood, leading to a high dependence on income from the agricultural sector. However, market access for their produce often encounters obstacles. One of the main reasons for this is the lack of formal marketing institutions, such as agribusiness companies, that are accessible to farmers to help distribute their products. Furthermore,

field observations indicate that traditional marketing institutions, such as middlemen and local retailers, cannot provide price certainty for farmers' produce. As a result, the ongoing issues of limited market access and price uncertainty pose a serious threat to farmers' income (Aku *et al.*, 2018; Nandi *et al.*, 2021). This is especially true for the majority of maize farmers on Madura Island, who are small-scale farmers with limited access to agricultural land, capital, and labour.

In such conditions, efforts are needed to secure new, more profitable marketing channels than traditional institutions such as middlemen and retailers. Contract farming, a marketing partnership agreement between farmers and agribusiness companies as buyers, has been viewed as a solution to provide small farmers with new market access through various cooperative schemes that offer higher value returns. Additionally, contract farming can help minimise the risks of price fluctuations and production uncertainties (Hoang, 2021). Agribusiness companies also have greater access to resources compared to individual traditional marketing institutions. Building on this, contract farming focuses on the marketing of agricultural produce and, in some cases, provides additional benefits to farmers, such as the provision of inputs and cultivation training. In this context, contract farming impacts farmers' direct monetary income and grants easier access to inputs and knowledge (Swinnen & Maertens, 2007; Ragasa *et al.*, 2018).

On a deeper level, contract farming contributes to reducing hunger and poverty, improving household food security, boosting agricultural productivity, and enhancing the social influence of farmers (Abebe *et al.*, 2013; Ton *et al.*, 2018). Although agribusiness investments in contract farming schemes with farmers are popular in many developing countries, they are not widely adopted in Indonesia. This is especially evident in smaller regions such as Madura Island. Several studies on contract farming in developing countries have been published (Mwambi *et al.*, 2016; Khan *et al.*, 2019; Nhan & Yutaka, 2019; Selorm *et al.*, 2023).

Therefore, efforts to increase farmers' knowledge of contract farming schemes, which would ultimately affect their income, as well as to encourage agribusiness companies to expand their cooperation, are essential. Despite the opportunities, farmers may have concerns regarding contract farming, particularly regarding compliance with contractual agreements (Bellemare & Bloem, 2018). While this scheme can enhance farmers' business capacity, could it also pose a threat if they fail to meet the contractual terms? Correspondingly, this paper will provide important empirical evidence on the positive impact of contract farming on farmers' income, which may further encourage small farmers to engage in contract farming.

Previous studies have indeed explored the contribution of contract farming to farmers' income. For example, research on contract farming in developed countries such as China (Miyata *et al.*, 2009) highlighted that more complex contract farming schemes require more stringent cooperation regulations. This makes it necessary for farmers to operate on a larger scale (Hoang, 2021; Selorm *et al.*, 2023). However, the situation differs for small-scale farmers. While studies on the impact of contract farming on small farmers' income have been conducted, such as by Mwambi *et al.* (2016) on fruit farmers in Kenya, minimal attention has been given to contract farming between buyer companies and small-scale food crop farmers, such as maize. In line with this, while some qualitative studies have been conducted (Bellemare & Bloem, 2018), econometric approaches may yield more precise results. Additionally, contract farming at smaller scales with larger-scale farmers involves different cooperation schemes. This emphasises an intriguing research gap to explore and an opportunity for future research. Moreover, this paper focuses on contract farming for food commodities, as other commodities such as vegetables, palm oil, and sugar have been previously studied (Cahyadi & Waibel, 2016; Mulatu *et al.*, 2017).

This research is crucial for addressing the research gap that previous studies have not been able to resolve. Following this, to promote farmers' participation in contract farming and uncover its positive impacts, this study is considered essential as a fundamental reference for policy formulation. This is particularly important for increasing contract farming participation and subsequently boosting agricultural productivity on Madura Island. In this paper, we have two main objectives. The first objective is to estimate the socioeconomic factors that influence farmers' decisions to participate in contract farming. Second objective is to estimate the impact of contract farming on farmers' income. This study has the potential to fill the research gap outlined in previous sections. Concurrently, to mitigate potential bias in farmers' decisions to participate in contract farming, which arises from the varying socioeconomic and demographic conditions of individual farm households, this study will also utilise the Propensity Score Matching (PSM) method, a technique proven effective in addressing this issue (Nugroho *et al.*, 2022; Wijayanto *et al.*, 2022; Rahman *et al.*, 2023).

