doi:10.14720/aas.2023.119.1.2472 Original research article / izvirni znanstveni članek

Impact of coffee sustainability schemes on rural coffee producer households' living standard in Aceh province, Indonesia

Ahmad Humam HAMID [1, 2], Agus NUGROHO [1, 3] , Tamara Husna POSPOS [1], Glennice SUHERMAN [1]

Received December 21, 2021; accepted January 24, 2023.
Delo je prispelo 21. decembra 2021, sprejeto 24. januarja 2023

Impact of coffee sustainability schemes on rural coffee producer households' living standard in Aceh province, Indonesia

Abstract: As the 3rd largest coffee producer globally, the gains from certified coffee trades have not significantly affected the farmers' economy. This study aims to re-examine the impacts of coffee certification on coffee smallholders' living standards. This study employs household survey data of 487 Aceh Gayo Arabica smallholder coffee farmers consisting of 205 fairtrade farmers, 116 organic farmers, and 166 non-certified farmers from 8 districts in Aceh Province, Indonesia, collected in 2020. A propensity score matching (PSM) approach was employed to evaluate coffee certification's impact on coffee price, per capita income, and per capita expenditure. This study found that the effect of certification was significant on the coffee price under fairtrade and organic schemes, in which fairtrade provided higher coffee prices than organic. This price improvement was also followed by an increase in the farmers' monthly per capita income. However, the application of the coffee standards has no impact on the daily per capita expenditures. This research suggests a deeper understanding to the certification scheme proponents to evaluate coffee farmers' living standard in the future.

Key words:coffee certification; smallholder farmer; living standards; propensity score matching; Indonesian Gayo Arabica

Vpliv trajnostnih shem pridelovanja kave na življenjski standard kmečkih gospodinjstev v provinci Aceh, Indonezija

Izvleček: Kot tretjemu, globalno največjemu pridelovalcu kave, certificirana trgovina ni v večjem obsegu izboljšala ekonomskega položaja kmetov. Namen raziskave je bil ponovno preveriti vpliv certificiranja na življenski standard majhnih pridelovalcev kave. V raziskavi so bili uporabljeni podatki pregleda 487 gospodinjstev majhnih pridelovalcev kave (Aceh Gayo Arabica), katere je sestavljalo 205 "Fairtrade " kmetov, 116 kmetov z organsko pridelavo in 166 ne certificiranih kmetov iz 8 območij province Aceh, Indonesia, zbranih leta 2020. Za ovrednotenje vpliva certificiranja kave na njeno ceno, prihodek na pridelovalca in njegovo potrošnjo je bil uporabljen PSM pristop (propensity score matching). V raziskavi je bilo ugotovljeno, da je certifikacija značilno vplivala na ceno kave v primerih "prijazne" (Fairtrade) in organske sheme pridelave, kjer je prijazna shema omogočila višje cene kave kot organska shema. Izboljšanju cene je sledilo tudi povečanje mesečnega prihodka kmetov. Uporaba teh shem v pridelavi kave pa ni vplivala na dnevno potrošnjo posameznika. Raziskave napeljuje k poglobljenem razumevanju shem certifikacije v pridelavi kave pri vrednotenu življenskega standard kmetov v prihodnosti.

Ključne besede: certifikacija kave; majhni kmetje; življenski standard; PMS pristop; indonezijska 'Gayo Arabica'

1 Department of Agribusiness, Faculty of Agriculture, Universitas Syiah Kuala, Banda Aceh, Indonesia
2 Center for Sustainable Agriculture and Rural Development (CSARD), Universitas Syiah Kuala, Banda Aceh, Indonesia
3 Corresponding author, e-mail: nugroho@unsyiah.ac.id

1 INTRODUCTION

Over the past several decades, the international food trades have undergone several significant changes. One of the reasons is based on the preference to introduce social, environmental dimensions and, most importantly, the sustainability of agricultural commodities or other market products (Helmsing & Vellema, 2012). To create this, food quality and safety standards have begun to emerge around the world. Over the last decades, these food standards have been developing in developed countries, where the population has a higher level of self-awareness of the importance of ethical and environmental aspects in the production process of agricultural products and the trade processes. In developing countries, this standard is starting to dominate urban markets, which have an increasing demand for food products of guaranteed quality and safety (Henson & Reardon, 2005; Maertens & Swinnen, 2009).

