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Does Income Inequality Exist among Urban Farmers? A Demonstration of Lorenz Curves from Northern Thailand

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Abstract: This study was motivated by the profound disparity of farmers' income in northern Thailand. We aimed to investigate the inequalities in the distribution of estimated income among urban farmers in the Mueang district area of Nan province using the Lorenz curves and Gini indices. Approximations of farmers' incomes were calculated and the Tobit model was applied to identify the determinants of farm income diversification in each sub-district. Results showed that urban farmers had high inequality scores, and there was a wide range of income among farmers. Ownership, land entitlement, and farmland size positively contributed to farmers' estimated income. Agricultural activities further showed that rice farming significantly raised income disparity, while maize cultivation negatively affected it in nearly all sub-districts. Therefore, this study contributes an important indication that leads farmers to a sustainable livelihood while simultaneously adjusting relevant institutional policies.

Keywords: income inequality; income distribution; urban farmers; northern Thailand

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1. Introduction

Although farming is an essential career driving the economy and the agricultural sector in Thailand, there are about 10 million Thai farmers active in the industry who are still affected by the large income inequality gap in the country [1]. Greater inequality could, consequently, lead to an unequal distribution of income, and this repeatedly happens to those with few resources. This study is focused on the income inequality prevalent in the farming profession, which may in turn affect the nation's economic growth. The level of inequality is typically calculated by income, available resources, and other criteria relevant to wealth [2]. Income inequality is useful to workers with particular workloads who can benefit from this discrepancy by being compensated with additional incentives to the detriment of those who do not have their privilege [3]. On the contrary, it also has a negative impact in terms of the limited finances available for those in poverty to support their education, which is correlated with diminishing demands for and consequently discourages their adoption of new technologies [3].

The income disparity within the same occupational group of agricultural careers and the elimination of available resources are being further analyzed. Farmers can become gravely worried and anxious about their low income as against high debt, imbalances of low income and increased expenditures, and the inaccessibility to financial assets and credit. These elements are all directly associated with the income inequality of farmers. Kingnet and Maneejuk [4] contended that income-generating disparity was commonly found among Thai farmers in each region. In general, the average net revenue for the Thai farmer household was Thai baht (THB) 16,000 per month (approximately USD 513, i.e., one

U.S. Dollar can exchange for about THB 31.21, currency exchange on 14 October 2020). It was also found that 60% of the Thai farmers' net income was below the average of the total revenue of other farmers at the same level in different parts of the country. Farmers in the central region, for example, had the highest income in comparison to that of those from other areas. In 2017, farmers in the northern part of Thailand had the lowest income per capita, which averaged to about THB 6000 per month (approximately USD 192), compared to other regions. Six factors that further contributed to farmers' income inequality were the irrigation system, location, attitude and self-adjustment, crop varieties, skills and experience, as well as technology adoption [3]. Other studies [5–7] also found that public policies, education, and health may also contribute to farmers' income inequality. Besides, there is also the government's implementation of policies to deal with the income inequality faced by farmers, which—if continuously ineffective—will exacerbate the current inequality of distribution of income.

Extrapolating the existing situation of income disparity among farmers in Thailand, this study aimed to provide an understanding of the case of urban farmers and their income inequality. Though that previous studies [8–10] pointed out the potential methods, our study was based on accessible data in the Mueang district of Nan province, sought to provide explanations for the income inequality among agricultural occupations, and raise questions that are necessary for improving developmental strategies.

2. Literature Review

During the 1970s, income inequality was observed in some developing countries, with a focus on the relationship between economic growth and income distribution. In contrast, the developed countries raised questions regarding quality-of-life factors that were contradictory to the consequences of economic growth, e.g., reduction of natural resources and considerable pollution. Moreover, inequality is a multidimensional concept and an ambiguous explanation of society [11]. Although it classically refers to notions of compatibility between different indicators, i.e., economic growth, quality-of-life, etc., it is about comparing several living conditions with one another, excluding the indicator of social wages.

Moreover, the indicator of equality uses income to identify which individuals lack resources to attain adequate social standards of living. Hence, it can be used to compare urban and rural populations living in different regions [11,12]. Additionally, Tsounta [13], as well as Maneejuk and Yamaka [14] mentioned that income inequality could interfere with economic growth and become problematic in the following ways: preventing access to technological development for unskilled workers who are job hunting [15], obstructing human capital accumulation, creating political and economic instability, producing misallocation of resources, and inducing a nepotistic employment system.

According to Nelson [16], the number of people living in poverty is increasing in developing countries, while life expectancy and other factors that directly measure welfare are improving in other places. This discrepancy exacerbates income inequality. Several recent studies explored inequality and income distribution in many developing countries. Evidence showed that poverty was prevalent in African regions and income inequality was higher among rural male-headed households in Southwest rural Nigeria, for instance, by 76% of the Gini coefficient [17]. Crucial determinants of income distribution were the size of households, farming experience, extension access, credit access, and membership of a social group [17]. In terms of reducing income inequality, these substantial determinants (i.e., the size of the farm, type of crops, obtaining credit, the efficiency of the farmer, technology, soil fertilizer, input supply, and agricultural-extension services) are considered as key elements for enhancing policy implementation [18]. In Indonesia, Schwarze and Zeller [19] demonstrated that agriculture was a vital income source in rural households of central Sulawesi, even though the household members' income was insufficient for living. Off-farm (i.e., non-farm) activities also play a role in income distribution [20], so

policymakers should consider the inter-household paradox. The share of income resulting from non-farming activities also positively influences the poverty index [21].

