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RESEARCH ARTICLE

Impact of Participation in Young Smart Farmer Program on Smallholder Farmers' Income: A Propensity Score Matching Analysis

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Abstract: The increase of elderly workers in the agricultural sector will decrease productivity using traditional agriculture production which causes the reduction of income. The Young Smart Farmer program is one of the solutions to solve the problem by developing new generation farmers' agricultural abilities replacing elderly farmers and creating incentives for the new generation to turn to agricultural occupation. Thus, this paper principally assessed the impact of the participation of young farmers in the YSF program on farm income and the determinants of the YSF program factor of young farmer's participation in the YSF program. The total number of samplings is 340 comprising 210 participants and 130 non-participants in the YSF program of the northeast area of Thailand. The data were analyzed using descriptive statistics and the propensity score matching approach to estimate the treatment effect of YSF participation on farm income among smallholder farmers. The results presented that the participants were younger with higher education, more experience and technology support, and had higher farm income compared to non-participants. The propensity scores matching results revealed a significant effect between farmer participation and farm income. The increase in farmers' income from the participation of young smart farmers was estimated to be approximately 6758.59 $/year compared to non-participants of 3066.63 $/year. To encourage young people to participate more in the YSM program the government should provide more support that can stimulate the young farmers' farming economic activities to improve their quality of living and be fully satisfied with their livelihood. Also, the government should encourage a strong network within the group which consequently increases knowledge sharing, technology, and agricultural activities from the production process to marketing.

Keywords: Young smart farmer; Participation; Farm income; New generation; Aging farmer

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1. Introduction

Changes in the population structure of Thailand moving towards an aging society (over 60 years of age) with a tendency to increase from 11.6 million people or 17.57 percent in 2020 to 20.5 million people or 32.1 percent in 2040 [1,2] have affected the rate of economic growth, labor efficiency and food security of Thailand in the future. Moving toward an aging society of workers in the Thai agricultural sector is more severe than the overall image of the country. It was found that the proportion of agricultural workers aged over 60 years increased from 2003 to 2013 with a percentage of 13% to 19% and in 2021 it reached 62.8% while the proportion of younger workers (15-40 years) dropped significantly from 48% to 32% during the same period. The proportion of elderly workers has increased in every area and all production activities [3,4]. This tendency consequently affected the labor quality of the agricultural sector with an emphasis on high labor intensive and productivity of the agricultural sector with the use of new technology in modern agriculture, which has decreased too. The reason for this phenomenon is that elderly workers in the agricultural sector are still unable to adapt to the changing situation and learn or use low technology [5]. With this context, future agriculture will obviously use less labor, but may be more productive by applying new technology to increase productivity of production for moving toward agricultural development 4.0. From the abovementioned problems, the government has provided guidelines in the National Economic and Social Development Plan No. 11 (2012-2016) and No. 12 (2017-2021) as well as the 20-year National Strategy (2018-2037) to address the problem. Emphases have been placed on developing youth farmers' capacity through increased per capita income as well as improving livelihood [6,7]. As a result, the Department of Agricultural Extension implemented a project on the development of young farmers aged 17-45 years to become Young Smart Farmers (YSF) by focusing on the process of exchanging knowledge and networking, letting farmers be the "center for self -learning and learning design" and having agricultural extension staff for "learning management". Therefore, the main goals of this project are to develop new generation farmers' agricultural abilities to replace elderly farmers and create incentives for the new generation to turn to agricultural occupation by applying knowledge, experiences of ancestors, wisdom and modern technology to increase production and marketing efficiency in preparation for becoming Smart Farmers [8]. Being Young Smart Farmer (YSF), they must pass the criteria of potential assessment which consists of (1) having a total agricultural income (2) having knowledge of what they are doing (3) having information for decision-making (4) having production and marketing management (5) being aware of product quality and consumer safety (6) being responsible for the environment/social aspect and (7) being proud to be a farmer. In 2014-2017, a total of 7,598 youth farmers participated in the Young Smart Farmer project. The youth farmers were diverse in terms of agricultural land size. Some youth farmers worked in agriculture as a supplementary occupation in agricultural production areas of less than 0.15 hectares or 1 rai. Besides, other youth farmers inherited agricultural production from their parents in large agricultural areas [1,9]. Furthermore, it was found that such new youth farmers had a variety of agricultural production. For example, some of them had business-oriented agricultural production. At the same time, some farmers' production attached importance to sustainable agricultural production and was related to community development. At present, young farmers have participated in the Young Smart Farmer project, many of whom completed higher education with master's and doctoral degrees and came from various professions such as engineers, architects, civil servants, factory owners, etc. The development of young farmers has appeared in some countries as visible in the project on lending money to young farmers so as to start farming in the European Union, the United States, and Japan [10]. Moreover, Korea provided funds for training and knowledge, the areas for farming and housing, and funds and technology in farming for the youth interested in agriculture [11]. The above points have demonstrated the importance of joining the Young Smart Farmer project for production development in the agricultural sector.