Materials and Methods

Research Location

The research location was purposively selected to focus on areas with active contract farming arrangements, particularly companies involved in maize production on Madura Island. The selection of research sites was conducted using a multistage sampling method, following several steps. First, two main regions were identified as the research locations, where existing contract farming collaborations between companies and maize farmers were already in place. Pamekasan and Sumenep districts were selected to represent Madura Island. Second, within these districts, Lenteng Subdistrict was selected to represent Sumenep, while Larangan and Proppo Subdistricts were selected to represent Pamekasan (Figure 1). Third, 50 respondents were selected from each district, resulting in a total of 100 maize farmers for this study. Collectively, these respondents included both farmers participating in contract farming and those who were not.

Respondents were purposively selected with the assistance of extension workers and local administrators. While this approach facilitated

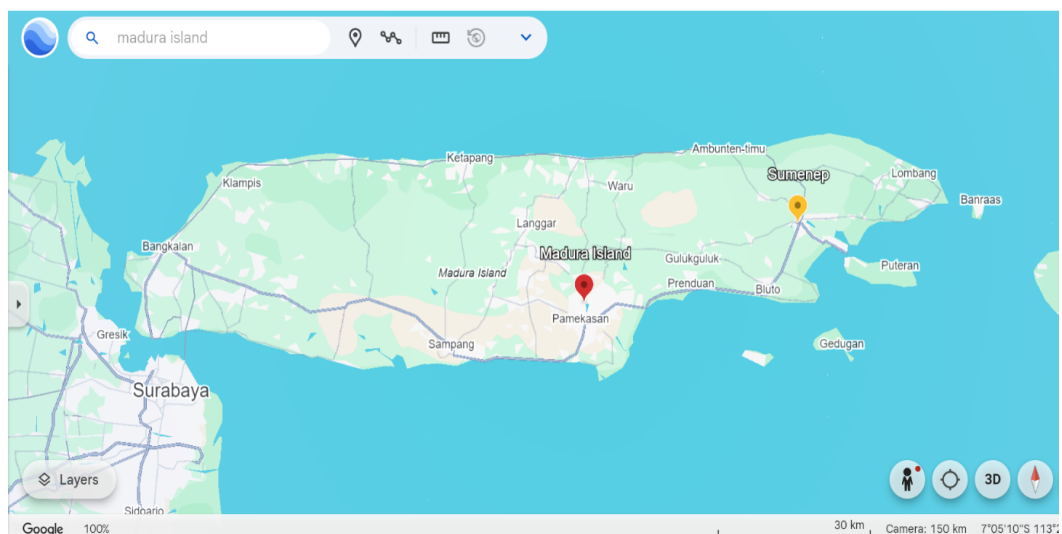


Figure 1: Map of Madura Island
Source: <https://earth.google.com>

access to contract and non-contract farmers, it may introduce selection bias, as farmers who are more engaged or connected may have been more likely to be included in the survey. Moreover, a structured interview or survey method was employed, using a questionnaire that focused on the primary research objectives. This includes farmers' socioeconomic factors, decisions to engage in contract farming, farming activities, access to resources, and other relevant aspects. In the data collection process, university students from nearby institutions served as field data collectors due to their familiarity with local farmers, especially regarding the language spoken in the research areas.