Less developed countries, such as Ethiopia, Demissie and Legesse [22] also showed evidence of income diversification among smallholder farmers in rural sites. Besides agricultural activities, Ethiopian farmers have opted to take part in non-farming activities to increase their earnings. As a result of their diversification efforts, the activities outside of the farm contributed to the income of 23% of the households, but this was not as high as the income they received from farming activities. In contrast, farmers who had livestock and cultivated a large farm were unable to participate in non-farming activities. It is undeniable that fewer resources lead to a lower income [22]. According to Sun [23], farmers in the Liaoning and Jilin provinces of China also participated in non-farming activities that could reduce the problem of rural income inequality in their region. However, the farmland's size had a negative effect on non-farming activities. Therefore, this bears some similarity to the findings of Demissie and Legesse [22]. Nevertheless, income distribution in different areas, while also considering the dissimilarity between individuals' characteristics, will lead to different outcomes and necessitate different approaches to policy development.

In Thailand, the national poverty line was considerably higher than that of other countries in Southeast Asia, such as Indonesia, Philippines, Vietnam, and Cambodia in purchasing power parities (PPP) since 2011 [24]. This gap keeps increasing in tandem with the growth of the economy and the availability of health and well-being facilities [24,25]. There are three notable dilemmas in Thailand. First, the richest 1% of the population have increased their share of income and wealth (including property) over a long period of time, either by raising their physical assets or human capital. This is hardly ever noticed by most of the population who mainly consist of rural and uneducated individuals. Second, a disparity in education and skills has increased even though inequality may have been reduced [3,24]. Finally, more studies showed that the critical element of inequity in Thailand was education, which determines the choices of occupation, career accessibility, and level of revenue [14,26].

Despite the importance of Thai agriculture internally, farmers have yet to attain better financial status. The education level of most Thai farmers is not high. Available resources like farmlands' access, land ownership, and land entitlements have been an issue for a decade [27–30]. In order to appreciably solve the issue of income inequality faced by Thai farmers, the most important circumstances that need to be addressed are how to improve the quality of life of farmers [3]. In addition, Parlińska and Pomichowski [31] stated that farmers' earnings were not parallel to those of workers in other occupations, such as entrepreneurs. However, it is clear that the level of income of entrepreneurs is vastly higher than that gained from farming. For the farmer, farm earnings could appropriately serve as indicators to measure farmers' wellbeing [32] and help diversify their income level. Moreover, the rural farmers' group varies in income distribution with regard to access to government assistance programs. It was found that rural farmers who were wealthier had more opportunities to access governmental assistance [33].

To date, studies on farmers have been conducted on a wider scale in rural areas than in urban areas of developing countries. In addition, Nan province in northern Thailand was ranked as the third poorest province in the country [34]. Despite the sprawling area of the city and the increase in its population, urban farming profoundly dominates the provincial economy. Despite physical constraints of the province (e.g., inadequate lowland areas and the entire countryside being covered with mountainous and steep areas), choices of occupation, and a greater contribution of the agriculture sector, on-farm working in Nan province (67.68% of total Nan population) is still dictating most of its share of income [35,36]. Regarding the Nan Provincial Statistical Office [36], an urban area named the Mueang district was disclosed as a planted area of both non-glutinous rice and glutinous rice, which accounts for 32,816 hectares. According to Kuhns et al. [37] and Orsin et al. [38], states urban farming corresponds to rural production, which widely produces perishable agricultural products (e.g., vegetable, egg, herb, and ornamental flower) and commonly with small-

scale farming. Inversely, in this study, the unusual choice of urban crops can be commonly discovered in the area (e.g., rice, maize, rubber) due to topographical characteristics, and this province shows clearly that inequality remains continuously present between social groups even in an urban area. Accordingly, this study aimed to provide an understanding of income inequality specifically among urban farmers.

Furthermore, Cowell [12] illustrated that an effective method of describing wealth distribution inequality was the Lorenz curve. The Lorenz curve was applied to observe the distribution in estimated income [16,17]. Gini indices provide relevant descriptions of equality according to Xu et al. [39]. Atkinson [40] also supported that the Gini coefficient is a specific measure of inequality commonly used in empirical work. Aside from this, Dararatt [41] provided data concerning income inequality among older people in 17 provinces of Thailand using the Gini index. In the matter of farmers in Thailand, income from agriculture sustains their lives and family. However, is the distribution of farm income equal lately? Does income inequality exist among farmers? Accordingly, we employed Lorenz curves' associations and Gini indices to determine how income is unequally distributed and the dissimilarity in inequality among ten sub-districts in the urban area of Nan province.

3. Data and Methodology

3.1. Data Sources

We analyzed survey data from the registration conducted in 2018 for the improvement of farmers—with 10,328 respondents—to calculate the estimated income and measure the inequality of estimated income among the urban farmers of the Mueang district in Nan province (i.e., Mueang district in Thai refers to capital district of Nan province), which comprises 11 sub-districts. One sub-district was not involved in this study owing to the nonexistence of farmland areas. The study site is located in the northern part of Thailand and next to the Lao People's Democratic Republic boundary (located at 18.4647° N 100.46400° E). The province mostly comprises steep areas and people are mainly involved in agriculture. The data, which had an intricate design and construct, were regional raw data from a survey that is conducted annually and that was retrieved from the Department of Agriculture Extension of Thailand [42]. Specifically, the estimated income of registered farmers in the Mueang district was calculated by multiplying the market price of agriculture products sold by the quantity produced in 2018; it can be written in Formula (1) as:

$$\begin{aligned}\text{Estimated income} = \text{Price} \times \text{Quantity} = \text{Price} \times (\text{total output weight per hectare}) \times (\text{total hectare}) \\ \times (\text{total harvest frequency in a year})\end{aligned} \quad (1)$$

3.2. Lorenz Curve and Gini Coefficient

In order to measure inequality in society, the most broadly used tool is the Lorenz curve, which assesses wealth distributions. The Lorenz curve is a graphical method that plots the cumulative proportion of income (on the y-axis) to the cumulative proportion of the population (on the x-axis). The shape of the Lorenz curve indicates how much inequality there is in income distribution [2,12,43,44]. Additionally, this shape is derived from the ascending order of income ranking. The cumulative percentage of total income then is plotted against the share of farmers' population, with curves farther away from the inequality line, indicating a higher income inequality.