Farmers' engagement in agriculture activities is a significant factor in rural development because they play a vital role in alleviating poverty, polishing decision-making capacity, sustaining self-reliance and a better standard of living, improving farming products, and increasing the acquisition of new knowledge for farming activity [12]. There is a need to determine factors that delimitate farmers' participation in the Young Smart Farmer program in order to enhance the performance of such a program. The major determinants of farmers' choice to participate in the agricultural program comprise social economic elements of the households such as demographic variables (for example, age, occupation, farm size, education level, knowledge, skills, and finance), institutional (for example, cooperative's membership, credit accessibility, social support, and land holdings), technology, (for example, access to machines and equipment) [13-15]. The conclusion of how factors affecting the farmers' decision to engage in an agriculture scheme are context-specific and changeable from one region to another. Specifically, the objectives of the study are to analyze the socioeconomic and institutional factors that affect the farmer's participation in young smart farmers in order for policymakers to enhance this program planning and execution mechanism for crop productivity. Furthermore, the literature emphasizes studies associated with participation in agriculture scheme is focused specifically on knowledge transmission and subsidy program for crop production [10,16]. As the aforementioned reviews, the literature further perceives that the participation of youth in the agriculture sector is not completely investigated including scarce studies on socioeconomic factors of young farmer's participation in agriculture. In addition to this limitation, it is apparent that there are no previous studies reviewing the impact of young farmers' participation on farmer's income in Thailand and this program is typically voluntary. However, an individual farmer engages only when the benefit outweighs the cost of participation. The current methodical approach of determining the differences between young smart farmer participants and non-participants requires the segregation of the 'true' effect of the program (causal effect) from the effect of initial differences in characteristics of the two groups ('selection effect'). The motivation of the study is based on the insufficiency of research on the effect of young smarter participation on farm income. Additionally, the study aims to analyze the impact of young smart farmer participation by using the Propensity Score Matching (PSM) method. Consequently, the study findings will be invaluable for policy-makers to formulate strategies that contribute to the effectiveness of the existing young smart farmers in agricultural development.

2. Methodology

2.1 Study Area

The study consists of a household sample survey and data collection in Northeastern Thailand study areas comprising 5 provinces; namely, KhonKaen, Chaiyaphum, Kalasin, Maha, Sarakham and Nakhon Ratchasima provinces (Figure 1). The Northeast is located between latitudes 14°7' and 18°27' north and longitudes 100°54' to 105°37' E [17]. The Northeast's total area is 105.53 million rai as plateau, which slopes towards the east and resembles a pan, divided into 2 large zones, namely the Korat plain basin in the Mun and Chi River basins characterized by plateaus interspersed with hills and the Sakon Nakhon basin to the north of the region from the Phu Phan Mountain range to the Mekong River. The mountain range of

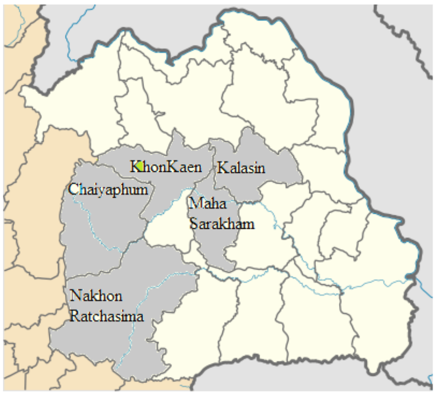

Figure 1. Northeast map.

