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Smallholders' Preferences for Different Contract Farming Models: Empirical Evidence from Sustainable Certified Coffee Production in Vietnam

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Abstract: Contract farming is considered as institutional arrangements that manage the coordination of production and distribution between smallholder farmers and agro-industrial firms. Under the market reforms and industrialization process, contract farming links smallholder farmers to a better market through effective farming management and high-quality products. Despite the many benefits attributed to participation, the existing literature addresses the main issues that result in the opposing attitudes and motivations toward contract farming. This study therefore aims to analyze factors that influence the choices of smallholder farmers for different contract faming models using multinomial logistic (MNL) regression. Different contract attributes and socio-economic characteristics of farmer households are used as endogenous variables in the MNL model. Based on a research sample of 183 smallholder farmers involved in certified coffee production in Dak Lak province, Vietnam, the study revealed that there are different typologies of production contract including the informal model, intermediary model, and nucleus estate model. Significant factors that affect smallholders' preferences for different contract farming models are gender, farm size, the provision of inputs, price option, technical assistance, delivery schedule, and monitoring. Main issues that induce failures of contract farming are farmer's overdependence and the monopolistic power of industrial coffee firms in the nucleus estate model, as well as the information asymmetry in the informal model. In addition, a cost-benefit analysis symbolizes the role of the cooperative in the intermediary model, which is essential for augmenting win-win outcomes for smallholder farmers and industrial coffee firms.

Keywords: contract farming; smallholder; certified coffee production; multinomial logistic regression

1. Introduction

The transformation process of the global agriculture industry has introduced a higher level of managed coordination which is increasingly shaping the modern structure of agriculture in the third world [1–5]. In this context, contract farming has been considered as an important form of vertical coordination in order to provide small-scale farmers in developing countries opportunities to be part of the world market [3]. The existing literature has already highlighted the role of contract farming in addressing market failures [3,6–8], coordinating agribusiness activities to produce high quality products [3,9–13], improving farmer's income [6,8,13,14], and enhancing rural development by providing credit, inputs, information, services, and new cropping technologies [14–19]. However,

there also has been much debate about the contractual arrangements by the agro-industrial firms that often lack transparency and commitment and consequently cause a high default rate, cheating, delayed payment, and crop failure [6]. Further, the farmers' decisions to participate in contract farming are due to a variety of reasons, such as an inefficient market system, pervasive production risks, capital shortage, a lack of technical support, an input supply problem, product standardization, or simply the purpose of earning additional income [8,13,20].

Vertical coordination in the agricultural sector refers to the process of synchronizing successive stages of production, distribution, and marketing in order to manage economic relationships between farmers and agro-industrial firms [21,22]. Several forms of vertical coordination range from open production (spot market) to contract farming and vertical integration [21–24]. In the top hierarchy of vertical coordination in agriculture, a single agro-industrial firm acquires two or more successive stages within the same production vertical [21], which could be either backward or forward [25]. An agro-industrial firm vertically integrates because it secures the supplies needed to produce its product and the market needed to sell the product. At the lowest level of vertical coordination, open production notably leads to farm products more adapted to local markets where spot prices coordinate resource transfer across the stages of farm production [21,26]. Slightly different from both, contract farming involves more interaction between the agro-industrial firms and farmers in predetermining a delivery schedule, pricing mechanism, and product standards [21,24]. In contract farming, farmers and agro-industrial firms engage in intense relationships that include conflict, trust, commitment, and the expectation of continuity [27,28]. In recent years, increasing farmer participation in the export sector through contract farming has been attributed to the major role of processing and trading firms (both private and state-owned) in providing production resources and guiding farmers to a commitment of farming methods, delivery quantities, and product quality [7,8,13,22,29,30]. There is a belief that this trend stems from the so-called industrialization process, globalization, and agricultural market reforms, which demand greater vertical coordination [3,31]. In addition, concerns about food safety and a higher demand for international standards have tended to adopt the coexistence of contract farming and standardized agricultural production [22,32,33]. More generally, the incentives for contract farming in developing countries have recently increased as a response to market imperfection and transaction cost minimization [8,20,34,35]. Under the transaction cost economics (TCE) perspectives, agricultural transactions involve high uncertainty and there are additional risks facing smallholder farmers [8,20].

Key to understanding what contributes to the success and failure of contract farming are the motives of farmers and agro-industrial firms to engage in such economic relationships. However, contract farming models are diverse, not only with regard to the types of production, but also with respect to how they can be structured and managed [36]. Eaton and Shepherd (2001) have illustrated five broad contract farming models including the informal, intermediary, multipartite, centralized, and nucleus estate [37,38]. Individual small firms involved in an ad-hoc or semi-formal production contract (often on a seasonal basis) are characterized as the informal model [36,37]. The intermediary model consists of semi-formal to formal subcontracting by agro-industrial firms to intermediaries (farmer groups, buying agents, or cooperatives) who manage farmers' production and provide services [36,37]. Under the multipartite model, a variety of organizations, including statutory bodies, contract with farmers, which may involve public or private providers of credit, extension services, and inputs [38]. In the centralized model, an agro-industrial firm buys from a large number of farmers with pre-determined product quality and supply quantity. Input provision varies from minimum to opposite extremes where an agro-industrial firm takes control of most production stages [37]. The nucleus estate refers to large farm unit that operates centralized production and processing, guarantees technical assistance and a certain minimum provision of throughput via direct contracting with farmers (out-growers), and implements close monitoring and supervision throughout the production [15,36,37]. Differences in the technical requirements associated with production and transaction costs lead to the diversity of contractual arrangements between farmers and agro-industrial firms [39].

The Dak Lak coffee sector is an excellent case for examining the opportunities of certified coffee farmers and agro-industrial firms to enhance vertical coordination through contract farming in Vietnam. Vietnam remains one of the world's most competitive coffee producers but the sustainable future of the industry is being questioned due to various challenges [40,41]. First, production expansion cannot continue due to environmental limitations. Second, global issues such as climate change and deforestation directly affect coffee farmers through changes in local weather and water supplies [40,42]. Third, coffee replantation is urgent as more than 30% of the country's coffee trees are diminishing in coffee yield and quality [40]. Foremost, small-scale operations and the typical problems of limited access to credit and technical assistance do not allow coffee farmers to benefit from economies of scale, reduce production costs, raise productivity, and apply synchronous technologies. In this regard, the Vietnamese government has launched a sustainable certified coffee program in which coordinating production and distribution with main coffee processors/exporters is believed to bring better market access, new product development (standardized and higher quality), and an improvement of farmers' welfare. However, while new institutional arrangements have achieved successes, there remain many issues regarding continuity in the program's development.

Several authors have successfully explained the production efficiency [43] and ecological sustainability [44–47] of the Dak Lak coffee sector, but the motivation of smallholder farmers and coffee processors/exporters to engage in such a socioeconomic relationship of new product development [28] have never been explored. For that reason, this study aims to analyze the factors that influence farmers' preferences for different contract farming models under a sustainable certified coffee program by a revealed choice model using multinomial logistic (MNL) regression. The nature of this study is important from the transaction cost economics (TCE) perspective, in that contract farming could more likely strengthen vertical coordination or hamper the efforts of certified coffee farmers to access to high value markets. This study used a sample of 183 farmers who have participated in the sustainable certified coffee program in Dak Lak province. Key informant interviews, document analysis, and field observations were used to provide an overview of the coordination of production and distribution within the program, as well as the general benefits and main issues of contract farming. A household survey with semi-structured questionnaires was conducted to uncover key aspects of farmers' particular strategies to take part in vertical coordination through different contract farming models. The paper is organized into four sections. The first section provides the research area, data source and sampling, data analysis and empirical model specification. The next section outlines the main findings. A discussion, conclusion, and the direction of future research are presented in the final section.

2. Review of Literature

2.1. Farmers' Motivations towards Contract Farming Participation

Contract farming can be conceptualized as one of the governance structures in a vertical coordination continuum that can be utilized to influence the requirements of a higher level of managed coordination [3,48]. Governance structures such as networks, bureaucracy, cooperation, or markets are institutional arrangements that have evolved to prevent or reduce transaction costs [35,49]. Therefore, contract farming is explained as an institutional response to high transaction costs in agriculture resulting from uncertainty, risk, an incomplete market, information asymmetry, and coordination failures [3,6–8,50,51]. The farmers' motivation to participate in contract farming is increasing across various agricultural sectors in developing countries as part of so-called agro-industrialization [3,52].

Farmers choose to participate in contract farming for different reasons, and their motivations and attitudes reflect the type of contracts and specific contract attributes [8,53,54]. However, it is also possible to recognize two broad categories of farmers' motivation to participate in contract farming, namely performance assurance and risk management [52]. Thus, farmers are motivated to participate in contract farming as they find the potential returns more attractive than returns from alternative activities, or the level of risk to be acceptable [13,37]. More specifically, these attitudes emanate from the

need for access to credit in order to obtain input availability, the need for access to market information, opportunities to reduce factors of production, ability to enhance farm performance from access to technical assistance, or market integration [15,20,55,56]. Indeed, risk-averse farmers will accept more favorable contract terms in exchange for their certain returns [8]. However, previous studies also proved that the relationships between farmers and agro-industrial firms in contract farming are rarely governed by risk-sharing incentives [52]. That leads one strand in the literature to highlight how contract farming is replete with manipulation and the exploitation of agro-industrial firms [6,13]. The other strands, as already mentioned, emphasize that the motivations to participate are related to the positive impacts of contract farming on local economies by improving the welfare of rural smallholders [7,8,31,38,57,58]. In general, motivations are attributed to the perceived benefits of contract farming that alleviate the market uncertainties, enhance skills and knowledge acquisition, increase cash income, and most importantly social esteem [13,52].