Data Analysis Method

To estimate the socioeconomic factors influencing smallholder farmers to participate in contract farming schemes, a probit regression analysis was employed. This method has been widely used by other researchers to address similar research objectives, as demonstrated in studies by Rahman *et al.* (2021) which own a fishing boat smaller or equal to five gross tonnages (GT, Loquias *et al.* (2022), and Wijayanto *et al.* (2022). Likewise, the use of this method is appropriate since the dependent variable, the smallholder farmers' decision to participate in contract farming, is binary (1 = Participates; 0 = Otherwise). The independent variables in this study include various socioeconomic factors such as age, education, land size, family size, annual income, off-farm employment, credit access, and capital loans, among others. The probit regression equation in this study refers to Equation (1) as follows:

$$A_i^* = X_i\alpha + u_i; A_i^* = 1 \text{ if } A_i^* > 0 \text{ and } 0 \text{ otherwise.} \quad (1)$$

The notation A_i^* refers to the decision of smallholder farmers to participate in contract farming with a company. A value of 1 indicates that the farmer decides to participate in contract farming, while 0 indicates otherwise. Meanwhile, the symbol α represents the vector of variables to be estimated in this study, and u_i is the error term. Furthermore, X_i denotes the

socioeconomic characteristics of the farmers, which are included in the probit regression model. These factors may influence the farmers' decision to engage in contract farming agreements with partner companies.

In the following section, two main stages were employed to assess the impact of participation in contract farming on farm income. In the first stage, the income levels of farmers, both those who participated in contract farming and those who did not, were estimated. Farm income was calculated as total revenue minus total farming costs. The econometric equation is referred to in model Equation (2) as follows:

$$\pi = TR - TC \quad (2)$$

The symbol π represents the income level of both contract farming and non-contract farming farmers, while TR stands for total revenue, and TC refers to the total cost incurred by farmers in their maize farming activities. In the second stage, the impact of farmers' participation in contract farming on their income was estimated. Since there may be concerns regarding self-selection bias in the farmers' decision to participate in contract farming, this issue was addressed using the PSM method. This method has been widely applied in similar impact evaluation studies. It has also proven effective in correcting self-selection bias between respondents who participate in contract farming (treatment group) and those who do not (control group), which in this study are smallholder farmers (Rahman *et al.*, 2022).

After estimating the socioeconomic factors influencing farmers' decisions to participate in contract farming, the PSM method calculates the propensity score for all farmer respondents in the subsequent stage. This score serves as a reference for determining which respondents are retained in or excluded from the model based on whether their propensity score exceeds the threshold. The econometric equation is presented in Equation (3) as follows:

$$P(X_i) = \text{Prob}(A_i = 1/X_i). \quad (3)$$

The notation $\hat{\theta}_i$ denotes the propensity score value for each respondent after estimation using the probit regression model Equation (1). The matching algorithm evaluates and excludes respondents with significantly different propensity scores (Bezabeh *et al.*, 2020; Rahman, Toiba, *et al.*, 2023). In this study, two matching algorithms were employed: Nearest Neighbour Matching (NNM) and Kernel-based Matching (KBM). In the subsequent stage, the PSM method calculates the Average Treatment Effect on the Treated (ATT) to compare the outcomes of the second research objective. It aims to assess the income of farmers involved in contract farming versus those not involved. The econometric equation for calculating ATT is referenced in Equation (4) as follows:

$$ATT = E\{Y_{1i} - Y_{0i} | A_i = 1\} = E[E\{Y_{1i} - Y_{0i} | A_i = 1, p(X_i)\}] = [E\{Y_{1i} | A_i = 1, p(X_i)\} - E\{Y_{0i} | A_i = 0, p(X_i)\} | A_i = 1]. \quad (4)$$

The decision of smallholder farmers to either engage in or refrain from contract farming is denoted by symbols Y_1 and Y_0 , respectively. The ATT method compares farm income outcomes between contract and non-contract farmers, based on the analysis conducted previously. ATT calculations use bootstrapped standard errors to estimate the differences from the matching methods applied earlier. Based on the research objectives, the following hypotheses were proposed. First, we hypothesised that farmers' household social, economic, and demographic factors significantly influence their decision to participate in contract farming schemes. Second, we hypothesised that contract farming has a significant impact on maize farm income. In this study, we utilised Microsoft Excel 2016 (<https://www.microsoft.com/id-id/microsoft-365/previous-versions/microsoft-office-2016/>) for data tabulation and STATA MP-17 (<https://www.stata.com/statamp/>) for statistical data analysis.