The transformation of the food market and the increasing consumer demand for safe and quality food products are influenced by several factors, including globalization, urbanization, changing consumer preferences resulting from increased living standards of the population, and increased awareness of healthy living resulting in changes in the dietary habit (Borsellino et al., 2020; Chiputwa et al., 2015). Among various agricultural commodities in the world, coffee is one of the first commodities to have standards on a sustainability basis (Ruben & Verkaart, 2012).

Most of the sustainable coffee standards are pioneered by non-governmental organizations (NGOs) that usually work with certification bodies and global retail businesses (Ibnu & Marlina, 2019; Kolk, 2013; Tran et al., 2013). Products with labels and certifications containing sustainable and ethical backgrounds attract consumers to pay prices higher than conventional products (Jena et al., 2012; Loureiro & Lotade, 2005; Meemken et al., 2017). This is supported by buyers' interest or motivation to pay extra for products that meet certain standards. The moral and personal values of a buyer also play a role in the willingness to pay for certified products (Kolk, 2013).

In Indonesia, approximately 75 percent of the total certified coffee is 'Arabica', while the rest is 'Robusta' (Ibnu et al., 2015). As the third-largest coffee-producing country in the world after Brazil and Vietnam (FAO, 2018), Indonesia still has the potential to develop its coffee production. In 2018, Indonesia's coffee production reached 756,051 tonnes (Directorate General of Plantation, 2018). It is recorded that the export figure increased to 45,360 kg in August 2020 (ICO, 2019). Domestic coffee consumption has also increased by 6 percent in December 2019 (Rahmanulloh and Mcdonald, 2020), associated with coffee outlets growth to balance the demand for coffee drink lifestyles from America and Europe.

In the late 1990s, coffee farmers in Aceh Province, Indonesia, began to adopt organic coffee intervention with assistance from an international development agency such as USAID (Arifin, 2010). The coffees from this region refer to the 'Aceh Gayo Arabica' based on geographical indication (GI) to distinguish among other coffee beans from other areas. Currently, most coffee cooperatives in Aceh possess Organic, Fairtrade, Starbucks C.A.F.E Practices certification as well as a collaborative program between Nespresso and the Rainforest Alliance since 2013, namely the AAA Sustainable Quality Program. The four certification programs have relatively similar goals in improving the welfare of coffee farmers while at the same time applying the principle of sustainability in its implementation. Fairtrade focuses on small farmers managed by cooperatives with democratic principles (Macdonald, 2007).

On the other hand, Organic emphasizes on environmental ecology. It is one of the strictest voluntary standards because farmers' land must pass a transition period of at least three years before obtaining certification (Blackman & Naranjo, 2012; Ibanez & Blackman, 2016). Both Starbucks Cafe Practices and Nespresso AAA promote sustainability and concentrate on improving producers' quality, production, and socioeconomic conditions (Niemuth et al., 2014; Renard, 2010).

The centers of certified 'Gayo Arabica' coffee in Aceh are in Aceh Tengah and Bener Meriah's districts. The physical environment and climatic conditions are suitable for agriculture and 'Arabica' coffee farmings. For that reason, coffee is the main livelihood and source of income for most of the population in these two areas. The smallholders consist of 124,236 hectares (100 percent), with coffee production reaching 70,774 tons in Aceh (Central Bureau of Statistics, 2019).