The Gini index also measures income inequality through the Lorenz curve, which is found on the deviation between the actual income distribution within farmers' population (the Lorenz curves) and the hypothetical income distribution, which will be the inequality line afterwards. The value of the Gini index ranks from 0 to 1 (generally multiplied by 100 for this study). When the concentration coefficient is close to 0, it means that there is more equality; in contrast, if the concentration coefficient is close to 1, it refers to increasing

inequality [44–49]. To measure farmers' income inequality in the study, the Gini coefficient was calculated according to the following formula (2):

$$\text{Gini Coefficient(G)} = \frac{1}{2n^2\overline{y}} \sum_{i=1}^{n} \sum_{j=1}^{n} |y_{i-} y_j| \quad (2)$$

where i represents the unit within a population of size n; y represents the farm income of a farmer; and j is the total sum index.

3.3. Empirical Model

The Tobit model is a regression model based on addressing left or right truncation in the data (also known as the censored regression model), which censors the distribution of the dependent variable from the upper bound and lower bound, respectively [50,51]. In this study, the Tobit model was utilized to identify the determinants of estimated income among farmers of each sub-district of Mueang district using different characteristics. The Tobit model has been extensively adopted in surveys for wealth that continue to count data with excess zeros and have values bound within the given range. The model mainly considers a latent variable, described as y^*. For this study, y^* is the total of farmers' estimated income through the effect of variable x on y^*. Numerous studies have used the Tobit model in the same context, such as those conducted by [17,52–54] in Nigeria, Schwarze and Zeller [19] in Indonesia, and [22,55] in Ethiopia. Following Sallawu et al. [56], the model was expressed in an Equation (3) as:

$$\begin{gathered} y* = \mathrm{X}_i\beta_i + \varepsilon, \\ y = 0 \text{ if } y* \leq 0 \text{ and } y = y* \text{ if } y* > 0 \end{gathered} \quad (3)$$

where y^* is the dependent variable (estimated income); β_i is the regression coefficient; X_i is the vector of explanatory variables; and ε is the error term, which is normally distributed with a zero mean and constant variance.

The empirical Tobit model may be written in Equation (4) as:

$$\begin{gathered} y^* = \beta_0 + \beta_1\text{Gender} + \beta_2\text{Farm size} + \beta_3\text{Land use entitlement} + \beta_4\text{Land ownership} \\ + \beta_5\text{Land ownership and entitlement} + \beta_6\text{Agronomy} + \beta_7\text{Livestock} + \beta_8\text{Agroforest} + \beta_9\text{Bo} \\ + \beta_{10}\text{Bosuak} + \beta_{11}\text{Chaisathan} + \beta_{12}\text{Dutai} + \beta_{13}\text{Kongkhwai} + \beta_{14}\text{Nasao} + \beta_{15} \\ \text{Rueang} + \beta_{16}\text{Sanian} + \beta_{17}\text{Thuemtong} + \varepsilon \end{gathered} \quad (4)$$

4. Results and Discussion

4.1. Implications of Urban Farmers' Income Distribution in the Mueang District of Nan Province

Figure 1 presents the Lorenz curve for the Mueang capital district in Nan province. The gap between the Lorenz curve and the diagonal line (i.e., equality) presents the amount of income inequality, with a bigger gap, meaning that there is a high level of income inequality in Mueang district (i.e., a higher income disparity among its 10 sub-districts). Results in Figure 1 showed that the distribution of estimated income in the Mueang district had a high level of inequality; namely, farmers' estimated income showed high disparity, implying that the 10 sub-districts in Mueang district exhibited an income disparity situation. Given this reality, we deemed relevant to examine which sub-districts were causing this high-income disparity; accordingly, we compared the Lorenz curve for each sub-district with the curve of the Mueang district.

Figure 2 further demonstrates the Lorenz curves for each sub-district compared to that of the Mueang district. The Lorenz curves for each sub-district are neither equal with the line of equality, nor the same with the Lorenz curve of the Mueang district. Not all sub-districts revealed an income disparity that showed an identical outcome. Interestingly, the Bosuak, Nasao, and Rueang sub-districts showed intersection of curves that are comparable to that of Mueang district, implying that these three sub-districts have a level of estimated income distribution similar to that of the Mueang district. Furthermore, the line of equality

and the Lorenz curve of the Chaisathan and Phasing sub-districts were farther away from those of the Mueang district. This shows that the Chaisathan and Phasing sub-districts had the highest level of income disparity in the Mueang district. Meanwhile, the Lorenz curve of the other sub-districts (i.e., Bo, Kongkhwai, Sanian, Dutai, and Thuemtong) had minor differences to that of the Mueang district. Various potential factors may have led to these differences; further examination and discussion is required to determine the factors causing this high magnitude of income disparity in these sub-districts.

The Gini index (in Figure 3) displayed a value that was far off from zero, which indicates higher inequality on average in the estimated income distribution. The Phasing sub-district showed a low estimated annual income (THB 35,759, approximately equal to USD 1146), with a high Gini index at 67.59. In comparison, the Sanian sub-district had the highest estimated annual income (THB 111,651, approximately equal to USD 3578) among the sub-districts, with a Gini index of 29.93. In terms of the lowest estimated annual income, farmers in the Thuemtong sub-district earned THB 25,057 per year (approximately USD 803), with a Gini index of 31.44. For the Bosuak, Nasao, and Rueang sub-districts, the estimated annual income was THB 32,571 (equal to USD 1044), THB 32,990 (equal to USD 1057), and THB 39,777 (equal to USD 1275), respectively, with the Gini index at 22.60, 23.40, and 22.35, respectively.

The Lorenz curves in each sub-district showed different inequalities, and the Gini indices expressed the same situation; namely, registered farmers in the Mueang district mostly faced a situation of inequality of income distribution. Further studies should indicate the determinants of such inequality in each sub-district and investigate whether they show any significant evidence of income disparity.