2.2. Empirical Studies on Preference of Contract Farming

Many authors have explored the field of preference or motivation for agricultural production contracts where specific contract attributes are decisive factors for smallholder farmer in choosing whether to sign a contract [49,53,54,59,60]. Most of the study approaches referred to the neoclassical theory of farmers' maximizing behavior [57], transaction cost economics [6–8,20,30,53,61], agency theory [8,58], game theory [8], or combinations of these concepts [3,6,8]. Based on a stated preference or revealed preference data, a discrete choice model (binary logistic, multinomial logistic, mixed logistic, or conditional logistic) was developed for estimating farmers' behavior. However, the multinomial logistic model was widely used because it neither accommodates preference heterogeneity within choice data nor allows each respondent to respond to multiple choice sets [62]. Other authors utilized cluster analysis where factor analysis with PCA (principle component analysis) as the extraction method and varimax rotation are used to group different variables that influence farmers' preference toward different contract attributes. Then the optimum numbers of clusters are identified based on similar farmers' preferences. A few considered using latent class cluster analysis as a mixture likelihood approach to clustering. Empirical studies have found several contract attributes that affect farmers' choices or motivation toward contract farming including inputs supply [8,49], technical assistance [8,30,49], variable output [49], price options [30,49,54,61], delivery volume [54,59,63], contract duration [54,58,59], access to credit [8], quality agreement [49,60,64], monitoring [8,60], and payment [60].

Abebe et al. (2013) [49] employed a multi-category discrete choice model (conditional and alternative-specific conditional logistic) in the study of smallholders' preferences for contract design attributes. The study shows that smallholder farmers' willingness to participate in the contract farming of seed potatoes depends on several contract attributes such as the form of contract, inputs supply, technical assistance, seed supply by the involved agro-industrial firms, variable output qualification, and variable price options. In addition, the study results also indicated input market concern was more important as smallholder farmers considered contract farming as a mechanism to reduce production input uncertainty and fixed price option was not preferable in the output market. Beside, institutional factors (rising food prices) and individual factors (entrepreneurial attitude of farmers) discouraged farmers to participate in contract farming because it limits farmers' autonomy in making decision. Arouna et al. (2017) [60], used a stated choice model with mixed logistics in a study of contract farming preferences by smallholder rice producers in Africa. The findings described that producers preferred contract farming under several contract attributes including contract duration (short term), credit provision, monitoring and supervision, payment at delivery, group selling, and having agro-processors as a partner. Heterogeneity in preference indicated the different attitudes between male and female producers towards contract farming participation. Schlecht and Spiller (2012) [59] applied a latent class (LC) cluster analysis of farmers' attitudes towards contract design in the dairy industry in Germany. The study identified three different clusters indicating heterogeneity among dairy farmers' attitudes towards contracting and long-term business relationships. Independent dairy farmers

preferred short-term contracts. In addition, the authors suggested that higher base prices could be a factor leading to the acceptance of a long-term contract as independent dairy farmers displayed the highest price orientation. Furthermore, a long-term contract with committed contractual partners could help dairy processors to secure a stable raw milk supply. The group uninvolved majority represented the majority of farmers who were undecided on their preferences towards contract attributes. In brief, due to the novelty of the topic of farmers' motivation and attitude towards contract design and participation, empirical studies often encounter the problem of endogeneity due to omitted or unobservable variables.

3. Materials and Methods

3.1. Research Area

Dak Lak, a province of Vietnam, was chosen for this study. Dak Lak province is located in the Central Highlands (Figure 1). The province's geographic coordinates are from 107°28′57″ to 108°59′37″ east longitude and from 12°9′45″ to 13°25′06″ north latitude with an average elevation from 400 to 800 m. The total land area of the province is 13,125.37 square kilometers. Due to its unique geographical location with high altitude and favorable natural conditions with rich basaltic soil, Dak Lak has been the capital of coffee production in Central Highland regions, accounted for more than 30 percent of total coffee production in the whole country (Dak Lak Peoples' Committee). Coffee production provided employment for over 400,000 rural labors and greatly contributed to the economic and social development of the region. Nowadays, hundreds of private (including the foreign-invested) and state-owned exporter/processor are thriving in the coffee business, making the coffee bean market highly competitive [41]. The city Buon Me Thuot is the center of all coffee trading activities.

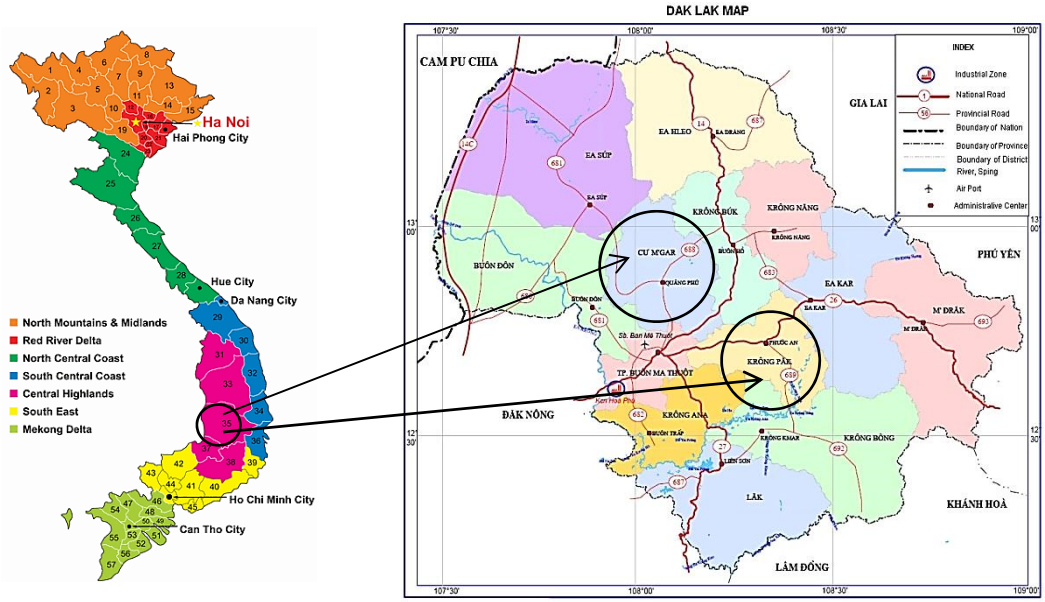

Figure 1. Study area.

Despite its successes, the coffee sector has recently confronted many issues and problems. First, climate change, i.e., a rising temperature, reduces the area of land suitable for coffee farming. Further, the traditional farming habits of intensive use of fertilizer and excessive water irrigation diminish soil fertility and induce water pollution [40,47,65]. Ground water reserves of the entire region are in danger as massive cases of digging wells during the dry season [40,45,47]. In addition, deforestation and a reduction of shade coffee are threatening biodiversity [42]. Besides, many farmers are now facing typical problems of limited access to capital and technical assistance [40,66]. On the other hand, economic transactions though spot markets often cause deficiencies in transferring production and

market information in terms of coffee quality, timing, and future demand [67]. In response to these challenges, a local government has been developing a model that encourages production-distribution coordination between smallholder farmers and coffee industrial firms. However, the coffee production areas designated in this coordination program account for less than 20% of total coffee production in the province [68]. In this program, coffee farmers sign production contracts with several exporters/processors and may or may not attain the full supports from these companies during production and distribution. This program has initially brought significant impacts on farmer' income and temporarily considered as a solution to achieve the goal of adding value to farm products and maintaining stable production of the sector. According to the local authorities, the coordination through contract farming between the coffee exporters/processors and the household farmers not only creates a stable source of high-quality certified coffee beans for export demand yet also contributes to improved awareness, better farming practices, production efficiency, environment protection, and the reciprocal relationship between coffee farmers and exporters/processors. Examples of such production coordination is with the use of cooperatives, namely Ea Kiet (183.3 ha), Cu Dle Mnong (233.5 ha), Quang Tien (105 ha), Minh Toan Loi (259.4 ha), and Tam Giang (166 ha). Here, horizontal and vertical linkages are promoted through input subsidies, synchronous production management, technical exchange and transfer, monitoring, production certification, and quality examination [68].

By the end of 2014, the total number of farmers involved in sustainable certified coffee production through contract farming was 49,680, which covers an area of 67,808 hectares with total output of 222,711 tons. Accordingly, this accounts for 33.3% of the total coffee land area and 48.2% of total coffee yield in Dak Lak. The most popular certification was 4C with 32,706 farmers and an area of 43,802 ha resulted in the production of 141,447 tons. UTZ Certified accounted for 12,937 farmers and an area of 17,446 hectares with production of 55,840 tons. The total 3823 farmers followed RFA certification, which accounts for an area of 6,143 hectares with production of 23,793 tons. At last, there was only small number of 214 farmers who applied Fair Trade certification in an area of approximate 417 hectares with production of 1631 tons. Except for the 4C and UTZ Certified existed early in Vietnam, other certified coffee productions are quite in the pilot phase to expand [68].