Even though it has received recognition in the domestic and international markets for its quality, assistance, and attention from all agencies or organizations are needed to improve the 'Aceh Gayo Arabica' coffee farmers' living standard. The fact that certified coffee has a higher selling price, the role of certification in improving household welfare is still questionable. Furthermore, the poverty rates in Aceh Tengah and Bener Meriah are above the national rate, as illustrated in Figure 1 (USD/IDR = 15,496.1 as per 30 December 2022). The monthly income per capita line (poverty line) in Aceh is higher than the national line, meaning that the locals require a higher standard of living. Moreover, coffee export gains have not been enjoyed by farmers living in the Bener Meriah district since their poverty rate is even higher than the poverty rate of Aceh Province and the national.

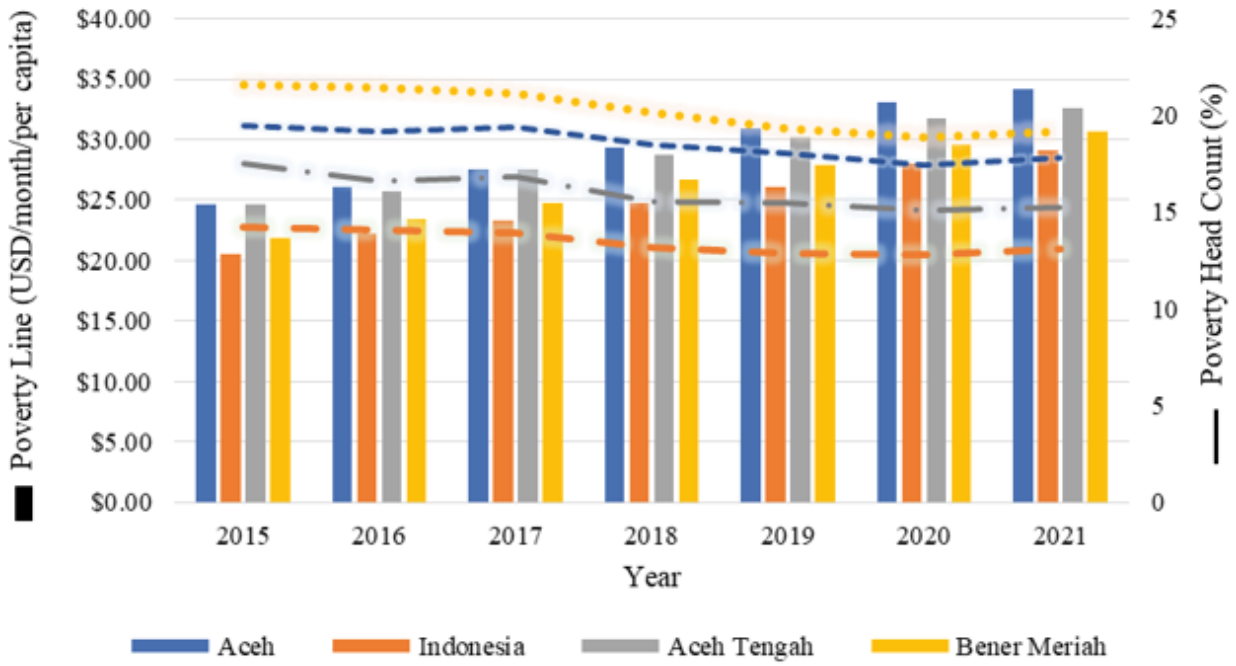

Figure 1. Poverty line and Headcount Poverty Ratio in Aceh

This study aims to assess the impacts of coffee certification schemes on smallholder 'Aceh Gayo Arabica' coffee farmers in Indonesia, highlighting the certification scheme that would give the best impacts on overall farmers' living standards. There are two research questions to be addressed: 1) What are the impacts of coffee certification on the coffee producer households' living standards?; 2) Which type of coffee certification has the greatest impact on smallholder coffee producer households?