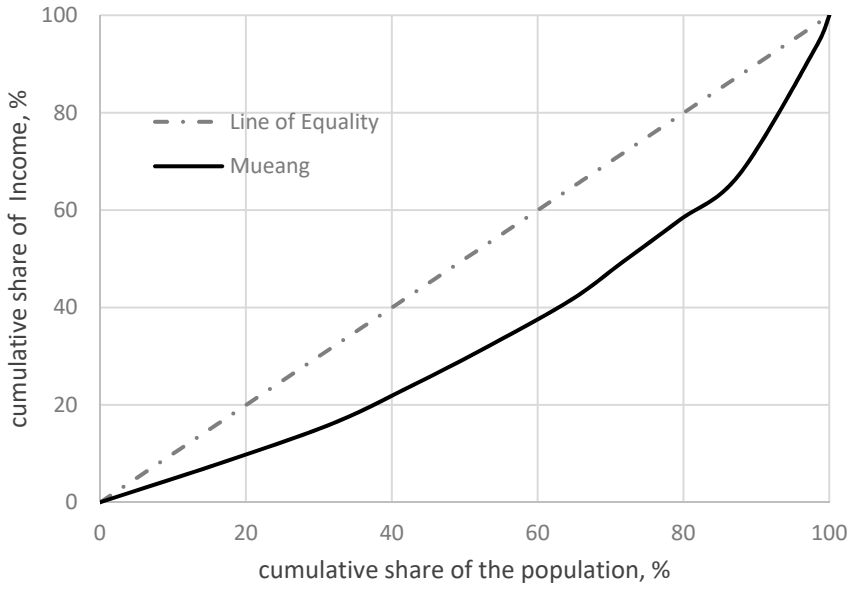

Figure 1. Lorenz curve for the Mueang district. Source: Authors' calculation based on data from the Department of Agriculture Extension of Nan province, Thailand (2018).

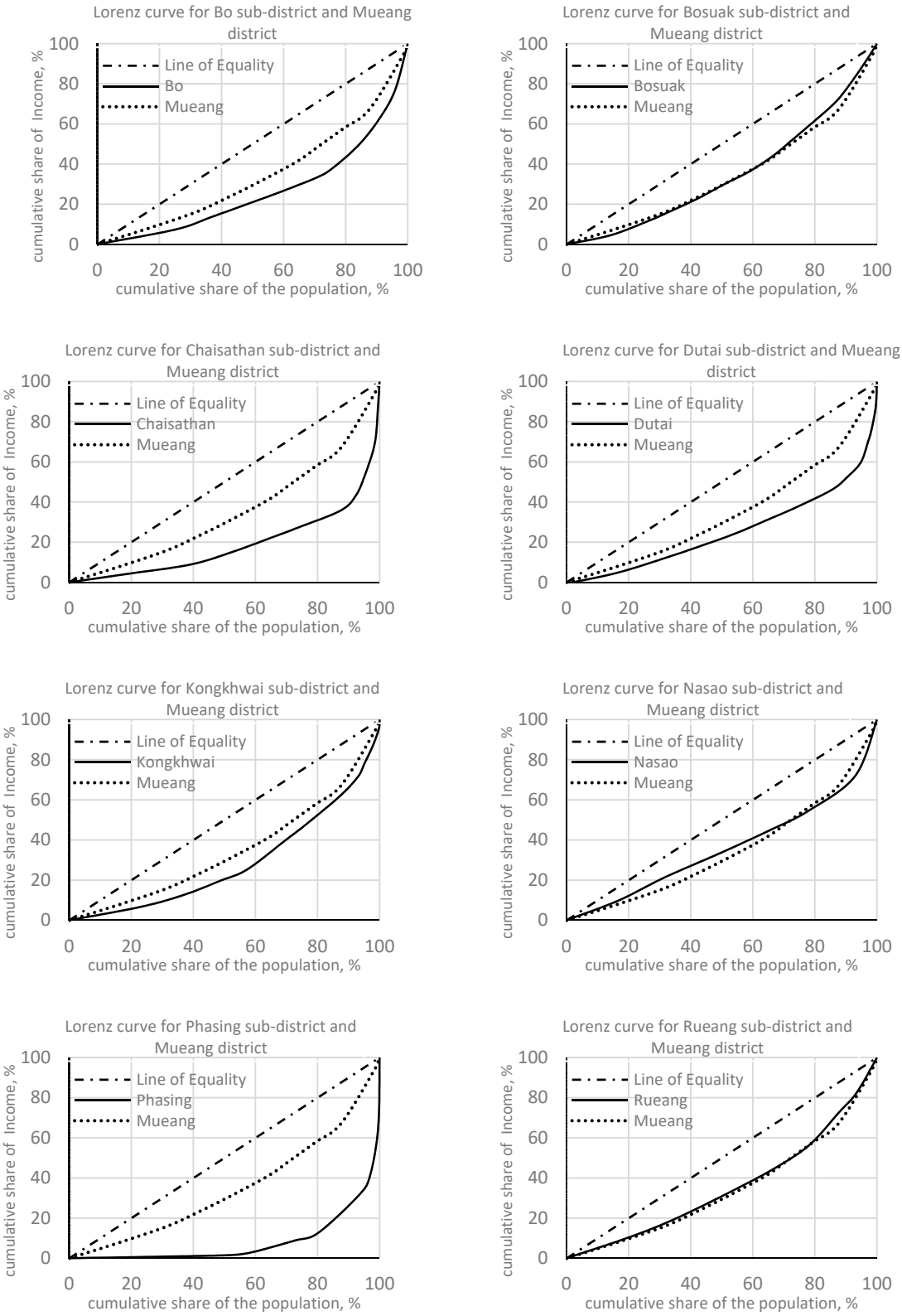

Figure 2. *Cont*.