3.2. Data Source and Sampling

The data for this study were collected from the Cu M'gar and Krong Pak districts of Dak Lak. These districts are adjacent to the city center Buon Me Thuot of the province. Both primary and secondary data source were used. First, the document analysis gathered reports and official statistics from Dak Lak DARD, Cu M'gar DARD, Krong Pak DARD, WASI (Western Highlands Agro-Forestry Scientific and Technical Institute), Buon Ma Thuot Coffee Association (BMTCA), and VICOFA (Vietnam Coffee Cocoa Association). These documents are in regards to the details of coffee production and coordination program between main exporters/processors and smallholder farmers. Second, key informants was selected via a process of "theoretical sampling" [69] based on their potential to offer distinct and important perspectives on coffee contract farming and recent issues regarding farmers' participation in coffee coordinating production through contract farming. The key informants involved Dak Lak People Committee and DARD officials, Buon Ma Thuot Coffee Association (BMTCA) members, exporters/processors involved in coordinating coffee production program, cooperative directors, and heads of village. Third, the pre-test survey included exploratory direct interviews of six key informants and 50 coffee farmers, which was implemented in April 2016. The purpose was to justify the contents of the questionnaire and to assess the respondents' understanding. Hence, we analyzed responses and incorporated into the finalized questionnaire for household investigation in 2017. Based on the classifications of Eaton and Shepherd [37], Bijman [38], and Minot [63] (Figure 3), pre-test survey results elicited three different contract farming models for certified coffee farmers in Dak Lak. Those are informal model (InforM), intermediary model (InterM), and nucleus estate model (NeM). Out of 11 proposed contract attributes based on existing literature of [6,8,49,52,58–60], the pre-test survey also confirmed nine common contract attributes in most contract farming models,

including the duration of contract, provision of inputs, technical assistance, sale volume agreement, price premium agreement, coffee bean qualification agreement, speed of payment, delivery procedure, and supervision. Finally, the household investigation in 2017 covered 200 coffee farmers. However, empirical analysis was based on 183 coffee farmers due to the response rate was 91.5%.

The semi-structured questionnaire was designed to uncover key aspects of farmers' particular preference regarding contract farming model that they selected (i.e., types of contract farming, contract terms and conditions, the roles and functions of each contracting party, farm performance, and contract execution). At the beginning, the respondents were asked to provide the general information of the households' socio-economic characteristics. The latter section focuses on different contract attributes that reveal the farmers' choices of their contract farming model. The revealed preference data have the advantage of capturing actual choice decision [70]. The final section comprised several questions on farmers' perceptions toward general benefits, problems, and concerns related to contract farming participation. We conducted the interviews at the farmers' home, operational place or at the field. The observation was supplementary to the interviews, described as "unobtrusive observation" [71].

In this study, a two-stage sampling method was used. The first stage involved a purposive sampling of 200 sustainable certified coffee farmers from Krong Pak and Cu M'gar in Dak Lak where coordinating coffee production through contract farming has recently been promoted. In this area, coffee production is the main source of farmers' income. The second stage was to identify groups of farmers in different contract farming models. In the sample selection process, official experts in local authorities, extension centers, and the Dak Lak Department of Agriculture and Rural Development (DARD) were consulted. The major coffee exporters/processors, cooperative directors, heads of each local village were also involved in the finalizing process of respondents list.

3.3. Data Analysis and Model Specification

Data analysis with SPSS version 22 was carried out in two steps. The descriptive data analysis serves to identify basic socioeconomic characteristics of farmer household and farm performance (farm size, coffee yield, gross margin, and rate of return from coffee production) under different contract farming models. Farmers' attitudes toward contracting and revealed preferences for specific contract attributes were analyzed using cross tabulation and Chi-square test. Initial data analysis also includes multivariate assessment. Specifically, a multicollinearity test was utilized using the variance inflation factor (VIF) and the Eigen value. If the VIF is greater than 10, then there is a potential multicollinearity problem [72]. No serious multicollinearity problems among variables in the sample were detected by the VIF test as the variance inflation factors (VIF) ranged from 1.060 to 1.550. Accordingly, the tolerance values ranged from 0.696 to 0.956 and Eigen values was 10.499 (Appendix A Table A1). In addition, the Breusch-Pagan test was employed to detect the presence of heteroscedasticity and the test result indicated no problem of heteroscedasticity (p-value = 0.611) (Appendix A Table A2). In order to identify major factors that influence farmers' choices of contract farming model, the empirical multinomial logistic model (MNL) was used in the second step of analysis. The multinomial logistic model is a multi-equation model that estimates k-1 model, where k is the number of levels of the outcome variable. Each of the k-1 models is a binary logistic regression equation that compares each alterative choice with the base or reference choice. The choice of contract farming model is important decision for farmers where many transaction cost attributes are considerably the basis for precise decision.

In this study, the MNL model of farmers' choices of contract farming is based on the random utility theory [73]. The multinomial logistic is analogous to a binary logistic regression except that the probability distribution is categorical placement. The independent variables can be either dichotomous or continuous. Suppose that the U_{ij} is the utility of certified coffee farmer ith derived from alternative contract farming model j (where $j = 1, 2, \ldots, J$), a certified coffee farmer utility function can be represented as follows:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \quad (1)$$

The perceived U_{ij} is overall utility that can be expressed as sum of two terms: a systematic utility V_{ij} and a random residual ε_{ij}. Indirect utility V_{ij} represents mean of all coffee farmers having the same choice context as farmer *i*. The ε_{ij} captures the combined effects of the various factors that introduce uncertainty in the model. If the certified coffee farmer *i*th selects the contract farming model *j*, the U_{ij} is the largest utility among other *j* utilities. The probability that farmer *i* selects alternative *j* can be specified as:

$$P_{ij} = P(V_{ij} + \varepsilon_{ij} > V_{ik} + \varepsilon_{ik}) \text{ for all other } k \neq j \quad (2)$$

If the error terms are identically and independently distributed, the probability that coffee farmer *i* chooses contract farming model *j* can be explained by the multinomial logistic model (Green, 2000). In this study, multinomial logistic (MNL) regression was used identify the determinants of coffee farmers' choice of contract farming model (j = 1: InforM referred to informal model; j = 2: InterM referred to the intermediaries model; j = 3: NeM referred to nucleus estate model). Multinomial logistic regression is often considered as standard method for estimating multi categorical dependent variables, which does not assume normality, multicollinearity, or homoscedasticity across the choices [74,75]. Slightly different from discriminant function analysis that requires these assumptions are met, MNL is a more flexible and robust method in the case of violations of these assumptions [75]. Application of MNL in this study only has assumption of independence among the dependent variable choices (Table 1). The probability of contract farming model choices among certified coffee farmers from the alternatives is the function below:

$$P(Y_i = j/X_i) = P_{ij} = \frac{e^{Xi.\beta j}}{\sum_{j=1}^{J} e^{Xi.\beta j}}, i = 1, 2, \ldots, 183; \; j = 1, 2, 3 \quad (3)$$

Table 1. Explanatory variables hypothesized in MNL model.

Variables	Questionnaire/Variable Specification	Mean	SD	Hypothesis
AGE	Age of respondents (years)	44.60	10.03	+/−
GEN	Binary variable =1 if respondent is male, 0 = female	0.67	0.47	+/−
EDU	Continuous variable (number of years in school)	9.66	2.45	+
ETHN	Binary variable = 1 if respondent is Kinh ethnic majority, 0 = ethnic minorities	0.76	0.43	+/−
FARM	Continuous variable (number of hectares allocated for coffee)	1.40	0.65	+/−
DURA	How long is the contract? 1 = long term, 0 = short term (seasonal basis)	0.62	0.49	+/−
INPUT	Does contract include inputs provision during planting? 1 = yes, 0 = otherwise	0.37	0.48	+
TECH	Does contract include technical assistance during planting? 1 = yes, 0 = otherwise	0.63	0.48	+
SUPP	Do you have agreement on supply volume in production contract with coffee-industrial firm? 1 = yes, 0 = otherwise	0.56	0.50	+
PRICE	Do you have agreement on price premium in production contract with coffee-industrial firm? 1 = yes, 0 = otherwise	0.36	0.48	+
QUAL	Do you have agreement on coffee bean qualifications in production contract with coffee-industrial firm? 1 = yes, 0 = otherwise	0.45	0.50	+
PAY	Do you have payment within a week after delivery? 1 = yes, 0 = otherwise	0.54	0.50	+/−
DELI	Does coffee-industrial firm have schedule for your delivery? 1 = yes, 0 = otherwise	0.80	0.40	+
MOR	How often are the monitoring and supervision by coffee-industrial firm during planting? 1 = frequently, 0 = not frequently	0.67	0.47	−

Note: SD denotes standard deviation.

Where, P_{ij} is the probability of ith farmer choice of contract farming model j. Hence, j = 1, 2, and 3 are the choices of informal coordination model (InforM), intermediaries model (InterM), and nucleus estate model (NeM), respectively. Accordingly, P_{i1}, P_{i2}, and P_{i3} are the probabilities representing the selection of ith coffee farmer for the informal model (InforM), intermediaries model (InterM), and nucleus estate model (NeM), respectively. X_i are independent variables (explanatory) that include socioeconomic characteristics of certified coffee farmers and attributes in each contract farming model. These are X_1 = Age of household farmers (AGE), X_2 = gender (GEN), X_3 = education (EDU), X_4 = ethnic (ETHN), X_5 = farm size (FARM), X_6 = contract duration (DURA), X_7 = input provision (INPUT), X_8 = technical assistance (TECH), X_9 = supply volume agreement (SUPP), X_{10} = price premium agreement (PRICE), X_{11} = agreement on coffee bean qualification (QUAL), X_{12} = Payment, X_{13} = delivery schedule (DELI), and X_{14} = monitoring (MOR). Table 1 represents a detail of variables used in MNL model. β_j are parameters to be estimated by maximum likelihood estimation (MLE) with InforM (informal model) as a base (reference) category ($\beta_1 = 0$). The probability that a base (reference) category was chosen are the following equation:

$$P(Y_i = 1/X_i) = P_{i1} = \frac{1}{1 + e^{Xi.\beta 2} + e^{Xi.\beta 3}} \quad (4)$$

The fact is that sum of P_{ij} equals to 1, the separate probabilities that InterM (intermediary model) and NeM (nucleus estate model) were chosen can be expressed as:

$$P(Y_i = 2/X_i) = P_{i2} = \frac{e^{Xi.\beta 2}}{1 + e^{Xi.\beta 2} + e^{Xi.\beta 3}} \quad (5)$$

$$P(Y_i = 3/X_i) = P_{i3} = \frac{e^{Xi.\beta 3}}{1 + e^{Xi.\beta 2} + e^{Xi.\beta 3}} \quad (6)$$

The parameter estimates measure the actual magnitude of change in the MNL for one unit change in the explanatory variable while holding the other explanatory variables constant. The positive estimated coefficient indicates an increase in probability that a coffee farmer will choose the alternative contract farming model from base reference category (InforM) [73]. The negative estimated coefficient refers to less likelihood that a coffee farmer will change to alternative options. The marginal effect Exp (B) (see Table 4) measures the expected change in probability of a particular contract-farming model being chosen with respect to a unit change in an explanatory variable from the mean. A common measure of goodness of fit in choice models is the pseudo-R^2 [76].