Source: Northeastern Thailand—Isaan [17].

separation between the Korat basin and the Sakon Nakhon basin is the Phu Phan Mountain range. The Northeast's total area of 106.03 million rai is classified into a forest area of 56.38 million rai or 53.17 percent, an agricultural area of 32.50 million rai or 30.65 percent and other usable areas of 17.15 million rai or 16.18 percent of the region. Most agricultural products in the area are major plant products, viz. rice, animal feed corn and industrial sugarcane. This location produces the main economic crops of the country. Nevertheless, the production model still relies heavily on rainwater which results in low productivity. The Northeast's main crops include rice, industrial sugarcane and cassava with the largest rice-growing area in the country. Jasmine rice 105 is mostly grown in the central and lower areas of the region. Thung Kula Ronghai particularly covers the areas of Yasothon, Sisaket, Surin, Maha Sarakham, and Roi Et Provinces while Thung Samrit covers the areas of Nakhon Ratchasima and Buriram Provinces. The overall average yield per rai is lower than the national level due to traditional agriculture. Also, it has the most sugarcane and cassava growing areas in the country. Most sugarcane is cultivated in the areas of Nakhon Ratchasima, Chaiyaphum, Khon Kaen, Kalasin and Udon Thani Provinces and cassava is obtained mostly in the areas of Nakhon Ratchasima, Chaiyaphum and Udon Thani Provinces [18,19]. In 2018, the Department of Agricultural Extension assigned the Offices of Agricultural Extension and Development No.1-9 of the Northeast to conduct a training project on Young Smart Farmer's empowerment for youth farmers who passed the development process of the Department of Agricultural Extension at the provincial level since 2014-2017. The purpose of training is to promote and develop the capacity of young farmers to apply modern technology for increasing production efficiency, agricultural product management and marketing like professional farmers and 1,500 youth farmers participated in the project [8].

2.2 Data and Sampling Procedure

Primary data were mainly used for the study and the data were collected from 2022 to 2023 through a questionnaire distributed to smallholding farmers. Information on socio-economic variables and production activities was obtained through the use of a structured questionnaire. A multiple-stage random sampling technique was employed to conduct this research. First, it purposively selected 5 provinces, namely, KhonKaen, Chaiyaphum, Kalasin, Maha, Sarakham and Nakhon Ratchasima provinces and focused on young farmers aged less than 45 years who participated in the young smart farmer program (YSF). Second, it selected a district of each province totaling 5 districts to engage for consultation with the Office of Agricultural Extension and Development No 4, namely, Mueang Khon Kaen district, Mueang Chaiyaphum district, Mueang Kalasin district, Mueang Maha Sarakham district and Mueang Nakhon Ratchasima district. Two communities were selected in each district based on a simple random technique and this included 10 communities respectively. In this study, the number of households selected from each district is quite the same without considering the ratio of the number of total farm households in each district. On average, 21 young farmers participated in the YSF program while on the other hand, 13 young farmers without participation in the YSF program from each community totaled 340 young farmers.

2.3 Data Analysis

Impact evaluation attempts to estimate the mean effect of participating in a young smart farmer program (treatment group) by comparing the outcomes of non-participants. This evaluation of the treatment effect may be biased due to the existence of confounding factors [18]. The impact evaluation studies typically rely on propensity score matching (PSM) techniques that refer to creating a comparison group by matching each observation on the treatment group with a control group by similar characteristics which provides an accurate estimate of the average treatment effects [20-22] and appropriately weighted by the propensity score distribution of treated participants [23,24], The propensity score is a prominent method to calculate the balancing score based on the estimated equation of a logistic regression. Upon estimation of the propensity scores, the actual matching may be consistent with numerous algorithms such as nearest neighbor matching, caliper matching, radius matching, and kernel matching [25]. Having estimated the propensity scores, the actual matching can follow various algorithms [25-29] such as nearest neighbor matching, caliper matching, radius matching, and kernel matching. The matching algorithm is a compromise choice between bias and variance and is crucial for small samples because the distinct algorithms produce the same result in an asymptotic way.

Moreover, the purpose of the study is to evaluate the average treatment effect on treated (ATT) for explicating participants in the YSF program (treatment) affecting farm household income [30,31]. The outcome would have been observed for the treatment group if they had not been treated (control group). The treatment effect can be calculated as the difference in mean outcome. The average treatment effect on the treated (ATT) is defined as Caliendo and Kopeinig [25]. The assumptions are to be fulfilled for the matching; the first is the conditional independence assumption required in the absence of treatment of both groups that produces the same outcome variable value given no differences to the relevant characteristics [24]. These pertinent characteristics are dedicated to those who are not themselves affected by the treatment but are involved in influencing the treatment status and the outcome variable. The stable unit treatment assumption is the situation in which the condition of the individual's decision does not rely on the behavior of others [25,32,33]. It is achievable to assess the mean effect of professional preparation of the entire population rather than the individual itself. In this regard, estimating the effect of participants is the assignment of treatment of selection participants that are not randomly selected but instead, these participants voluntarily elect to participate in YSF program [25,26,32]. A propensity score model is applied in this research which is calculated based on the estimated equation of a logistic or probit regression [22,25] to overcome the problem of self-selection bias. The function of these characteristics expresses matching multiple characteristics is identical to matching on a single balancing score as Rosenbaum and Rubin's [22] views.