Results and Discussion

Descriptive Statistics

The definition and descriptive statistics of respondent characteristics for this study are presented in Table 1. Contract farming represents the farmers' decision to enter into marketing agreements and access new markets through partnerships with agribusiness companies. According to Table 1, of 100 smallholder maize farmers surveyed, 84 were engaged in contract farming, while 16 were not. Furthermore, the average age of the interviewed farmers is 51.39 years, with an average education level of 7.56 years, corresponding to a junior high school level. The average number of family members per household is 3, while the average farm income per planting season is 1,007.813 USD. The farmers have considerable experience, averaging 28.35 years (with a natural log value of 3.176). Additionally, 56% of the farmers are involved in activities outside the agricultural sector, such as running businesses, working as labourers, or in public and private sectors. In comparison, the remaining 44% are not engaged in non-agricultural employment. At the same time, the average annual income from these non-agricultural activities is 1,113.7 USD.

The average distance from farmers' homes to the nearest market or agricultural input store is 1,638 m or 1.63 km. Most farmers also keep livestock, including cattle, goats, sheep, and chickens, with an average of six animals per household (natural log value of 1.286). Notably, the majority of farmers do not own their agricultural land, with only 49% owning their land and 51% not owning it. Moreover, 55% of the farmers participate in farmer groups, 41% receive agricultural extension services, and 70% are involved in social groups, including religious, environmental, and security groups. Following this, 61% of the farmers have access to agricultural loans, 71% use the internet, and 32% have a bank account.

Table 1: Descriptive statistics of variables used in the study

Variable	Definition	Mean	Std. Dev.
Contract farming	Dummy (1 = Farmers participate in contract farming; 0 = Otherwise)	0.84	0.36
Age	Age of farmers (years)	51.39	13.15
Land	Land ownership area (ha)	0.494	0.701
Education	Level of education of farmers (years)	7.56	3.169
Income farm	Level of income from farmers' activity in one crop session (USD)	1,007.813	194.871
Family size	Number of family members (persons)	3.25	1.149
Experience	Level of experience of farmers (ln years)	3.176	0.686
Income off farm	Level of income from non-agricultural activity in one year (ln USD)	6.212	1.442
Livestock owner	Number of livestock (ln)	1.286	1.093
Distance agriculture market	Distance to agricultural markets (m)	1,638	1,183.795
Land status	Dummy, status land ownership (1 = Owner; 0 = Otherwise)	0.49	0.522
Non-agriwork	Dummy, family working in non-agriculture sectors (1 = Yes; 0 = Otherwise)	0.56	0.498
Farmers group	Dummy, participate in farmers group (1 = Yes, 0 = Otherwise)	0.55	0.5
Social activity	Dummy, participate in social activity (1= Yes; 0 = Otherwise)	0.7	0.46
Access loan	Dummy, access loan for farm activity (1 = Yes; 0 = Otherwise)	0.61	0.49
Consul farm	Dummy, farmers receive counselling (1 = Yes; 0 = Otherwise)	0.46	0.5
Internet	Dummy, farmers using internet (1 = Yes; 0 = Otherwise)	0.71	0.456
Account bank	Dummy, farmers have account bank (1 = Yes; 0 = Otherwise)	0.32	0.468

Table 2 presents the differences in characteristics between farmers who participate in contract farming and those who do not. Farmers participating in contract farming tend to be older and have more farming experience. Conversely, non-participating farmers have higher educational levels compared to their participating counterparts. Farmers involved in contract farming generally have larger family sizes than those who are not. However, non-participating farmers are more likely to have family members working in agriculture and to earn higher incomes from non-agricultural work. Farmers in contract farming also tend to have better access to loans, agricultural extension

services, social activities, and bank accounts. On the other hand, farmers involved in contract farming are less likely to be members of farmer groups or to use the internet.