4. Results

4.1. Socioeconomic Charecteristics of Coffee Farmer

Descriptive statistics also shows that the age of certified coffee farmers ranges from 20 to 67, and the average age is 44.6 years. The average education is 9.66 (years in school), which indicates farmers' capability to acquire and utilize skills and knowledge from trainings and transfer it into efficient production (Table 1). A majority of the 139 respondents are Kinh ethnic and the rest are Ede, Gia Rai, Tay, Thai, and other ethnic minorities (Table 2). Ethnic minority farms are less favorable for coffee production and most of ethnic minority farmers in remote areas are now facing typical problem of limited access to credit and technical assistance [46,68]. Among three contract-farming models, the frequencies of ethnic minority farmers are 6.6%, 10.4%, and 7.1% in InforM, InterM, and NeM, respectively. This accounts for 24% of total respondents in this study. Female farmers accounts for one third of total respondents. In addition, the frequency of female farmers in informal coordination model is relatively low at 2.2% (Table 2). It is worth noting that women are often a crucial resource in agriculture and rural economy.

Like most agricultural sectors in Vietnam, the unavoidable problem of the Dak Lak coffee sector is that most coffee plantations are small-scale operations (<2 hectares), which hampers farmers to benefit from economies of scale and apply synchronous production technologies. The average farm size is 1.4 hectares (Table 1). Descriptive statistics in Table 2 represent the frequencies of farm size in each contract farming model. In the informal model (InforM), number of farmers with specified coffee land for coordinating production smaller than 1 hectare, from 1–2 hectares, and more than 2 hectares account for 34%, 61.7%, and 4.3% of the total InforM farmers respectively. The similar statistics respectively are 13.3%, 75%, and 11.7% for the InterM and 13.2%, 76.3%, and 10.5% for the NeM. The frequency analysis indicates that the numbers of farmers who devote larger coffee land to coordination program are significantly higher in the intermediary model (InterM) and nucleus estate model (NeM) than informal model (InforM).

Table 2. Socioeconomic characteristics of coffee farmers.

Variable		InforM	InterM	NeM	Total	Chi-Square
Gender	Female	4 (2.2)	30 (16.4)	27 (14.8)	61 (33.3)	20.696 [a]
	Male	43 (23.5)	30 (16.4)	49 (26.8)	122 (66.7)	
Ethnic	Kinh	35 (19.1)	41 (22.4)	63 (34.4)	139 (76.0)	3.970 [b]
	Others	12 (6.6)	19 (10.4)	13 (7.1)	44 (24.0)	
Farm size	<1 ha	16(34.0)	8 (13.3)	10 (13.2)	34 (18.6)	10.874 [c]
	1–2 ha	29 (61.7)	45 (75.0)	58 (76.3)	132 (72.1)	
	>2 ha	2 (4.3)	7 (11.7)	8 (10.5)	17 (9.3)	
Total		47 (100.0)	60 (100.0)	76 (100.0)	183 (100.0)	

Note: [a, b] indicates zero cells (0.0%) have expected count less than 5. The minimum expected count is 15.67 and 11.30. [c] indicates 1 cells (11.1%) have expected count less than 5. The minimum expected count is 4.37. Figures within the parenthesis are percentages computed for each column.

4.2. *Coffee Contract Farming Model*

Three contract-farming models were identified through which coordinating production and distribution enhances production efficiency, technical synergies, standardization, and farm performance (Figure 2). These contract farming models, not mutually exclusive, are the informal model, intermediary model, and nucleus estate model. Typologies of contract are presented in Figure 3.

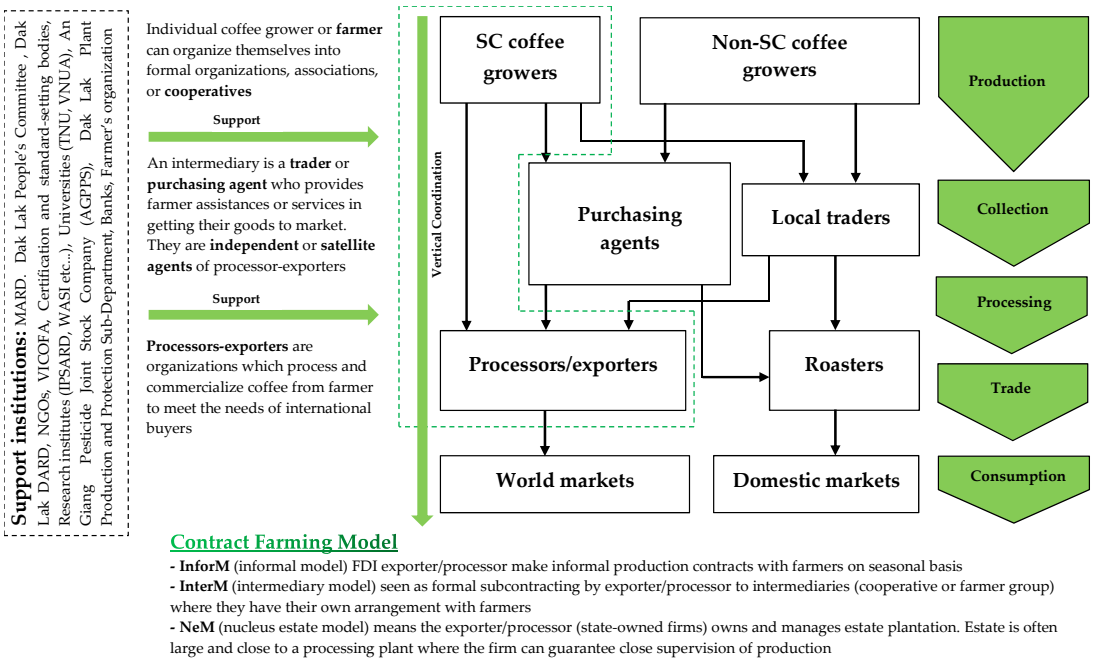

Figure 2. Coordinating production and distribution in the coffee supply chain of Dak Lak. Source: Own elaboration.

Increasing buyer investment →

Categories	InforM	InterM	NeM
Farmer selection	certified and well-endowed	certified and cooperative member	certified
Field selection	based on agro-ecological suitability, infrastructure conditions, and institutional reliability (contract compliance)		
Contract formulas	based on market specifications	based on market specifications and production management	based on income specifications, resource-providing and production management
Contract format	ad-hoc or semi-formal or verbal agreement	simple registration	legally formal agreement
Centralized production	no	no	yes
Crop schedule	no	yes	yes
Pricing policies	flexible pricing based on local market prices	fixed	flexible pricing based on local market prices
Technical assistance	sometimes	sometimes	frequently
Input provision	limited	limited	yes
Training provision	limited	yes	yes
Communication	direct	through cooperatives	direct
Monitoring	sometimes	sometimes	often
Post-harvest logistic	sometimes	often	always

← *Increasing risk of inconsistent supply*

Figure 3. Typologies of contract farming models. Source: Own elaboration based on [38,39,65].

The informal contract farming model (InforM), has been recently used by direct, informal, and simple production contracts with certified coffee farmers from Simexco Dak Lak, Anh Minh, and Armajaro companies. These contracts are signed on a seasonal basis with limited support of capital or material inputs. The advantage of this model is the ability to secure supply volume with technical advices, grading, and quality control. In fact, buyers (exporters/processors) in this model only sign a contract with well-endowed farmers. For the deprived ones, they only provide informal arrangements that specify the share of benefits and responsibilities of the two parties. However, these informal arrangements contain a high risk of default that requires legal actions. The success of this model depends on the availability of inputs markets and supporting institutions such as AgriBank, WASI, and Peoples' Committee in Dak Lak.

Intermediary model (InterM) involves Dak Man Company (coffee processor/exporter) in subcontracting linkages with certified coffee farmers to cooperatives, buying agents, or other small companies. The use of cooperative as intermediary is typical in this contract farming model in Dak Man. The advantage of this contract farming model is the large coffee processors/exporters can avoid the direct interaction through formal arrangement of cooperatives with multi small-scale coffee farmers. Besides, cooperatives are responsible for required farming practices and inputs regimen in exchange for marketing arrangement [8]. However, involved coffee processors/exporters can face potential risk of losing control over production, standardization, coffee quality, and coffee prices paid to farmers by cooperatives [25]. In addition, the buyers (Dak Man) must provide favorable policy terms, or even pay a commission to cooperatives. Dak Man Company has been practicing the intermediary model for a long time. In the beginning of 2016, Dak Man has already collaborated with 10 cooperatives, which account for 668 certified farmer households farming an area of 1241 hectares with coffee production of 4862 tons.