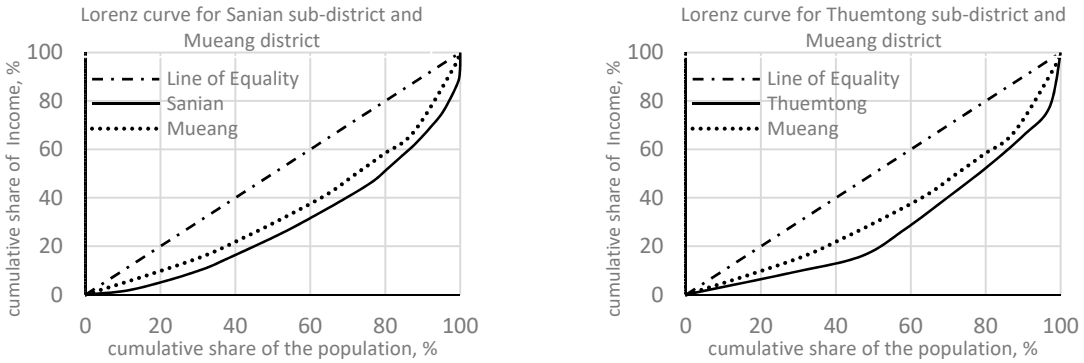

Figure 2. Lorenz curves of estimated income of urban registered farmers in 10 sub-districts and the Mueang district. Source: Authors' calculation based on data from the Department of Agriculture Extension of Nan province, Thailand (2018).

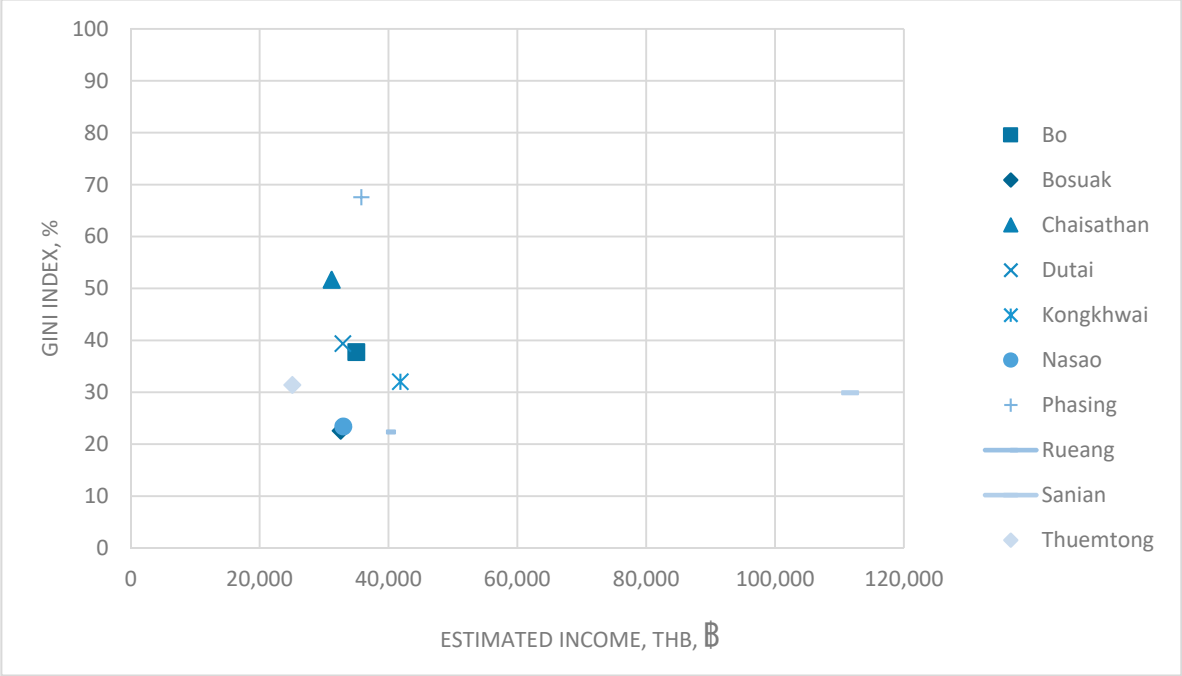

Figure 3. Estimated annual income and Gini index for sub-districts of the Mueang district in Nan province. Source: Authors' calculation based on data from the Department of Agriculture Extension of Nan province, Thailand (2018).

4.2. Descriptive Statistics on Socioeconomic Characteristics

Results of the analysis for the socioeconomic characteristics of urban farmers are presented in Table 1. The descriptive results revealed that the majority of urban farmers (68%) were male. About 82% of registered farmers had agricultural land ownership, with 73% having land use entitlement. Moreover, registered farmers who had both land ownership and entitlement accounted for 57% of the total, which implies that the other half of farmers in the Mueang district did not own the agricultural land, including the right to use the land. Land ownership was shown in past research to be a determinant of income diversification that can induce income inequality in farm households; farmland was also shown to be vital to farmers as landowners of small farms or near-landless farmers have very slight chances to gain any profit from agricultural activities [57–61].

Table 1. Descriptions of independent variables, with means and standard deviations.