The outcome variables of average income and YSF participation of participants and non-participants were in comparison with the nearest neighborhood matching method of ATT estimation without any significant biases. ATT is the average treatment on treated (the impact of participant), D = 1 is the group of participated farmers and D = 0 is the group of non-participants and X_i is the set of controlled Covariates [34]. Upon the evaluation match successful, the ATT can be calculated as the difference between the groups' mean values:

$$\mathrm{ATT} = \mathrm{E}\{\mathrm{E}[\mathrm{Y_i}|\mathrm{p}(\mathrm{X_i}); \mathrm{D} = 1] - \mathrm{E}[\mathrm{Y_i}\ |\mathrm{p}(\mathrm{X_i}); \mathrm{D} = 10]|\mathrm{D} = 1\} \quad (1)$$

In this context, the linear regression with treatment effects model is an appropriate procedure to estimate the impact of a treatment on an outcome variable [22,35] by comparing farm production and income between participants and non-participants in the young smart farmer program in Stata software, version 18.0 [36]. The Logit model was used to estimate propensity scores (p scores) of whether the young participants were in the program or not in which yes (for participant) = 1 and if not (non-participant) = 0, thus binary response variable. As mentioned, the study emphasized the factors influencing young farmer participation in the YSF program. The variables commonly used in many previous studies to investigate the effect of young farmer participation on farm income were gender, age of farmer, cultivated area, education level, membership of group farmer, farming experience, farm income, technology support such as agricultural machinery, drip irrigation and solar cells for farm use, agricultural training and agricultural input subsidy [18,26,28,37-41] (Table 1). The impact of treatment with a comparison of YSF participation and income between participants and non-participants was written with the following equation [15].

$$Y_i = \text{Ln}\frac{P_i}{1-P_i} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 ++ \beta_7 X_7 ++ \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \varepsilon \quad (2)$$

where P_i is the probability of adopting the use of rice straw compost, $P_i = 0$ indicates no adoption and $P_i = 1$ indicates adoption.

- Y = The probability of participating in young smart farmer program
- β_0 = The intercept
- β_1-β_{10} = The regression coefficients of the dependent variables
- X_1 = Gender of farmer
- X_2 = Farmer's age
- X_3 = Farmer's education
- X_4 = Cultivated area
- X_5 = Membership of group farmer
- X_6 = Farming experience
- X_7 = Farm income
- X_8 = Technology support
- X_9 = Training
- X_{10} = Agricultural input subsidy
- ε = The disturbance term

3. Results and Discussion

3.1 Description and Summary of the Explanatory Variables

A total of 340 respondents includes participants with a proportion of 61.76 percent and non-participants of 38.24 percent. Participants can be divided into 2 groups: (1) 49.92% of participants are those who have inherited the farm and farm successor, which can be divided into 3 groups as follows: Participants who graduated with bachelor's degrees from other fields accounted for 29.95%, participants who graduated with bachelor's degrees from agricultural-related fields accounted for 15.48%, and 4.49% were participants who graduated from high school level with grade 12. Also, (2) participants who were not descendants of farmers and graduated from other fields that were not related to agriculture accounted for 11.84%. The reason why participants decide to join the YSF is that most participants need new knowledge to develop their agriculture or upgrade their own agriculture because farmers have little experience in farming. It is different from non-participants in that most of them were descendants of farmers and graduated less than secondary school level, representing 35.18%, and 3.06% graduated with a bachelor's degree (Table 2).

About 57.6 percent are male participants while 66.2% percent are male non-participants interviewed females of 41.9% and 33.8% of participants and non-participants respectively. The difference between the two groups when disaggregated by gender was not statistically significant. The majority of participants just started family activities after stopping working in the non-agricultural sector while the most of non-participants had been involved in farming activities since childhood aged over 13. Participants have a higher year of formal education than non-participants indicating that most participants had graduated from uni-

Table 1. Definition and measurement of variables.