The nucleus estate contract farming model (NeM), referred to directed contract farming, has been utilized by Thang Loi and Phuoc An Company (state-owned) who owns and controls large estate plantation. They previously were state-owned farms during the 1990s and are now becoming joint-stock companies with major businesses in coffee processing and export. These sponsors provide material inputs and introduce synchronous technologies, management techniques, production certification to coffee farmers (considered as satellite growers) [25]. Thang Loi and Phuoc An normally sign a production contract with smallholder farmers on a long-term basis (sometime 5 to 6 year-crops). The contract specifies how risks and rewards from coffee production are shared. The advantage of this contract farming model is rigorous supervision over certified coffee production and distribution as well as economies of scale. In addition, this model creates employment opportunities to local communities. However, there have been incidents that certified coffee farmers have to pay an additional commission to these companies. Agreements on supply quantity and price are other controversial issues. The nucleus estate model recently accounts for 17%–18% of total coffee production in Dak Lak with participation of Thang Loi, Phuoc An, and other state-owned companies [68].

4.3. Contract Attributes

Contract farming in written form or verbal agreements usually specifies responsibilities and obligations of both parties, which can be made directly or indirectly with coffee farmers. In the case of intermediary model (InterM), the buyers (coffee processors/exporters) signs the contract with cooperatives or farmer associations who make their own arrangement with certified coffee farmers [25]. In this study, the specifications of coffee contract farming in Dak Lak include the duration of contract, quality standard, farmers' production quota, supply volume, required farming practices, delivery arrangement, price premium, technical assistance, material input provision, and payment. In term of contract length, formal arrangement between nucleus processors/exporters and coffee farmers (NeM) are legally endorsed contracts that last in long-term basis (Table 3). In some particular cases of NeM, contracts lasted for 5–6 years. In the informal model (InforM), the duration of contract is on seasonal basis of which certified coffee farmers could resign from contract position as if they are not willing to continue. However, farmers' contract resignation should be notified (notice of cancellation). In the InterM, the duration of contract depends on official cooperative membership of coffee farmers. This is considerably a simple registration format of contract farming. Table 3 shows different contract specifications in three contract farming models in Dak Lak.

Table 3. Contract attributes in different contract farming model.

Categories	InforM	InterM	NeM	Total	Test	
	(n = 47)	(n = 60)	(n = 76)	(N = 183)	χ^2	*p*-Value
Duration						
- long term	0 (0.0)	38 (63.3)	76 (100.0)	69 (37.7)	123.680	0.000
- short term	47 (100.0)	22 (36.7)	0 (0.0)	114 (62.3)	123.680	0.000
Provision of inputs	8 (17.0)	21 (35.0)	38 (50.0)	67 (36.6)	13.709	0.001
Technical assistance	23 (48.9)	42 (70.0)	51 (67.1)	116 (63.4)	5.813	0.055
Agreement						
- on supply volume	26 (55.3)	34 (56.7)	43 (56.6)	103 (56.3)	0.024	0.988
- on price premium	11 (23.4)	23 (38.3)	31 (40.8)	65 (35.5)	4.141	0.126
- on coffee quality	11 (23.4)	31 (51.7)	41 (53.9)	83 (45.4)	12.366	0.002
Payment						
- within a week	29 (61.7)	35 (58.3)	35 (46.1)	99 (54.1)	3.509	0.173
- delayed	18 (38.3)	25 (41.7)	41 (53.9)	84 (45.9)	3.509	0.173
Delivery						
- Scheduled	28 (59.6)	54 (90.0)	65 (85.5)	147 (80.3)	17.662	0.000
- Not scheduled	19 (40.4)	6 (10.0)	11 (14.5)	36 (19.7)	17.662	0.000
Monitoring						
- Frequently	39 (83.0)	34 (56.7)	50 (65.8)	123 (67.2)	8.399	0.015
- Not frequently	8 (17.0)	26 (43.3)	26 (34.2)	60 (32.8)	8.399	0.015

Note: Figures within the parenthesis are percentages computed for each column.

Provision of material inputs is limited in the InforM that refers to small proportion of surveyed farmers having access to fertilizer and pesticide provided by Armajaro Company (17%). This attribute was reported by a significant higher number of coffee farmers in intermediary and nucleus estate model, which are 35% and 50%, respectively. Limited access to technical assistance is typical problem that sometime hamper farmers efforts to boost productivity and make them unable to deliver the volume and quality of the produce. However, the percentage of farmers who have access to technical assistance in the InforM, InterM, and NeM are relatively high at 48.9%, 70%, and 67.1%, respectively. In the InforM, as previously mentioned, Armajaro Company only signs formal contracts with endowed farmers specifying required quality standards through percentage of ripe cherries. For those deprived ones, informal arrangements merely describe the price premium in terms of whether farmers could achieve good agricultural practices during planting. This ambiguous contract term later leads to pricing disagreement when the delivery is carried out. Coffee price agreement in most cases is based on local market prices and premium is calculated with regard to different production certification types. Fields observation in this study reports the premium ranges from 200 to 2000 VND/kg coffee bean (about 1 to 10 US cents). The number of farmers who reach agreement on supply volume, price premium, and coffee bean qualification in the InforM accounts for 55.3%, 23.4%, and 23.4% respectively. The agreements of these contract attributes between farmers and cooperatives were reported by 56.7%, 38.3%, and 51.7% of total surveyed farmers in the InterM. For the NeM, the statistics are 56.6%, 40.8%, and 53.9% of coffee farmers whose supply volume, price premium, and coffee qualification terms in their farming contracts were fulfilled. In different contract faming models, the buyers (processor/exporters) often pre-arrange and organize delivery at the procurement points, location of designated local buying agents, or at coffee farms. The respective frequency 59.6%, 90%, and 85.5% of total surveyed farmers in the InforM, InterM, and NeM reported that procurement is usually scheduled before harvest. However, late payment is common, as it occurred to 38.3%, 41.7%, and 53.9% of total surveyed farmers in these contract-farming models. It is surprising that many coffee farmers (83%) in the InforM claimed that the production was under frequent monitoring and supervision. The relatively lower percentages 56.7% and 65.8% of surveyed farmers in the InterM and NeM reported the frequent actions to monitor and manage production by the cooperatives and nucleus sponsors (processors/exporters) despite these contract-farming models are theoretically attributed to higher level of control over out-growers production and efficient management. Finally, a legal remedy will exercise in the provincial courts for a breach of contracts especially in case of NeM model that formal economic contracts have been used between nucleus sponsors and out-grower farmers. For informal to semi-formal arrangements in the InforM and InterM, non-compliance will lead to the exclusion of coffee farmers from production coordination. In the case of production risks (disease, drought, precipitation, etc.) or market price fluctuation, both parties come to a discussion of how such risks are evenly shared.

4.4. Estimation of MNL Model

Multinomial logistic (MNL) regression was used to assess certified coffee farmers choices in three different contract-farming models. Using Akaike information criterion (AIC), the MNL model fitted the empirical data (the lower the value of AIC the better model). The study used stepwise method (backward elimination using Wald test) for removing and retaining the independent variables. At the final step, there are seven independent variables enter the final models to evaluate the effects of these variable on the preference of farmers toward different contract-farming model. These selected variables obtained the probability of the likelihood-ratio statistic for variable entry smaller than 0.05 (see Appendix A Table A4), which include gender (GEN), farm size (FARM), provision of inputs (INPUT), agreement on price premium (PRICE), technical assistance (TECH), delivery (DELI), and monitoring (MOR). Excluded variables obtained the probability of the Wald test for variable removal greater than 0.1 (see Appendix A Table A3), which are the age of coffee farmers (AGE), ethnic (ETHN), education (EDU), duration of contract (DURA), agreement on supply volume (SUPP), agreement on coffee bean qualification (QUAL), and payment (PAY).

The results from multinomial logistic estimation of farmers' preference for different contract-farming models are in Table 4. Positive sign of estimated coefficient indicates an increase in the probability of the alternative outcomes (here are InterM and NeM) relative to the changes in the probability of the reference category (InforM) response [73]. On the contrary, negative sign of estimated coefficient indicates a decrease in the probability of the alternative outcomes relative to the changes in the probability of the reference category response. The selection of reference category depends on the scientific aims of the study. Therefore, we selected informal farming model (InforM) as a base category because it covers the smallest group of farmers in the research sample. The marginal effect value Exp (B) indicates the magnitude of the changes in the probability of the alternative outcomes relative to the changes in the probability of the reference category response as one-unit increases in the explanatory variables.

Table 4. MNL parameters estimates of farmers' preference for different contract farming models.

Contract Farming Model [a]		B	SE	Wald	Sig.	Exp(B)
InterM	Intercept	−0.610	0.899	0.460	0.498	
	GEN	−2.860	0.682	17.594	0.000 *	17.462
	FARM	−1.470	0.470	9.800	0.002 *	4.351
	INPUT	0.976	0.583	2.806	0.094	0.377
	PRICE	1.154	0.559	4.257	0.039 *	0.315
	TECH	1.327	0.534	6.190	0.013 *	0.265
	DELI	1.506	0.626	5.792	0.016 *	0.222
	MOR	−2.094	0.600	12.169	0.000 *	8.114
NeM	Intercept	1.011	0.811	1.552	0.213	
	GEN	−2.060	0.663	9.654	0.002 *	7.843
	FARM	−1.099	0.450	5.955	0.015 *	3.002
	INPUT	1.724	0.531	10.550	0.001 *	0.178
	PRICE	1.208	0.523	5.334	0.021 *	0.299
	TECH	1.078	0.490	4.839	0.028 *	0.340
	DELI	1.119	0.529	4.477	0.034 *	0.327
	MOR	−1.695	0.574	8.734	0.003 *	5.448
N = 183; LR Chi square (14) = 80.450; −2 Log likelihood = 314.715 Probability > Chi square = 0.000; Pseudo R^2 (Nagelkerke) = 0.402						

Note: [a] Base category is InforM. * Significant at $p < 0.05$.