Variable Name	Total Observations	Description †	Mean	Std. Dev. ‡
Estimated Income	10,328	CV: the estimated income followed by the Equation (1) calculation	40,914	81,791
Gender	10,328	DV; if farmer is male = 1, 0 o.w.	0.687	0.464
Land ownership	10,328	DV, if farmer is landowner = 1, 0 o.w.	0.827	0.378
Land use entitlement	10,328	DV; if farmer has the right from all the governmental and regulatory approvals for a particular use of the land = 1, 0 o.w.	0.736	0.441
Land ownership and entitlement	10,328	DV; if farmer is landowner and has the right from all the governmental and regulatory approvals for a particular use of the land = 1, 0 o.w.	0.575	0.494
Farm size	10,328	CV; the size of farmland (unit: Ha)	0.630	0.908
Rubber	253	DV; if farmer plants rubber = 1, 0 o.w.	0.024	0.155
Maize	1285	DV; if farmer grows maize = 1, 0 o.w.	0.124	0.330
Rice	8724	DV; if farmer grows rice = 1, 0 o.w.	0.845	0.362
Cassava	5	DV; if farmer grows cassava = 1, 0 o.w.	0.000	0.022
Palm Oil	2	DV; if farmer grows palm oil = 1, 0 o.w.	0.000	0.014
Soybean	15	DV; if farmer grows soybean = 1, 0 o.w.	0.001	0.038
Rambutan	4	DV; if farmer grows rambutan = 1, 0 o.w.	0.000	0.020
Longan	7	DV; if farmer grows longan = 1, 0 o.w.	0.001	0.026
Banana	0	DV; if farmer grows banana = 1, 0 o.w.	0.000	0.000
Other fruits	8	DV; if farmer grows other fruits = 1, 0 o.w.	0.001	0.028
Vegetable	3	DV; if farmer grows vegetables = 1, 0 o.w.	0.000	0.017
Animal	2	DV; if farmer raises animal = 1, 0 o.w.	0.000	0.014
Perennial tree	20	DV; if farmer grows perennial tree = 1, 0 o.w.	0.002	0.044
Horticulture	22	DV; if farmer cultivates fruits, vegetables and flowers, including plants for ornament = 1, 0 o.w.	0.002	0.046
Agronomy	10,029	DV; if farmer cultivates field crop, i.e., rice, rubber, maize, cassava, and soybean = 1, 0 o.w.	0.971	0.168
Livestock	2	DV; if farmer raises domestic animal = 1, 0 o.w.	0.000	0.014
Agroforest	275	DV; if farmer grows tree and shrub, e.g., teak = 1, 0 o.w.	0.027	0.161
Bo sub-district	319	DV; if farmer is in Bo sub-district = 1, 0 o.w.	0.031	0.173
Bosuak sub-district	1839	DV; if farmer is in Bosuak sub-district = 1, 0 o.w.	0.178	0.383
Chaisathan sub-district	1347	DV; if farmer is in Chaisathan sub-district = 1, 0 o.w.	0.130	0.337
Dutai sub-district	979	DV; if farmer is in Dutai sub-district = 1, 0 o.w.	0.095	0.293
Kongkhwai sub-district	1829	DV; if farmer is in Kongkhwai sub-district = 1, 0 o.w.	0.177	0.382
Nasao sub-district	1256	DV; if farmer is in Nasao sub-district = 1, 0 o.w.	0.122	0.327
Phasing sub-district	86	DV; if farmer is in Phasing sub-district = 1, 0 o.w.	0.008	0.091
Rueang sub-district	1076	DV; if farmer is in Rueang sub-district = 1, 0 o.w.	0.104	0.306
Sanian sub-district	728	DV; if farmer is in Sanian sub-district = 1, 0 o.w.	0.070	0.256
Thuemtong sub-district	869	DV; if farmer is in Thuemtong sub-district = 1, 0 o.w.	0.084	0.278

Note: † The abbreviations are as follows; DV, CV, and o.w. refer to the dummy variable, continuous variable, and otherwise, respectively. ‡ The abbreviation (Std. Dev.) means "Standard Deviation".

The results in Table 1 further indicate that the average size of farmland was 0.63 hectares. Several studies have demonstrated that farm size has an appreciable impact on income diversification, and that they have an inverse relationship [52–54,62]. Furthermore, the average estimated income from engaging in agriculture was THB 40,914 (approximately USD 1311) per year. The primary type of crop (97%) was agronomy, while rice cultivation (84%) was the main agricultural activity in the Mueang district. The farming activity could have a positive effect on the farm income diversification of farmers owing to the case study of the Bihar state of India [63], the farm enterprises horticulture and livestock incline to increase in farm income. Together with Schwarze et al. [19] alleged that in Indonesia, the crucial income source for rural households in the Lore Lindu National Park vicinity is gained from agricultural activities, about 68% of the total income.

4.3. Empirical Results from the Tobit Regression Model

The Tobit regression model was used to examine determinants that affect farm income diversification among farmers in the capital area of Nan province. The results in Table 2 show that farmers' socioeconomic characteristics drastically affect estimated income. There were 16 out of 17 variables that showed a statistically significant effect on estimated income diversification, with farm size, land ownership, land use entitlement, land ownership and entitlement, agronomy, livestock, and agroforest having shown statistical significance at the 1%.

Table 2. Empirical results from the Tobit regression model.

Dependent Variable: Estimated Income	Coefficient	Standard Error
Gender	–1694.6	1292.9
Farm size	37,988.4 ***	3656.7
Land ownership	20,650.4 ***	5378.7
Land use entitlement	29,269.3 ***	5477.8
Land ownership and entitlement	–20,950.1 ***	5440.5
Agronomy	109,883.3 ***	14,112.2
Livestock	936,494.6 ***	278,929.3
Agroforest	201,420.0 ***	28,456.7
Bo sub-district	–46,355.9 *	21,868.3
Bosuak sub-district	60,201.8 ***	12,441.5
Chaisathan sub-district	62,726.6 ***	12,524.6
Dutai sub-district	64,799.9 ***	12,394.2
Kongkhwai sub-district	61,823.8 ***	12,536.4
Nasao sub-district	67,229.8 ***	12,416.1
Rueang sub-district	56,721.1 ***	12,556.2
Sanian sub-district	99,272.6 ***	12,269.4
Thuemtong sub-district	63,012.0 ***	12,601.7
Constant	–181,620.3 ***	20,606.1
Number of observations	10,328	
F test	35.35	
Pseudo R-squared	0.0113	
Log Likelihood	–130,006.94	

Note: ***, * indicate the significance level at 1% and 10%, respectively.