Contract Farming Maize Farmers in Madura Island

Madura Island has long been known as a major maize-producing region in Indonesia. The island's climate and dry land conditions are conducive to maize cultivation, making farming a prevalent profession among its residents. Nonetheless, maize marketing on Madura Island has faced challenges, including direct sales to

Table 2: Mean difference in selected variables in this study

Variable	Participant	Non-participant	Difference	t-Value
Age	51.588	48.812	3.068	0.854
Land	0.485	0.54	-0.055	-0.288
Education	7.5	7.875	-0.375	-0.431
Income farm	1,033.387	873.545	159.841	3.138***
Family size	3.369	2.625	0.744	2.431**
Experience	3.229	2.895	0.334	1.807*
Income off farm	6.055	7.036	-0.98	-2.561**
Livestock owner	1.196	1.759	-0.562	-1.912*
Distance to agriculture market	1575	1968	-393.75	-1.222
Land status	0.488	0.5	-0.011	-0.083
Non agriwork	0.547	0.625	-0.077	-0.566
Farmers group	0.547	0.5625	-0.014	-0.108
Social activity	0.702	0.6875	0.014	0.117
Acces loan	0.654	0.375	0.279	2.129**
Consul farm	0.488	0.312	0.175	1.289
Internet	0.702	0.75	-0.047	-0.381
Account bank	0.357	0.125	0.232	1.836*

Note: *, **, *** denote significance on 10%, 5%, and 1% levels, respectively

markets and intermediaries, which have resulted in lower prices for farmers. Accordingly, the emergence of new market access through contract farming schemes offers a viable solution to improve farmers' prices, ultimately leading to higher incomes. The process of contract farming at the research location is illustrated in Figure 2.

Figure 2 illustrates the general process of contract farming activities between maize farmers and partnering companies at the research site. Both the company and the farmers, as marketing partners, have specific rights and obligations. The partnering company is responsible for providing agricultural inputs,

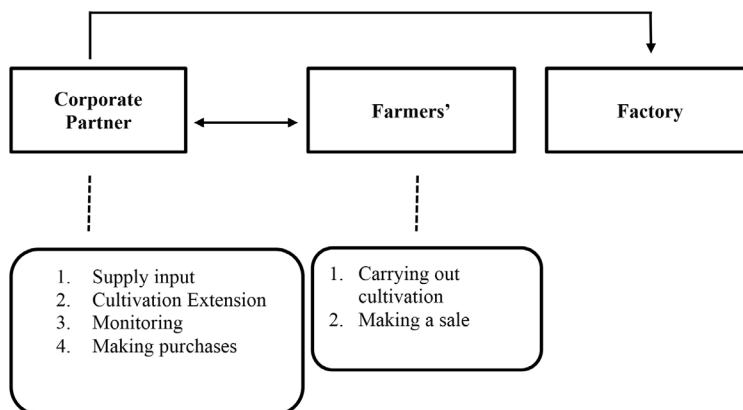


Figure 2: Contract farming process between maize farmers and partner companies

offering technical assistance for cultivation, monitoring and inspecting both the quantity and quality of the farming and production processes, and purchasing the maize produced by the farmers. On the other hand, the farmer partners are obligated to cultivate the maize and sell the harvested produce to the partnering company. In managing partnership marketing activities, the company employs field agents who collect produce from farmers, which is then purchased at the agreed price. Consequently, farmers are also required to adopt proper cultivation practices to ensure the quality of the produce meets the standards agreed upon with the company. The purchased maize is sent to or sold to factories in the company's target markets, including food processing factories and animal feed mills.

Factors Influencing Farmers' Participation in Contract Farming

The decision of farmers to participate in contract farming is characterised by self-selection, suggesting that it can be influenced by the socioeconomic and demographic characteristics of the farmers and their families (Ton *et al.*, 2018). To illustrate the factors that may affect farmers' decisions to participate in contract farming, probit regression analysis was employed, with participation as a binary dummy variable. A total of 17 independent variables were included in the probit model, of which six highlighted significant effects: Family size, experience, off-farm income, social activity, access to loans, and bank account ownership. Conversely, other variables did not have a significant impact. The results of the probit regression estimation are presented in Table 3.