The estimation results show that the variables of gender (GEN), farm size (FARM), and monitoring (MOR) negatively and significantly influenced the preference of certified coffee farmers for the intermediary model (InterM) and nucleus estate model (NeM) over the informal model (InforM) (Table 4). The marginal effects of GEN and FARM indicate that as one unit increases in gender or farm size expect to decrease the probability of farmer's preference for the intermediary model over the informal model by respective factors of 17.462 or 4.351, ceteris paribus. Accordingly, as one unit increase in gender or farm size, the probability that farmers prefer to participate in the nucleus model relative to the informal model expects to decrease by respective factors of 7.843 or 3.002, ceteris paribus. Hence, we concluded that the preferences for the contract-farming model InterM and NeM over the InforM were negatively relative to gender and farm size of certified coffee farmers. This means male farmers who own larger farm size might not prefer to participate in the intermediary or nucleus estate contract-farming model to the informal model. Given a one unit increase in the variable MOR, the marginal effect of this contract attribute (monitoring) also implies that the probability of preferring intermediary model and nucleus estate model over the informal model would decrease by 8.114 and 5.448 times, ceteris paribus. It did not seem that certified coffee farmers prefer to be under frequent monitoring and supervision during planting.

The inputs provision (INPUT) variable positively and significantly affected the farmers' choices of nucleus estate model (NeM) over the informal model (InforM). Access to good material inputs not only helps coffee farmers to increase quantity and quality of coffee supply but also enhances the livelihood of coffee farmers. In the study areas, credit shortage often leads to farmers' purchase of low-quality

fertilizers and pesticide, which later results in inefficient coffee production. The marginal effect of INPUT variable indicates that the likelihood of preferring a nucleus estate model to the informal model would increase by 17.8%, ceteris paribus, given one-unit increase in this variable. Thus, the farmers' preference for the nucleus estate model is positively relative to the ability of nucleus sponsors to provide throughput via direct contract farming with their out-grower farmers.

Variables PRICE (agreement on price premium), TECH (technical assistance), and DELI (delivery) positively and significantly affected the preference of certified coffee farmers for both intermediary (InterM) and nucleus estate models (NeM) compared to the informal model (InforM). Holding other variables constant, the marginal effects of PRICE, TECH, and DELI indicate that the likelihood of preferring intermediary model to the informal model would increase by respective 31.5%, 26.5%, and 22.2%, as one-unit increase in PRICE, TECH, and DELI variables. As well, the contract attributes PRICE, TECH, and DELI of certified coffee farmers expect to increase the likelihood of preferring the nucleus estate model to the informal model by respective 29.9%, 34.0%, and 32.7%, ceteris paribus. We confirmed that farmers' preferences of intermediary and nucleus estate model over the informal model were positively relative to several contract attributes such as agreement on price premium, technical assistance, and delivery. More generally, it would be expected that certified coffee farmers are more likely to prefer intermediary and nucleus estate contract-farming model if the cooperatives and the nucleus estate sponsors could provide favorable premium price, persistent technical advices, and pre-arranged procurement.

4.5. Farm Performance under Different Contract Farming Models

In the coordinating production program, coffee farmers grow high-yield clonal Robusta coffee lines such as TR5, TR6, TR7, TR8, TR11, TR12, TR13, TR14, TR15, and TR16 [77]. These clones provide the productivity of 4-6 tons per hectare with good quality bean and percentage of R1 seed-size over 80 percent [68]. However, not many farmers could obtain the expected coffee yield due to water scarcity, complicated pest and disease outbreaks, and inappropriate farming practices. Aged coffee is also another concern associated with capital shortage problem of coffee farmers. Statistics from Table 5 show that the highest percentage of coffee farmers who could obtain the productivity of over 4 tons/hectare is in the informal model (31.9% of total number of respondents in the InforM). Accordingly, there were 25% and only 2% coffee farmers in intermediary and nucleus estate model achieved this productivity level, respectively. None of respondents in intermediary model reported the productivity level lower than 2 tons/hectare. This productivity level was found at significant 13.2% of coffee farmers in nucleus estate model. Many farmers in three contract farming model achieved productivity level from 3–4 tons/hectare, which are 36.2%, 53.3%, and 32.9% in informal, intermediary, and nucleus estate model respectively. The frequency of 35% of the total respondents in this study reported the productivity level from 2–3 tons/hectare.

Table 5. Coffee yield under different contract farming models.

Categories	InforM	InterM	NeM	Total
Yield				
<2 ton/ha	3 (6.4)	0 (0.0)	10 (13.2)	13 (7.1)
2–3 ton/ha	12 (25.5)	13 (21.7)	39 (51.3)	64 (35.0)
3–4 ton/ha	17 (36.2)	32 (53.3)	25 (32.9)	74 (40.4)
>4 ton/ha	15 (31.9)	15 (25.0)	2 (2.6)	32 (17.5)
Total	47 (100.0)	60 (100.0)	76 (100.0)	183 (100.0)
Chi-Square Tests	**Value**	**df**	**Asymp. Sig (2-Sided)**	**Exact Sig. (2-Sided)**
Person Chi-square	39.129 [a]	6	0.000	0.000
Likelihood Ratio	46.394	6	0.000	0.000
Fisher's Exact Test	42.429			0.000
Number of Valid Cases	183			

Note: [a] indicates 2 cells (16.7%) have expected count less than 5. The minimum expected count is 3.34. Figures within the parenthesis are percentages computed for each column.

The harvest of coffee in Dak Lak always lasts in approximately a month, starting at the end of November or beginning of December. Once the coffee cherry was picked, it is either stored for a few weeks or hulled right away to remove the outer skin and the inner parchment. Then the preliminary dry processing must begin as quickly to prevent spoilage. After this, sun-dried coffee beans are most likely being sold to buying agents (or collectors). However, under the coordinating production program, harvested red cherries might go straight to wet processing by selling directly to processors/exporters in accordance with signed contract terms. Contract farming normally does not have strict terms about sale volume except the case of nucleus estate model. In this contract farming model, coffee farmers have to turn in the designated quantity of harvested coffee to the company (60%). In other cases, farmers could maximize their profits by choosing different buyers or consign (deposit) their coffee beans to buying agents or processors/exporters and look forward to better future price. Statistics in Table 6 show that most coffee farmers obtained the gross margin from 60 to 80 million VND/hectare/crop year (approximate $2660 to $3550 in 2017) in three contract farming models. The highest number of 14 (23.3%) coffee farmer who achieved gross margin over 100 million VND/hectare/crop year (approximate $4440) was found in the intermediary model. On the contrary, the number of coffee farmers who could earn the gross margin less than 40 million VND/hectare/crop year (approximate $1770) was significantly high in the case of nucleus estate model. The statistics are 30 farmers, which accounts for 39.5% of total respondent in NeM. The statistics of Tables 5 and 6 refer to the fact that initial successes of coffee farmers in intermediary model stems from the important role of cooperative in coordinating and managing coffee production between smallholder farmers and coffee-industrial firms. More supporting evidence for this conclusion included the significantly higher rates of return for coffee farmers under the InterM compared to other contract farming models (see Appendix A Table A5 for more details). These were 1.765 (without the inclusion of family labor cost) and 0.936 (with the inclusion of family labor cost) for the InterM farmers.

Table 6. Gross margin of coffee farmers under different contract farming models.

Categories	InforM	InterM	NeM	Total
Gross margin				
<40 mil VND/ha	5 (10.6)	2 (3.3)	30 (39.5)	37 (20.2)
40–60 mil VND/ha	9 (19.1)	6 (10.0)	20 (26.3)	35 (19.1)
60–80 mil VND/ha	17 (36.2)	19 (31.7)	21 (27.6)	57 (31.1)
80–100 mil VND/ha	10 (21.3)	19 (31.7)	4 (5.3)	33 (18.0)
>100 mil VND/ha	6 (12.8)	14 (23.3)	1 (1.3)	21 (11.5)
Total	47 (100.0)	60 (100.0)	76 (100.0)	183 (100.0)
Chi-Square Tests	**Value**	**df**	**Asymp. Sig (2-Sided)**	**Exact Sig. (2-Sided)**
Person Chi-square	57.473 [a]	8	0.000	.[b]
Likelihood Ratio	63.868	8	0.000	.[b]
Fisher's Exact Test	.[b]			.[b]
Number of Valid Cases	183			

Note: [a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.39. [b] Cannot be computed. Figures within the parenthesis are percentages computed for each column.

4.6. Perceived Benefits and Concerns from Contract Farming Participation

The overall objective of the coordinating production program is to reduce market uncertainty and secure the possible return on the investment of both coffee farmers and coffee processors/exporters. Coffee farmers engaged in this program through contract farming with these coffee processors/exporters (private and state-owned) obtained the access to assured markets, improved their technical skill, enhances production efficiency, eliminated production risk by sharing it with buyers, and attained farming knowledge from trainings. However, there were many detected issues such as access to credit, small-scale operation, water scarcity, public infrastructure, contract noncompliance,

and over-dependency. Table 7 represents the benefits and issues regarding farmers' participation in the coffee production coordination program through different contract farming models.

Table 7. General benefits and main concerns in coordinating production and distribution.