On the one hand, land ownership, land use entitlement, farm size, and agricultural activities (i.e., agronomy, livestock, and agroforest) positively influenced farmers' estimated income diversification in the Mueang district. This denoted that as these variables have one unit of value increased, so does the estimated income. Farmers who owned cultivated land had a probability of attributing more farm income diversification. As expected, farm size also played a part in diversifying income for farmers. The coefficient for farm size was 37,988, which indicates that income distribution will be higher by 37,988 for increasing a hectare in farm size. According to Demissie and Legesse [22], the size of cultivated land and having livestock significantly and positively influence participation in a better position of wage. Together with Adebayo et al. [53] and Sallawu et al. [56], they stated that farm size had an impact on farm household income diversification practices.

On the other hand, farmers who owned the land with entitlement were negatively affected in their diversification of estimated income. This signified that if farmers themselves owned the cultivated land with the legal rights to utilize the land, their total share of income was reduced by THB 20,950 (approximately USD 671). This is an interesting outcome, as it denotes that registered farmers would not receive a higher income if they concomitantly owned the land and had the legal rights to utilize it; namely, as if the consequence of having land and the rights to use it would lead to lower farm income diversification. However, this outcome does correspond to previous studies that mentioned the owned land is one of the crucial factors to instigate income disparity in Thai farmers, and land resource is fundamental for producing in the agriculture sector [4,64,65]. Furthermore, the results in

the Tobit analysis demonstrated that living in the eight sub-districts of Bosuak, Chaisathan, Dutai, Kongkhwai, Nasao, Rueang, Sanian, and Thuemtong had a positive impact on farmers' estimated income if compared to the Phasing sub-district, while those living in the Bo sub-district would suffer a negative effect on their estimated income. Farmers cultivated in the Sanian sub-district have distributed the highest estimated income among other sub-districts by THB 99,272 (approximately USD 3180). In that case, farm activities or sizable land could conduct higher income diversifying in urban agriculture.

In addition, Table 3 shows the determinants of the estimated income divergence in each subdistrict. The results indicate that gender had no significant difference association with farm estimated income diversification in this study. Farm size, on the other hand, greatly impacted the estimated income for all sub-districts, especially in the Thuemtong and Chaisathan sub-districts. This indicated that the registered farmers in these two sub-districts would experience a bigger increase on their income if they increased the size of their farmland. This is similar to the findings of a study by Fadipe et al. [66]. An explanation for this finding could be that farmers who plant in sizable areas can produce more, which then enables an association with a higher income. Table 3 also shows that farmers in the Bo sub-district mainly cultivated rubber, maize, and rice. These crops had a significant and positive impact on diversifying income. Especially, the estimated income in Bo sub-district would be higher if registered farmers grew rice, instead of rubber or maize.

For the Bosuak sub-district, agricultural activity, such as producing rice, significantly and positively affected income diversification. Conversely, farmers in Chaisathan, Dutai, Kongkhwai, Nasao, and Phasing sub-districts were mostly engaged in maize plantation, which was substantially and negatively related to income diversification in these five sub-districts; namely, as long as farmers grow maize, the total farm estimated income diversification will be reduced. Cash crop as rice and maize had a significantly impact on diversifying income. In addition, farmers in the Rueang sub-district planted two significant crops: maize and rice; these two crops contributed to the dissimilarity of estimated income diversification in the area: maize plantation significantly and negatively influenced estimated income diversification, while rice plantation showed a significant and positive influence, so that growing more rice increased income by THB 55,625 (Approximately USD 1727) per year. In the Sanian sub-district, farmers produced many varieties of crops, like rubber, maize, rice, palm oil, soybean, rambutan, longan, and other fruits and vegetables. Growing these crops had a significant and negative impact on the diversification of estimated income. Last but not least, Thuemtong sub-district farmers were sole self-planters of maize, and this activity had significant and negative influences on the diversification of their farm estimated income.

In terms of cropping activities, one main economic crop that most farmers typically grew was maize. This crop was shown to negatively influence the overall farm income diversification in the area, except for the Bo sub-district. For instance, Phasing sub-district farmers who continued to engage in maize cultivation decreased their estimated income diversification by THB 165,640 (Approximately USD 5308). Meanwhile, Bo sub-district farmers who engaged in maize cultivation increased their estimated income diversification by THB 22,878 (Approximately USD 733). Conversely, rice plantations in most areas gave satisfactory and positive results in diversifying income. For example, in the Bo sub-district, farmers increased their income diversification by THB 103,552 (Approximately USD 3318) if they continued to grow rice; in contrast, the Sanian sub-district farmers' income would be reduced by THB 915,813 (USD 29,344) for growing the same crops. The outcomes in Table 3 can serve as important insights for the local government to devise relevant policies aimed at eliminating the potential income inequality in the area.

Table 3. Empirical results from the Tobit regression model of estimated annual income on each dependent variable by sub-district.