Family size positively influences the probability of farmers joining contract farming, indicating that family labour can support agricultural activities, either as workers or owners. This allows for the expansion of farming capacity through contract farming. Additionally, contract farming is viewed as a marketing scheme that provides more stable returns, which is beneficial for larger families who require more stable and higher income. This finding

is further supported by other studies (Ermias, 2021). In line with this, farmers with more experience are also more likely to participate in contract farming compared to those with less experience, as summarised in Table 3. In addition, experienced farmers are more adept at expanding their enterprises and are likely to consider marketing systems that are more advantageous to them, which relates to their assessment of marketing systems and associated risks (Rayasawath, 2018; McCown, 2002). Moreover, farmers involved in social groups are more likely to gain broader information and development opportunities compared to those who are not members (Vu *et al.*, 2020). On a similar note, farmers' involvement in social activities also significantly influences the probability of joining contract farming. The results of this study are consistent with previous research by Pham *et al.* (2021) and Hoang and Nguyen (2023). In essence, farmers' social activities, such as participation in cooperatives, religious groups, discussion groups, and others, can enhance their access to information and increase their interest in engaging in contract farming.

Likewise, access to agricultural loans is a significant factor. Farmers who can obtain loans, whether through formal credit, informal loans, or other financing schemes, are better positioned to secure financial capital for enterprise development. This is also related to their need to meet the requirements of contract farming agreements with companies (Awotide *et al.*, 2015; Odhiambo & Upadhyaya, 2021). Owning a bank account, such as a savings or online bank account, increases the likelihood that farmers will choose contract farming. This can be supported by the assumption that farmers with bank accounts are more open to technological advancements and marketing collaborations, such as those reported in contract farming schemes (Ruml & Parlasca, 2022; Olaniyi *et al.*, 2024; Ameh *et al.*, 2025). This is related to the convenience of transactions and payments, which can be conducted online. Conversely, farmers with higher off-farm income are less likely to participate in contract farming (Woldeyohanes

Table 3: The factors influencing farmers' participation in contract farming: Probit estimation

Variables	Coefficient	Std. Error
Age	0.007	0.039
Land	0.165	0.347
Education	0.166	0.116
Income farm	0.000	0.001
Family size	0.946**	0.394
Experience	1.363***	0.774
Income off farm	-1.192**	0.467
Livestock owner	-0.222	0.244
Distance to the agricultural market	-0.000	0.000
Land status	0.000	0.467
Non-agriwork	-0.253	0.563
Farmers group	0.911	0.629
Social activity	1.572**	0.801
Acces loan	1.971**	0.848
Consul farm	-0.496	0.615
Internet	0.077	0.705
Account bank	1.176***	0.660
_cons	-1.924	0.465
LR $\chi^2(17)$	44.13	
Prob > χ^2	0.0003	
Pseudo R ²	0.501	
Number of obs	100	

Note: **, *** denote significance at 10% and 5%, respectively

et al., 2017). This may be attributed to their already stable income and their preference for flexibility, enabling them to have other sources of income beyond agriculture.

Impact of Contract Farming on Maize Farmers' Income

In this section, the impact of farmers' decisions to join contract farming on their farm income was estimated. PSM was employed to address self-selection bias arising from farmers' socioeconomic characteristics.

First, Table 4 displays the income levels of maize farmers involved in contract farming compared to those not involved, for a single crop season. As depicted in Table 4, the total

income of farmers engaged in contract farming is higher than that of those not participating in contract farming. Specifically, contract-farming farmers earn 1,056.99 USD per crop season, while non-contract-farming farmers earn 894.50 USD per crop season. Second, Table 5 presents the results of the PSM analysis used to estimate the impact of farmers' decisions to participate in contract farming.