Categories	InforM	InterM	NeM	Total	Test	
	(n = 47)	(n = 60)	(n = 76)	(N = 183)	χ^2	*p*-Value
Benefits						
Better practices	6 (12.8)	22 (36.7)	34 (44.7)	62 (33.9)	13.560	0.001
Yield improvement	12 (25.5)	29 (48.3)	27 (35.5)	68 (37.2)	6.016	0.049
Risk mitigation	13 (27.7)	28 (46.7)	25 (32.9)	66 (36.1)	4.696	0.096
Knowledge attainment	9 (19.1)	28 (46.7)	37 (48.7)	74 (40.4)	11.956	0.003
Market access	16 (34.0)	17 (28.3)	7 (9.2)	40 (21.9)	12.676	0.002
Concerns						
Limited access to credit	8 (17.0)	26 (43.3)	30 (39.5)	64 (35.0)	9.181	0.010
Small-scale production	35 (74.5)	36 (60.0)	48 (63.2)	119 (65.0)	2.626	0.269
Water unavailability	38 (80.9)	43 (71.7)	39 (51.3)	120 (65.6)	12.690	0.002
Poor public infrastructure	37 (78.7)	39 (65.0)	54 (71.1)	130 (71.0)	2.413	0.299
Noncompliance	14 (29.8)	27 (45.0)	28 (36.8)	69 (37.7)	2.638	0.267
Over-dependency	26 (55.3)	39 (65.0)	31 (40.8)	96 (52.5)	8.088	0.018

Note: Figures within the parenthesis are percentages computed for each column.

In term of perceived benefits, the total number of surveyed farmers who claimed that their farming practices were better that later resulted in coffee yield improvement and production risks mitigation are 33.9%, 37.2%, and 36.1% respectively. In this regard, the highest percentage of surveyed farmers achieved better farming practices was in the nucleus estate model (44.7%), while coffee yield improvement (48.3%) and lower risk level in production (46.7%) was reported by many farmers in intermediary model. A majority of surveyed farmers also in nucleus estate model (48.7%) acquired benefit of knowledge attainment through trainings provided by involved processors/exporters. This explains the consecutive efforts of nucleus estate sponsors to reduce risks of supply ruptures from unstable coffee production. However, it was surprising that many certified coffee farmers claimed the benefit of improved market access in the informal contract farming model (34%). One of many overarching challenges in Dak Lak coffee sector is smallholder farmers' limited access to credit. Combined with other typical problems of small-scale coffee farming, these constraints are often auto-correlated. Among three different contract farming models, the largest numbers of surveyed farmers in the intermediary model have been struggling with capital shortage but a lack of access to credit (43.3%). In many cases, the certified coffee farmers had to borrow loan in form of material inputs with the interest rates 11 to 12%/year.

A majority of surveyed farmers in the informal contract farming model (74.5%) reported small-scale production constraints. These farmers in informal model also experienced the severe drought and insufficient water supply during their plantation (80.9%). In addition, they argued that the local poor infrastructures such as road condition and irrigation system hampered their efforts to achieve potential level of coffee production efficiency (78.7%). The intensive practices of over-dependency on fertilizer, pesticide, and irrigation water fostered several environmental problems such as water pollution and soil degradation, which are now threatening the sustainability of the coffee sector. The largest number of surveyed coffee farmers in intermediary model (65%) reported this problem. Accordingly, contract non-compliance issues from both certified coffee farmers and buyers (processors/exporters) have been ruining their shared-belief. This issue has most been found in the intermediary model (45%).

5. Discussion

The diversity of contract farming between farmers and agro-industrial firms is a result of the technical requirements of production, associated factors of production, and transaction costs [39]. The study results revealed three different typologies of contract farming model, which are the informal model, intermediary model, and nucleus estate model. These models differ in type of contractor (coffee

processors/exporters), the intensity of vertical coordination, and characteristics of involved coffee farmers [36–38]. However, the criteria to select coffee areas projected for coordinating production and distribution in these contract farming models are similar, which includes agro-ecological suitability, favorable infrastructure conditions, the prevalence of insecurity and crime, and the institutional reliability [58]. The informal contract farming model (InforM) focuses on pre-harvest arrangements between coffee processors/exporters and smallholder farmers, which specifies a set of conditions governing the coffee supply volume [63]. Under this contract farming model, candidate coffee farmers are certified (4C and RFA) and credit-available for coffee production. Informal coffee production contracts are most often ad-hoc or semi-formal, and sometimes a verbal agreement that induces the potential risk of default as pricing mechanism is flexible based on a local spot market price [37]. This leads to another problem of contract farming is side-selling where coffee farmers sell to other buyers such as buying agent or local trader for better price or payment conditions [78,79]. This type of contract cannot be enforced by legal authorities, which means that contract parties have economic and social incentives to honor the agreements in all contingencies [80]. Intermediaries contract farming model (InterM) binds the coffee farmers to follow particular farming practices to ensure quality standards of coffee bean at predetermined price [37,63]. Certified coffee farmers participating in this contract-farming model are cooperative members, which considers as simple registration format of coffee production contract. The contract formulas based on market specification and production management illustrate improved coffee yield as well as significantly higher farmer's earning compared to other contract-farming models in this study (see Table 6). By enforcing a fixed price agreement for Fair trade-certified beans, the cooperative involvement is essential for augmenting win-win outcomes for both Dak Man Company and certified coffee farmers in contract farming. From the coffee farmers' perspective, cooperative involvement not only helps to mitigate production risks through training, extension, and technology acquisition but also rebalance the power relation between processing/exporting firms and farmer growers. In this regard, farmers' participation in contract farming through cooperative arrangements can reduce information asymmetry and opportunism as horizontal linkages is built in production [13,81]. A fixed price option was an advantage for cooperative members against downside price risks in this case but can sometimes disfavor them if the ex post spot price at the time of delivery is by far higher than the contractual price [30,61,78]. Nucleus estate model (NeM) obliges the coffee processors/exporters to provide material inputs, technical assistances, and sometimes credit for coffee production on land leased to coffee farmers [8,15,37,63,78]. Nucleus estate model was expected to have advantages of fewer land acquisition, productivity improvement, equal farmer's welfare distribution, lower risk level of inconsistent coffee supply, and higher support from government [15,78,82]. However, empirical results in this study indicate the other way around, as coffee farmers in this contract farming model achieved a significantly lower coffee yield and earnings (see Tables 5 and 6). In addition, the distribution of farmers' earning from nucleus estate coffee farming was asymmetric. Coffee farmers in this contract farming model grow UTZ certified coffee and have to deliver the designated supply volume to state-owned sponsors (maximum 700 kg of coffee bean per hectare—the case of Thang Loi Company). A problem of farmer's overdependence on production schedule, technical assistance, and marketing arrangement provided by nucleus estate buyers impedes farmers' autonomy to gain efficiency. Further, the monopoly power of the nucleus estate processors/exporters in setting contract terms extracts the additional benefits of coffee farmers despite the productivity growth [50,83]. From this perspective, the contract farming becomes exploitative when severe power imbalances exist [13].

Coffee farmers' preferences for contract farming are depending on several significant contract attributes such as pricing mechanism, provision of material inputs, delivery schedule, technical assistance, monitoring and supervision [8,59]. In addition, farmers' specific characteristics such as gender and farm size [8,58] are also significant contributors to coffee farmers' preference toward different types of contract farming. These factors are decisive for farmers' decision in choosing whether to sign a contract [53,54,58]. First, the price option is often a contract attribute that entails risks and

rewards for certified coffee farmers under spot market volatility [49,84]. Estimation results from MNL model indicate significant and positive impact of this contract attribute on coffee farmers' preference of intermediary and nucleus estate model to the informal model. The results are consistent with a favorable pricing mechanism provided by the intermediary model (fixed price) and legal enforcement of a price agreement in the nucleus estate model. In addition, statistics in Table 7 also reveals the higher number of certified coffee farmers who reach price agreement in these contract-farming models than the informal. As previously discussed, fixed pricing policies increase firms' market risk, while transfer production risk to coffee farmers [85]. Second, inputs-providing agreement positively and significantly influences the choice of coffee farmers for nucleus estate model over the informal model, which indicates the advantage of resource-providing specification of this model over the other two. However, the impact of this contract attribute on coffee farmers' preference for the intermediary model was insignificant. Assuming the imperfect local input markets, ability to provide material inputs may give the involved agro-industrial firms a monopsony power in the product market [8]. To avoid this problem, coffee farmers could either improve access to key inputs through public agencies or NGOs (non-government organization). In fact, this also endangers the contract farming relationship. Third, frequent technical assistance motivates coffee farmers towards both the intermediary and nucleus estate model simply because it helps to improve farm performance as well as positive spillover effects on farmers' knowledge and accumulative farming experience [52]. Decreasing in technical assistance may result in inefficient coffee production, which leads to risk of default or contract cancelation. Certified coffee farmers could improve access to technical assistance through public extension services that often operates less effectively [49]. Fourth, scheduled delivery allows agro-industrial firms and farmers to minimize internal transaction costs, losses during harvest, and most importantly quality uncertainty [37,85]. Besides, standardized coffee quality at contractual price premium improves farmers' earning, which secure the long-term relationship of both parties in contract farming. This is consistent with MNL estimation that scheduled delivery positively and significantly influences the preference of certified coffee farmers for contract farming models. The last attribute, monitoring and supervision, represents the share of production risks between certified farmers and coffee processors/exporters. By close monitoring and supervision of production, coffee processors/exporters eliminate risks of unstable supply as well as quality uncertainty [86,87]. However, MNL estimation shows that monitoring and supervision negatively affect farmers' participation in contract farming. In addition, the relationship between contract farming preference and socio-economic factors such as farm size and gender depends on the correlation of these factors with the expected welfare gains [58]. MNL estimation results indicate that certified coffee farmers with larger land acquisition tend to choose informal contract farming model while female farmers prefer intermediary and nucleus estate model. Effect of gender on contract farming participation has never been explored in the previous literature.