Dependent Variable: Estimated Income	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
	Bo Sub-District	**Bosuak Sub-District**	**Chaisathan Sub-District**	**Dutai Sub-District**	**Kongkhwai Sub-District**	**Nasao Sub-District**	**Phasing Sub-District**	**Rueang Sub-District**	**Sanian Sub-District**	**Thuemtong Sub-District**
Gender	3648.9	−747.9	−827.0	1384.2	−704.4	−281.2	−225.7	66.76	−5662.4	−3.906
	(3356.4)	(1574.0)	(618.2)	(2002.7)	(772.3)	(1067.7)	(8368.4)	(1002.6)	(8859.3)	(256.6)
Land ownership	−3970.1	−14,805.5	1098.0	4287.1	−8743.0	21,484.2 ***	7409.2	19,110.0 *	15,233.8	−313.9
	(4018.2)	(16,125.3)	(1025.8)	(6055.2)	(6222.1)	(4269.0)	(5942.0)	(8541.5)	(30,491.1)	(173.9)
Land use entitlement	9203.3 *	−50,221.4 **	−20,984.6	4889.5	−22,967.7 ***	11,059.8 *	−27,601.0	12,397.8	44,391.0	−4990.0
	(4628.7)	(16,532.6)	(11,386.0)	(5562.9)	(6090.7)	(5220.6)	(20,979.2)	(8444.1)	(32,371.1)	(3045.3)
Land ownership and entitlement	−8288.9	18,856.0		−2105.6	7768.4	−25,255.6 ***	23,647.5	−21,432.8 *	−49,241.8	
	(7316.1)	(16,177.6)		(6230.3)	(6411.9)	(4528.8)	(41,273.9)	(8738.3)	(32,341.3)	
Farm size	13,529.5 ***	43,768.3 ***	74,817.0 ***	54,290.9 ***	58,114.6 ***	67,872.2 ***	12,908.5 *	47,179.8 ***	68,731.8 ***	90,306.6 ***
	(788.0)	(4580.9)	(8756.7)	(7004.0)	(8171.1)	(4631.0)	(5741.2)	(4306.8)	(5199.8)	(773.8)
Rubber	40,350.7 ***	1143.6							−1,079,290.6 ***	
	(1504.5)	(17,487.3)							(96,532.6)	
Maize	22,878.9 ***	−15461.3	−88,520.8 ***	−47,470.9 ***	−75,871.2 ***	−91,023.0 ***	−165,640.6 ***	−13,229.1 ***	−1,090,820.3 ***	−75,582.3 ***
	(3538.3)	(16,663.7)	(21,037.2)	(3891.1)	(5594.9)	(4393.8)	(31,165.4)	(1791.0)	(94,879.7)	(13,273.0)
Rice	103,552.2 ***	88,458.4 ***						55,624.6 ***	−915,812.9 ***	
	(7477.3)	(16,720.4)						(2035.7)	(95,706.0)	
Casava										
Palm oil									−971,593.5 ***	
									(97,067.8)	
Soybean									−1,008,960.0 ***	
									(97,418.2)	
Rambutan									−1,104,120.5 ***	
									(121,700.3)	
Longan									−1,080,500.8 ***	
									(104,111.6)	
Banana										
Other fruits									−1,077,396.0 ***	
									(102,252.5)	
Vegetable									−944,269.4 ***	
									(97,178.6)	
Animal									−200,737.2	
									(254,982.4)	
Constant	−42,737.3 ***	−24,165.2	26,327.8	13,225.5	36,116.9 ***	2400.6	133,150.9 ***	−51,013.8 ***	934,285.2 ***	5722.1
	(6637.6)	(23,244.1)	(13,820.6)	(7647.7)	(7581.1)	(6827.5)	(16,424.3)	(9384.3)	(102,803.6)	(3328.0)
Number of observations	319	1839	1347	979	1829	1256	86	1076	728	869
F-test	3,255,867.49	88.24	167.42	199.82	76.70	287.00	28.04	700.00	446.51	8780.72
Pseudo R-squared	0.0437	0.0410	0.0735	0.0460	0.0487	0.0645	0.0478	0.0435	0.0347	0.1704
Log-Likelihood	−3685.7936	−21,513.353	−14,842.877	−11,320.156	−14,516.874	−14,516.874	−1022.566	−12,028.466	−9746.0658	−8536.0923

Note: ***, **, and * show the significance level at 1%, 5%, and 10%, respectively.

5. Conclusions

The farming profession has been propelling the agricultural sector and economic growth in northern Thailand to a considerable degree. However, within-group inequality among farmers vividly creates a massive gap, exclusively found in income distribution. This study provided greater insight into the conception of income inequality among urban farmers in city areas of the Nan province. The findings showed that there was great and unequal income variation among farmers in all sub-districts of the area. Moreover, the Gini index of farmers in the Mueang district was incomparably greater than zero. Estimating the income inequality of farmers provided an overall picture of the conditions in the studied area, thus helping potentially stakeholders to better understand the actual state of the economic stratification of farmers in Nan province. Further, this study provided a basis for managing the reduction of income inequality in the concerned sub-districts in comparison with other areas.

Furthermore, there was a wide range of income disparity among urban farmers, especially in the Phasing sub-district—which showed high inequality scores. Land ownership, land use entitlement, and farmland size positively contributed to farmers' estimated income. Regarding agricultural activities, rice farming significantly raised income diversification, while maize cultivation negatively affected it in nearly all sub-districts. We noticed a diversity of profitable crops that were appropriate for cultivation and in a suitable quantity for agricultural productivity, and there was a targeted market for these agricultural products. Regarding governmental efforts, policy implementation may benefit from a greater commitment to maintain the sizable agrarian areas intensively for the entire Mueang district and foresee importance relevance to land ownership and land use entitlement.

Recently, Agro-zoning is the major policy implementing in Thailand's agriculture in order to encourage farmers to produce suitable crops that are appropriate for their agricultural areas. There is a need for further proposals on agricultural land utilization and sustainable land protection to manage the urban agrarian area due to sustaining the sizable land of agriculture. The large-scale farming policy could assist and aggregate farmer groups to cultivate crops and manage the farm together. As we may think that the crop diversity may reduce the income inequality for each sub-district, while we do not see this conclusion in Sanian sub-district. Therefore, government should rethink how to maintain an enough farmland size for each farmer that could potentially sustain farmers' income.

Although this study mostly represents the outcome before the COVID-19, which stands for the coronavirus disease of 2019, the outcomes of this study present a significant contribution to the entire Mueang district in northern Thailand at the current stage. Especially, this study found out that the Phasing sub-district faced the worst condition of income inequality before the COVID-19. The local government needs to prevent the decrease of the farm size for farmers in the Phasing sub-district, i.e., farmers may quit farming and sell farm land for living. However, this empirical study would undoubtedly contribute valuable help to the government on practical implications and policy afterward.

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