2 METHOD

2.1 COFFEE PRODUCTION IN THE STUDY AREA

On average, Aceh Province produces roughly 156.39 thousand tons of 'Gayo Arabica' coffee during 2016-2020 (Directorate of Agriculture, 2020), mainly located in Aceh Tengah and Bener Meriah. Approximately, the coffee production areas in Aceh Tengah are 49,835 ha and in Bener Meriah are 48,950 accounting for 12 percent and 22 percent of total agricultural land in those two districts. These two districts are located in the Gayo highland with an altitude ranging from 800 to 2,600 meters above sea level and temperatures ranging from 18-20 °C, suitable for growing 'Arabica' coffee. This condition is very potential for the growth of crops, especially 'Arabica' coffee. Coffee estates in these two districts have existed since the 1900s. In 1980, coffee expansion was implemented through the transmigration program, inviting farmers from the island of Java and granting land ownership rights of 2 hectares per family, such as those in Jagong Jeged Sub-District, Aceh Tengah. Therefore, coffee plantations were characterized by similar patterns (planting year, size of the land, and coffee variety, especially in this area.

In general, Aceh Arabica Gayo coffee farmers are familiar with the traditional organic cultivation processes. The farmers applied coffee and livestock manure as natural fertilizers. Regarding pests and diseases, the farmers have different choices in dealing with them to avoid the production risks. Seeds are generally from the parents' plant. Certified seeds are rarely used due to being expensive. The common varieties are Ateng Super, Tim-Tim, Jember.

Generally, harvesting periods start from September to April annually. The coffee is harvested in the form of cherry, then is sold directly to local collectors at prices ranging from USD $0.448-$0.64 per kilogram (IDR/USD = 0.000064). Selling in the form of cherries is more convenient due to the absence of coffee processing machines. Moreover, most of the farmers demand immediate cash. In general, bean processing machines are owned by collectors. At these collectors, cherries are processed into unhulled or green beans to add value and obtain higher prices. It is recorded that the prices range from USD $0.96-$1.28 per kilogram for unhulled beans and USD $2.56-$3.2 for the green beans. The collectors sell these

processed beans to local coffee cooperatives and exporters.

The certification scheme in the two districts is driven by the cooperative. In other words, certified 'Arabica' coffee exports are the core business of coffee cooperatives. There are two main certifications in Aceh Tengah and Bener Meriah districts, namely Fairtrade and Organic, demanded by importers. Through coffee cooperatives, contracts for certified coffees are created with the existing or newly established coffee farmer groups. The communication between cooperatives and the group leaders is connected by the cooperatives' agent.

Moreover, a coffee farmer group leader also acts as a coffee collector in the village. This relationship has been maintained since the first coffee certification scheme was introduced in Aceh. This relationship is dynamic. In Aceh Tengah and Bener Meriah, a farmer who has several lands can participate in many cooperatives. The farmers may decide to change or resign from a particular cooperative or farmer group. Therefore, Fairtrade or Organic label/signature in a particular coffee plot typically changes over time depending on the on-going contracts.

2.2 HOUSEHOLD SURVEY

We conducted structured interviews during June-July 2020 despite the Covid-19 pandemic and applied a multi-stage sampling procedure. At the first stage, we contacted the several coffee cooperatives and exporters in Aceh Tengah and Bener Meriah to obtain certification details, distribution of members, and coffee plantations' areas. Based on these lists, we purposely selected eight sub-districts in Aceh Tengah and another four sub-districts in Bener Meriah (Figure 2). All the selected locations produce 'Arabica' coffee.

At the time of the survey, most cooperatives joined Fairtrade and Organic certification, while the cooperative members possess only one specific certification, either Fairtrade or Organic. We could not identify cooperatives nor farmers that are under UTZ, C.A.F.E Practices, and Rainforest Alliance certifications.