Several empirical studies have examined the benefits and problems regarding farmers' participation in vertical coordination through contract farming. Main issue revolves around the unequal distribution of benefits [88,89]. In this study, the benefits stem from coordinating production and distribution between certified coffee farmers and processors/exporters are in line with findings of [8,30,49,52,90,91]. On the contrary, the main issues regarding vertical coordination are common problems of smallholder coffee farmers in Dak Lak, which was mentioned in previous studies of [41,47,79]. In addition, contract breach is attributed to an asymmetry of information in the informal model [58]. The problem of farmers' overdependence exhibits the monopoly power of agro-industrial firm over inputs management and the monopsony power in the local coffee markets [8].

6. Conclusions

Agro-industrial firms can either rely on the spot market or completely manage farm production for securing their supply of raw product. In this regard, contract farming is an institutional arrangement that allows agro-industrial firms control over the production and distribution process with or without owning the farms. On the other hand, smallholder farmers who participate in contract farming are

able to access to credit, quality inputs, technical advancement, and high value markets. Farmers can choose to contract for different reasons that most often are favorable set of contract attributes. Based on multinomial logistic estimation, several contract attributes that influenced the choices of coffee farmers for different contract farming models include a pricing option, delivery, technical assistance, inputs provision, monitoring and supervision. Farmers' preferences for the intermediary and nucleus estate contract-farming models over the informal contract-farming model were negatively related to monitoring and supervision by coffee-industrial firms, but were positively related to pricing option, inputs provision, technical assistance, and delivery procedure. The result also indicated heterogeneity among coffee farmers' preferences towards different contract farming models as a verbal commitment in the informal model was not preferable to a written commitment in the nucleus estate model or the trust factor built on repeated transactions through cooperatives in the intermediary model. In order to promote farmers' participation in contract farming, coffee-industrial firms should facilitate agreement and enforcement of the preceding contract attributes. This also could help minimizing ex ante and ex post transaction costs occurred during the negotiation, execution, and termination of contract terms as well as problems of side selling or contract breach. A cost-benefit analysis confirmed the important role of cooperative in rural areas where economic transactions are embedded in social relationship.

From transaction cost economics (TCE) perspectives, contract farming is a response to uncertainty, an incomplete market, and information asymmetry [50]. Rural coffee farmers most often encounter input market uncertainty, product quality uncertainty, and output market uncertainty, which sometimes discourage them from contract farming participation. In addition, the problem of incomplete market, on one hand, gives the coffee-industrial firms monopolistic power in providing and managing inputs for coffee farmers. On the other hand, the quality uncertainty and market imperfection lead to firms' monopsony in the output markets despite the fact that coffee beans are certified. Information asymmetry creates an imbalance of power relations in transactions between coffee-industrial firms and farmers, which sometimes facilitates contract breach (side selling) or coordination failures. In this regard, the dominance of spot markets in Viet Nam [92] indirectly encourages opportunism behavior of smallholder farmers. For all it is worth, contract farming as a response to these problems may fail to reduce smallholder farmer exposure to risks.

Previous literature has often overlooked the effects of socioeconomic factors on farmers' decisions toward contract farming, while most focuses are on the institutional arrangement and transaction cost attributes. In fact, this study provides empirical evidence that gender and farm size have significant impacts on farmers' preferences for different contract farming models. Limitations of the study could include the potential problem of endogeneity from unobserved variables and the omitted region-specific characteristics in MNL model, which supposedly causes bias estimates as contracts are not randomly assigned across smallholders in different candidate locations. In addition, the inclusion of social and welfare effects and the level of trust in preference-theoretic models could also be another direction of further research. The study is not extrapolated to the entire coffee sector due to the results being pertained from a small research sample and the data surveyed in one crop year.

Author Contributions: W.B. formulated research idea and provided instructions for the research design and approach. N.H.A. collected data through surveys in Vietnam, developed and improved the paper, and provided responses for the journals' reviewers and editorial board. N.T.T. participated in interpretation and discussion of the results. D.T.N. provided suggestions on questionnaire design, survey methods, and contributed data on coffee farm. N.V.M. collected data through survey in Vietnam and provided suggestions on research sample. All the authors read and approved the final manuscript.

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Appendix A

Table A1. Collinearity Diagnostics.

Variables	Unstandardized Coefficients		Standardized Coefficients	t Ratio	Sig.	Collinearity Statistics	
	B	SE	Beta			Tolerance	VIF
(Constant)	1.081	0.250		4.319	0.000		
AGE	−0.004	0.004	−0.050	−0.985	0.326	0.696	1.437
GEN	0.009	0.080	0.005	0.110	0.912	0.808	1.238
EDU	0.006	0.015	0.019	0.401	0.689	0.820	1.219
ETHN	0.207	0.099	0.110	2.082	0.039	0.645	1.550
FARM	0.047	0.054	0.038	0.868	0.387	0.944	1.060
DURA	1.298	0.080	0.782	16.199	0.000	0.769	1.300
INPUT	0.208	0.076	0.125	2.724	0.007	0.857	1.167
TECH	0.092	0.077	0.055	1.192	0.235	0.843	1.186
SUPP	0.042	0.070	0.026	0.594	0.554	0.956	1.046
PRICE	0.107	0.076	0.064	1.414	0.159	0.880	1.136
QUAL	−0.009	0.075	−0.006	−0.123	0.903	0.832	1.202
PAY	0.020	0.074	0.012	0.272	0.786	0.858	1.165
DELI	−0.024	0.093	−0.012	−0.259	0.796	0.840	1.190
MOR	−0.036	0.075	−0.021	−0.472	0.637	0.929	1.077

Note: VIF denotes variance inflation factor.

Table A2. Heteroscedasticity test.

	LM	Sig
Breusch-Pagan	11.936	0.611
Koenker	25.013	0.034

Note: Significant value is less than 0.05 referring to rejection of the null hypothesis. Null hypothesis: heteroscedasticity not present (homoscedasticity). LM denotes Lagrange multiplier test statistics.

Table A3. Removed variables from MNL estimation.

Model	Action	Effect(s)	Model Fitting Criteria	Effect Selection Tests		
			−2 Log Likelihood	Chi-Square [a]	df	Sig.
0	Entered	<all>	170.754			
1	Removed	DURA	302.569	0.004	2	0.998
2	Removed	AGE	303.124	0.552	2	0.759
3	Removed	EDU	303.889	0.761	2	0.684
4	Removed	SUPP	305.066	1.158	2	0.561
5	Removed	PAY	306.792	1.715	2	0.424
6	Removed	ETHN	310.352	3.451	2	0.178
7	Removed	QUAL	314.715	4.173	2	0.124

Note: [a] The chi-square for removal is based on the Wald test. Stepwise method is Backward Elimination.

Table A4. Likelihood ratio tests of selected variables in MNL estimation.

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	−2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	314.715 [a]	0.000	0	0.000
FARM	326.083	11.368	2	0.003
DELI	321.725	7.010	2	0.030
PRICE	320.788	6.073	2	0.048
TECH	321.717	7.003	2	0.030
GEN	338.641	23.926	2	0.000
INPUT	328.210	13.495	2	0.001
MOR	329.632	14.918	2	0.001

Note: The chi-square statistic is the difference in −2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are zero.

Table A5. Cost-benefit analysis of coffee farmers under different contract farming models.

Variables	Contract Farming Model			Comparisons of Column Means [a]		
	InforM	InterM	NeM	InforM [A]	InterM [B]	NeM [C]
Coffee area	1.200	1.544	1.414	ns	A	ns
Productivity	3117.872	3516.917	3038.553	ns	A C	ns
Selling price	33.809	37.110	33.633	ns	A C	ns
Synthetic fertilizer	14,651.489	15,908.500	13,564.605	ns	C	ns
Organic fertilizer	6899.362	6617.647	6186.047	ns	ns	ns
Manure	6380.851	5370.000	5690.789	ns	ns	ns
Pesticide	1777.660	1872.500	1727.990	ns	ns	ns
Irrigation water	3690.000	4528.333	3646.184	ns	ns	ns
Hired labor	7963.830	9183.333	12229.605	ns	ns	A B
Depreciation	2543.976	2993.873	6035.776	ns	ns	A B
Other cost	1251.064	1210.500	1222.500	ns	ns	ns
Family labor	20,885.597	20,316.344	16,860.662	C	C	ns
Total cost [1]	45,158.231	47,684.686	50,303.497	ns	ns	A
Total cost [2]	66,043.828	68,001.031	67,164.159	ns	ns	ns
Total return	105,373.830	130,511.833	102,319.553	ns	A C	ns
Gross margin [1]	60,215.599	82,827.147	52,016.056	ns	A C	ns
Gross margin [2]	39,330.001	62,510.803	35,155.394	ns	A C	ns
Rate of return [1]	1.346	1.765	1.035	C	A C	ns
Rate of return [2]	0.591	0.936	0.514	ns	A C	ns

Note: Results are based on two-sided tests assuming equal variances with significance level 0.05. Labels A, B, and C denote test results of each variable under categories InforM, InterM, and NeM. For each significant pair, the label of the smaller category appears under the category with larger mean. [a] Tests are adjusted for all pairwise comparisons within a row of each innermost sub-table using the Bonferroni correction. A superscript number 1 and 2 indicate non-inclusion and inclusion of family labor cost in computations of total production cost, gross margin, and rate of return. Family labor cost was measured by the average local market price for hired labor. A superscript letter "ns" denotes "not significant". Measurement unit for production cost was thousand VNDs per hectare, for productivity was kilogram per hectare, and for selling price was thousand VNDs per kilogram.

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