Variable	Definition and measurement
Gender of farmer (X_1)	0 = Female 1 = Male
Farmer's age (X_2)	Years
Farmer's education (X_3)	0 = Otherwise 1 = Bachelor degree or above
Cultivated area (X_4)	ha
Membership of group farmer (X_5)	0 = No 1 = Yes
Farming experience (X_6)	Number of year spent in farming
Farm household income (X_7)	Gross farm earnings ($/Year)
Technology support (bio-fertilizer, solar cell energy, machinery) (X_8)	0 = No 1 = Yes
Training (X_9)	0 = No 1 = Yes
Agricultural input subsidy (X_{10})	0 = No 1 = Yes

Table 2. Type of young farmer who participates in YSF program.

Item	Percentage
Participants	**61.76**
Farm successor	49.92
Participant who graduated with bachelor's degrees from other fields and quitted a non-farm job before entering agriculture	29.95
Participant who graduated with bachelor's degrees from agricultural-related field and quitted a non-farm job before entering agriculture	15.48
Participant who was graduated with high school level and worked farming job aged over 13	4.49
Non-farm successor	11.84
Non-participants	**38.24**
Non-participant who was successor involved farm activity aged over 13 and graduated less than secondary school level	35.18
Non-participant who was successor involved farm activity after quitting non-farm job and graduated with bachelor's degrees fromother fields	3.06
Total	**100**

versity with a bachelor's degree and also engaged in non-farm jobs. In contrast, most non-participants have not continued their education after having inherited the farm. The participation in YSF program has increased with increased education [42]. The difference between the two groups with education was statistically significant at 1%. The mean age of participants was 39.10 years while non-participants had a mean of 37.46 years and the difference is statistically significant (p = 0.01) showing that most of the participants were below 40 years of age in line with Muhammad-Lawal [43]. This implies farmers have a capacity and experience with an average of 6.80 years of participants and 16.99 years for non-participants. The mean difference in farmer's experience between participants and non-participants is 10.18 and statistically significant at 1 percent. Most participants ever worked in non-agricultural sector and the YSF program has encouraged young people to become new entrants in agriculture [44,45] to learn practical knowledge in agricultural production either in organic vegetable farming or value-added farming activity [46,47]. In addition, about 47.10 percent of the participants were formally involved in membership of community enterprise groups whereas 61.5 percent of the non-participants were. Most participants are likely to identify as entrepreneurs with self-investment [48,49]. Most of participants with the proportion of 84.3% have more technology support than non-participants (27.0%) with a statistically significant (p = 0.01). Participants had a mean income of 6758.59 $/year while non-participants obtained a mean of 3066.63 $/year which was mostly derived from rice, cassava and sugarcane. The difference between the mean incomes for the two groups was significant at 1 percent (Table 3) and the participant's income has the potential to improve their livelihood [16,50].

3.3 Propensity Scores and Matching

From the estimates of parameters by the Logit model, the propensity score is calculated for all farms with the matching analysis. In this study, PSM analysis is carried out using psmatch2 module [51]. The parameter testing was carried out simultaneously and partially. Simultaneous testing used the likelihood ratio test. The test results obtained by the LR chi^2 value of 287.68 with Prob > chi^2 of 0.000 indicate that the independent variables in the model simultaneously influenced the participation of and explained the farmer's propensity of participation in the young smart farmer program [52,53]. The estimated log likelihood value is highly significant indicating that the model with predictors is to be preferred over a model without predictors. Farmer's gender (X_1), farmer's age (X_2), farmer's education (X_3), membership of farmers (X_5), farming experience (X_6), farm income (X_7) and technology support (X_8) were statistically significant at the confidence level of 99 percent. Also, agricultural input subsidy (X_9) was statistically significant at 95 percent, as well as cultivated area (X_4) and training (X_9) had a relationship in the same direction except is not significant. It was found that if the gender, farmer's age, education level, farm income, agricultural input support and technology support were increased by 1 year, the probability that farmers decided to participate in young smart farmers increased by 1.374, 0.1367, 2.483, 0.001, 0.626 and 2.455 percent, respectively (Table 4). According to the results, farmer participation in YSF was higher among farmers who were older nearly

Table 3. Summary of statistics for participants and non-participants.