Contract farming between companies and traditional small-scale maize farmers in rural areas, as indicated in Table 5, has a positive impact on farm income. Beyond statistical significance, the estimated ATT of approximately 196.636 USD and 182.201 USD per season translates to an 18% to 20% increase in household farm

Table 4: Differences in cost and income between contract and non-contract maize farmers' one-crop session

Description	Contract Farming	Non-contract Farming
Fixed cost (USD)	93.56	94.75
Variable cost (USD)	219.94	179.80
Total cost (USD)	313.49	274.55
Production (kg)	4,736.90	4,756.25
Revenue (USD)	1,370.49	1,168.05
Income (USD)	1,056.99	893.50
R/C Ratio	4.37	4.25

Table 5: Impact of contract farming on maize farmers' income

Matching Algorithm	Treated	Control	ATT	Std. Error	t-Value
Nearest neighbour matching	84	9	196.636	66.241	2.968*
Kernel-based matching	84	11	182.201	28.085	6.487*

Note: * denotes significance at the 1% level

income, which is highly meaningful in the rural Madura context. This additional income can cover essential expenditures such as schooling or health care, underscoring the economic relevance of contract farming participation. Previous studies have also demonstrated positive implications of contract farming, although the requirements can be more complex (Mwambi *et al.*, 2016; Bezabeh *et al.*, 2020). In contrast, contract farming on Madura Island operates under simpler terms and conditions agreed upon by both farmers and companies.

The higher income for farmers engaged in contract farming is attributed to the higher prices they receive compared to those not participating. The price received by farmers participating in contract farming was between 0.34 USD and 0.37 USD per kilogram, while the selling price for non-contract farmers was 0.31 USD to 0.34 USD per kilogram. Additionally, partnering companies provide agricultural inputs such as seeds, fertilisers, and pesticides at reduced prices, thus lowering the total costs for farmers. Notably, the companies are responsible for providing technical support, including pre-planting guidance, monitoring during the growing season, and assistance with harvesting processes. This support ensures that

maize production quality meets the company's standards and optimises output. Simultaneously, the standardisation benefits both parties involved in the contract farming system (Hung Anh *et al.*, 2019; Zou & Wang, 2022).

However, contract farming in traditional and small-scale rural agriculture is still considered a relatively new marketing system. Efforts are needed to encourage increased investment from partner companies and to boost farmer participation to enhance incomes and overall welfare. The findings of this study highlight the positive impact of contract farming on traditional maize agriculture on Madura Island. Despite these benefits, contract farming arrangements may expose farmers to risks, including dependence on buyers, price-setting imbalances, and challenges with contract enforcement. These risks highlight the importance of designing fair and transparent contractual mechanisms.

Nevertheless, this study is subject to several limitations. First, the relatively small and imbalanced sample size (84 participants and 16 non-participants) may reduce statistical power and limit the robustness of PSM. Second, the purposive sampling strategy, relying on extension workers and local administrators, may introduce selection bias that could overstate

the benefits of contract farming. Therefore, the results should be interpreted with caution, and future research with larger and more representative samples is recommended.

Conclusions

In summary, this study's results address the research objectives and questions. First, maize farmers' decisions to participate in contract farming on Madura Island are positively influenced by several socioeconomic factors, including family size, experience, social activity, access to loans, and having a bank account. On the contrary, off-farm income has a significant negative effect on the probability of farmers joining contract farming. The contract farming system also demonstrates a positive impact on farmers' income. This is supported by the PSM analysis, which reveals that farmers participating in contract farming earn 196,636 USD more per crop season using the NNM method and 182,201 USD more per crop season using the KBM method. Overall, these results indicate that contract farming positively affects maize farming activities by providing essential inputs, training, monitoring, and purchasing production outputs. In response, policymakers should facilitate inclusive contract schemes that balance benefits and risks, strengthen farmer cooperatives to improve bargaining power, and establish monitoring mechanisms to prevent unfair practices. Lessons from Madura may also be relevant for smallholder-based economies in other developing countries.

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Conflict of Interest Statement

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare absence of conflicting interests with the funders.

Author Contributions Statement

Mardiyah Hayati: Developing ideas of research, coordinating research activities, analysis, writing; Mohammad Wahyu Firdaus, Taufik Rizal Dwi Adi Nugroho, Ni Putu Rizky Arnani: Developing ideas, supervising data collection, analysis, writing; Dian Eswin Wijayanti, Desi Ramadhani, Ravita Nila Aswar, Syauqi Agung Firmanda, Hendra Hendra: Coordinating collecting data, analysis, writing, editing.

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