Smallholder Aceh Gayo Arabica coffee producer households in Aceh Tengah and Bener Meriah Districts in Aceh Province, Indonesia, were selected for the population in this survey. There at least 60,000 farmers living

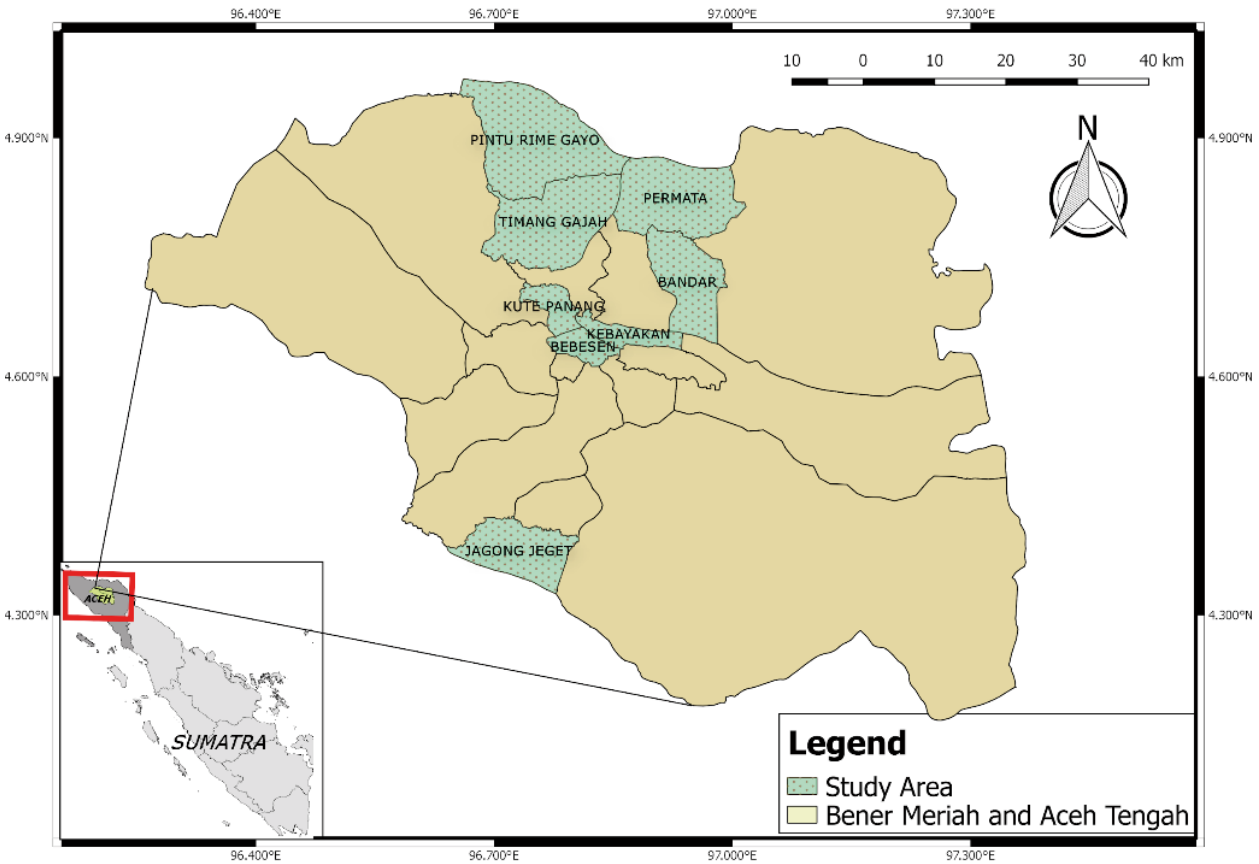

Figure 2:. Coffee household survey location

in those two regions (Central Bureau of Statistics, 2019). These farmers normally cultivate more than one commodities, a combination of coffee and horticulture. Based on eight sub-districts that were selected previously, certified and non-certified coffee farmer households were randomly selected for the survey. These certified coffee producer households will be treated as the treatment group in the impact analysis whereas the non-certified coffee farmer households will be the control group. Using a 95 % of confidence level and 5 % margin of error, the minimum size of samples needed will be around 382 farmers. In total, we interviewed 487 smallholder Aceh Gayo coffee farmers, consisting of 205 fairtrade farmers, 116 organic farmers, and 166 non-certified farmers (Table 1).