Variable	Participant (N = 210, 61.76%)			Non-participant (N = 130, 38.24%)			Mean difference	*t*-value
	Mean	SD	%	Mean	SD	%		
Gender	0.819	0.341		0.338	0.475		–0.481	–1.549^{ns}
0 = female			41.90			33.80		
1 = male			57.60			66.20		
Farmer's age (years)	39.10	5.267		37.461	5.946		–1.638	–2.652***
Farmer's education	0.771	0.420		0.154	0.362		–0.618	–13.851***
0 = Otherwise			22.9			84.6		
1 = Bachelor degree			77.1			15.4		
Cultivated area	3.571	2.995		3.278	2.653		–0.293	–0.914^{ns}
Membership	0.471	0.500		0.616	0.488		0.144	2.602***
0 = No			52.90			38.50		
1 = Yes			47.10			61.50		
Farming experience (years)	6.805	5.180		16.992	8.783		10.188	12.525***
Income ($/year)	6758.595	8593.056		3066.631	7206.823		–3691.965	–4.698***
Technology support	0.843	0.365		0.277	0.449		–0.566	–12.706***
0 = No			15.70			72.30		
1 = Yes			84.30			27.00		
Training	0.719	0.451		0.739	0.442		0.019	0.389^{ns}
0 = No			28.10			47.70		
1 = Yes			71.90			52.30		
Agricultural input subsidy	0.200	0.401		0.184	0.389		–0.154	0.348^{ns}
0 = No			80.00			81.20		
1 = Yes			20.00			18.50		

Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

40 years because they had more experience from non-farm jobs before entering the YSF program and applied to improve toward modern farms as well as try new concepts to increase the yield of product similar to the studies [54,55]. Male farmers are more likely to participate in the YSF program because they must manage and control a limited resource efficiency and farm activity requires more physical work consistent with the studies [10,55,56]. The participants are educated the more they decide to participate in the YSF program to acquire more knowledge on advanced technology and the modern farming practices and apply it in production and marketing to increase the yield and marketing channel along with increasing the value added of agricultural products through the product processing. This result is in line with the findings affirming that participants with farming experience are less likely to participate YSF program [10,57-60]. This is probably due to the fact that experienced farmers were conservative in traditional farming with monocropping such as rice, cassava etc. and did not adopt modern farming with technology and innovation [61-63].

However, the farmers in the YSF program still have limitations in many aspects and that is farmers still lack knowledge and skills in production, marketing, innovation and technology that can be applied with local wisdom due to a lack of experience and expertise in farming (around 7 years) especially for farming management and addressing the issue of soil nutrient deficiency problems, drought, flooding in some areas and irrigation. The higher the farm income, the higher the probability level of YSF participation or the more likely to participate in the YSF program. This result is in agreement with the findings of the research [64]. The participant will change the farming practices from the traditional way to modern farming and high-precision agriculture that emphasizes the production of agricultural products by adopting innovation and modern technology management thus resulting in raising the income and quality of life of farmers through self-reliance. With increasing incomes, participants are able to raise capital to develop their products potentially. Participants are more likely to obtain technology support with modern farming and will manage to bring innovation and modern technology into production to increase efficiency, reduce labor use and production costs by managing the factors of production and existing businesses cost-effectively as well as increasing the value added of agricultural products and method is similar to previous studies [65-67]. Also, the development of production processes and products contributes to the certification of agricultural standards both domestically and internationally and helps to raise the level of export as well as to increase the income and quality of life of farmers for a better living.

3.4 Impact of Participating in Young Smart Farmer Program on Farmer's Income

The comparison between the characteristics of households and the matching algorithm explores the equal distribution of each value of the propensity score with both the treatment and control groups. It uses three matching methods namely; nearest-neighbor matching (NN) with either replacement or no replacement, kernel matching (Kernel), and Caliper with radius matching (0.05), to compare the results. It presents the p-values of the characteristics with insignificant differences between variables after matching after matching or most t-tests accept the null hypothesis that there was no systematic difference between the treatment group and the control group. These outcomes indicate no significant difference between the two groups matching [28,68,69]. The balancing hypothesis was satisfied because there were no significant differences between variables after matching (Table 5).

According to the estimates, the mean bias before matching was 67.9%. After matching, the mean bias reduced to 53.01%, 52.90%, 66.72% and 66.42% for nearest neighbor matching with its replacement, nearest neighbor matching with no replacement, kernel and caliper matching methods, respectively. It is obvious that the percentage reduction in bias for all four matching methods was greater than 50%. Kernel has the highest Bias Reduction at 66.72% and the matching substantially reduced the selection bias [23] (Table 6).

In this study, PSM analysis is carried out using psmatch2 [8] module. The ATT estimation based on their propensity scores using nearest neighbor matching, kernel matching and caliper matching methods of propensity scores [25,28,29,39] is shown in Table 7. The results show that the participation in YSF program had a significant impact on farm income and productivity at a significant level of 1% across all matching techniques. The farm income was positive and significant at $p < 0.010$, meaning that the increases in farmers' income were derived from the participation of young smart farmers. For this study, it can be inferred that any difference between the average incomes of participants and the matched group of non-participants, ATT on farm income is 3806.369 to 4450.172 $/year of participation in the YSF program (Table 7). In other words, the increase in farmers' income from the participation in the YSF program is higher than non-participants. This is based on the fact that the two groups are matched on the equality of their propensity scores. The increased farmers' income is also found in studies [58,70-75]. The fact that participants in the YSF program have the ability to be self-reliant and have creative ideas as well as use modern

Table 4. Propensity score estimation results by using the Logit model.

Variable	Coefficient	Standard error	Z	P > |Z|
Gender	1.374	0.489	2.80	0.005***
Farmers' age	0.137	0.040	3.39	0.001**
Farmers' education	2.483	0.439	5.65	0.000***
Cultivated area	0.501	0.082	0.62	0.536ns
Membership	–2.067	0.533	–3.88	0.000***
Farmers' experience	–1.446	0.029	–4.90	0.000***
Income	0.001	0.005	3.27	0.001***
Technology support	2.455	0.437	5.62	0.000***
Training	–0.289	0.476	–0.61	0.545ns
Farm input subsidy	0.626	0.531	1.74	0.082*
LR chi^2 287.68 Prob > chi^2 0.0000 Pseudo R^2 0.6360				

Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5. Testing of covariates balance for treated and untreated.

Variables	Unmatched matched		Mean		%bias	%Reduction in bias	*t*-value	*p*-value
			Treated	Control				
Gender	Unmatched		0.819	0.339	19.2		1.55	0.122
	Matched	NN replacement	0.819	0.339	20.0	–9.0	2.14	0.033
		NN no replacement	0.492	0.339	6.1	68.0	2.54	0.012
		Kernel	0.819	0.262	22.2	–16.0	2.28	0.023
		Caliper	0.819	0.255	22.5	–17.3	2.31	0.022
Farmers' age	Unmatched		39.1	37.462	29.2		2.65	0.108
	Matched	NN replacement	39.1	36.929	38.7	–32.5	4.33	0.000
		NN no replacement	37.7	37.462	41.7	84.5	0.37	0.712
		Kernel	39.1	37.106	35.5	–21.7	4.03	0.000
		Caliper	39.1	37.08	36.0	–23.3	4.10	0.000
Farmers' education	Unmatched		0.771	0.154	157.3		13.85	0.000
	Matched	NN replacement	0.771	0.681	23.0	85.3	2.08	0.038
		NN no replacement	0.646	0.154	12.4	20.3	9.33	0.041
		Kernel	0.771	0.661	28.2	82.1	2.53	0.012
		Caliper	0.771	0.664	27.4	82.6	2.46	0.014
Cultivated area	Unmatched		3.571	3.278	10.3		0.91	0.361
	Matched	NN replacement	3.571	3.703	–4.7	54.6	0.91	0.542
		NN no replacement	3.447	3.278	6.0	42.4	0.49	0.626
		Kernel	3.571	3.733	–5.7	44.7	–0.71	0.475
		Caliper	3.571	3.545	0.9	91.3	0.11	0.912
Membership	Unmatched		0.471	0.615	–29.1		–2.60	0.010
	Matched	NN replacement	0.471	0.376	19.3	33.8	1.98	0.048
		NN no replacement	0.523	0.615	–18.7	35.9	–1.50	0.134
		Kernel	0.471	0.364	21.7	25.4	2.24	0.026
		Caliper	0.471	0.358	22.9	21.2	2.37	0.018
Farming experience	Unmatched		6.805	16.992	–130.1		–12.52	0.050
	Matched	NN replacement	6.805	4.638	27.4	78.9	4.52	0.215
		NN no replacement	8.139	16.992	–113.1	13.1	–8.00	0.012
		Kernel	6.805	4.651	29.2	77.5	4.88	0.081
		Caliper	6.805	4.538	29.0	77.8	4.80	0.000
Technology support	Unmatched		0.843	0.277	138.3		12.71	0.000
	Matched	NN replacement	0.843	0.885	–3.5	97.5	–0.41	0.683
		NN no replacement	0.753	0.277	111.6	15.7	8.72	0.010
		Kernel	0.843	0.876	–8.2	94.1	–0.99	0.325
		Caliper	0.842	0.875	–7.7	94.4	–0.93	0.353
Training	Unmatched		0.719	0.738	–4.4		–0.39	0.697
	Matched	NN replacement	0.719	0.709	2.1	50.9	0.22	0.829
		NN no replacement	0.761	0.739	5.2	18.9	0.43	0.669
		Kernel	0.761	0.754	–7.9	–81.4	–0.82	0.414
		Caliper	0.719	0.759	–9.2	–11.7	–0.95	0.341
Farm input subsidy	Unmatched		0.200	0.185	3.9		0.35	0.728
	Matched	NN replacement	0.200	0.633	–10.6	–27.2	–10.0	0.010
		NN no replacement	0.200	0.185	3.9	30.0	0.31	0.754
		Kernel	0.116	0.629	–10.8	–26.9	–9.91	0.004
		Caliper	0.101	0.638	–12.7	–27.4	–10.12	0.000

Table 6. Test of selection bias after matching.

Mean algorithm	Unmatched/Matched	Pseudo R^2	Likelihood ratio x^2	Mean bias	% Bias reduction
NN replacement	Unmatched	0.639	288.98	67.9	53.01
	Matched	0.423	256.53	31.9	
NN no replacement	Unmatched	0.639	288.98	67.9	52.90
	Matched	0.423	246.53	32.0	
Kernel	Unmatched	0.639	288.98	67.9	66.72
	Matched	0.396	230.81	22.6	
Caliper	Unmatched	0.639	288.98	67.9	66.42
	Matched	0.549	197.97	22.8	

Table 7. Estimated treatment effects of participation on household income.

Mean algorithm	Unmatched matched	Treated	Controls	ATT	S.E.	*t*-value
NN replacement						
	Unmatched	6758.595	3066.631	3691.965***	785.828	4.70
	Matched	6758.595	2261.890	4496.705***	1277.896	5.52
NN no replacement						
	Unmatched	6758.595	3066.631	3691.965***	685.828	4.70
	Matched	6873.000	3066.631	3806.369***	722.285	5.27
Kernel						
	Unmatched	6758.595	3066.631	3691.965***	161.980	5.11
	Matched	6758.595	2308.423	4450.172***	158.715	3.31
Caliper						
	Unmatched	6758.595	3066.631	3691.965***	785.828	4.70
	Matched	3077.188	2194.939	4440.922***	1857.363	4.39

technology to manage agriculture is because they play an important role as a leader in local agriculture to transfer knowledge to youth and farmers in rural areas. As a result, the agricultural sector progress is improved by extending the results of development to other farmers as well as being the creator of a network and cooperation to encourage agricultural extension work and farmer organizations efficiently, resulting in community economic growth. The YSF group is useful for farmers as a network for learning in which friends can exchange information with each other and expand the market network to reduce production costs. The YSF network organizes two-month events called home visits at the provincial and district levels. However, the network is weak to help each other in terms of production and processing to reduce costs and expand the market.

4. Conclusions

The study evaluated the effect of participation in the YSF program for young farmers on farm income in Northeast Thailand. The study used regression with an endogenous treatment effect model to evaluate the effect of participation in the YSF program on farm income. The findings exhibited that gender, age, education, technology adoption, and income significantly increase participation. However, the farmers' participation was significantly reduced by their farming experience. The findings further imply that on average, participation in the YSF program could able to more earn an income of around 6758.59 $/year as compared to non-participants of 3066.63 $/year. The results showed significant positive impacts of participation in the YSF program. The participants prefer to quit their full-time jobs to do agriculture thus causing a feeling of being taken advantage of by the product marketing system. In terms of farm management, farmers are unable to solve the problems because of a lack of management skills towards modern farming. Therefore, the government should be more supportive of those who need to start farming to make it an economically satisfactory livelihood. Also, the government should encourage a strong network within the group which consequently increases knowledge sharing, technology, and agricultural activities from the production process to marketing. This will help motivate Young Smart Farmer to become a good leader in agriculture in the future and build the strength of learning groups and networks. The government should support participant to raise a network level in the form of a company, cooperative or enterprise that has an auditable and transparent accounting system which result in an increase of job opportunities, income, and good relationship with various agencies.

Author Contributions

Supaporn Poungchompu wrote the manuscript with input from all authors and analyzed the data. Porntip Phuttachat prepared a data survey and cooperated in the field survey. All authors discussed the results and commented on the manuscript.

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Data Availability

The findings of this study are available from the corresponding author upon reasonable request.

Conflict of Interest

The authors declare that there is no conflict of interest.

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