We used a structured questionnaire to interview all of the respondents in the research areas. The questionnaire includes most of the basic household demographics, income, food and non-food expenditures, and some aspects of coffee production and marketing. Field surveys and interviews were conducted during pre-harvest sessions. We believe that consumption spikes and money circulation are absent during these periods, and therefore it should not lead to any biases in the impact assessments.

2.3 METHOD ANALYSIS

As the first step, binomial logit is used to evaluate the factors that influence Aceh Gayo Arabica smallholder farmers' decision to participate in a coffee certification scheme. Later on, this binomial logit will be used to calculate the propensity scores for further impact analysis. The dependent variables in the logit regression model are based on the respondents' response to the question: "Are you joining a particular certification or not ?". The response will be given a score of "1" if the coffee household participates in a particular certification scheme; and a score of "0" if the coffee household does not participate in any certification schemes. In general, the logit model is written as follow (Azen & Walker, 2011)

$$\text{Logit}(Px) = \log Px/(1 - Px) = \beta 0 + \beta 1x1 + \beta 2x2 + \beta 3x3 + \cdots + \beta jxj \quad (1)$$

where *Px* is the probability of participating the certification; *1 - Px* is the probability of not participating the certification; β0 is the constant; β1, · · , βj are the parameter coefficients; and *x1, · · · , xj* are the explanatory variables.

It is predicted that many individual characteristics might influence farmers' decision to participate in a certification scheme, such as male household head, age, education, and dependents. The length of stay in the village may also influence farmers' decisions because farmers usually observe their villages' certification participation process. The coffee plantation age may also have an effect because it is generally easier to enter certification for newly established coffee states. An active member of a coffee farmer group or cooperative may also be more willing to participate in a certification scheme. Several accesses to agriculture may also determine the farmers' decision, e.g., access to input markets, access to finance, and access to extension services. The variables included in the multinomial logit and their estimation results are shown in Table 2.

In the second stage, the Propensity Score Matching (PSM) is used to estimate the impact of certification on coffee farmer poverty. PSM uses information from a group of units that do not participate in the intervention to identify the participating units' outcome in the absence of the intervention. By comparing how different the participants' results relative to the non-participants, the effect of the intervention will be estimated (Heinrich

Table 1: The study area and sample size

		Type of certification / Number of coffee producer households			
District	Subdistrict	Non-certified	Fairtrade	Organic	Total Sample
Bener Meriah	Bandar	43	38	27	108
	Pintu Rime	11	14	-	25
	Timang Gajah	9	16	2	27
	Permata	28	21	12	61
Aceh Tengah	Kute Panang	19	35	22	76
	Bebesen	27	30	24	81
	Kebayakan	14	13	6	33
	Jagong Jeged	15	38	23	76
Total Sample		166	205	116	487

et al., 2010). Based on Rosenbaum & Rubin (1983) and Abdia et al. (2017)such as matching, regression, stratification, inverse probability weighting (IPW, the formula for estimating the impact of a program on the participating individuals or the Average Treatment Effect on the Treated (ATT) is:

$$ATT = E(Y_1|e(X), Z = 1) - E(Y_0|e(X), Z = 0) \quad (2)$$

where Y_1 is the outcome under treatment, while Y_0 is the outcome under no treatment. Subjects with covariate *X (e (X))* in the treatment group will be compared with subjects in the comparison group with the same covariate *X (e (X))*. *Z = 1* indicates the treated group while *Z = 0* is the control group.

To match control households with treatment households, the Nearest Neighbour Matching (NNM) method is used. NNM is one of the most frequently chosen matching methods (Austin, 2011; Stuart, 2010). Participants from the control group will be paired with participants from the group that received the treatment based on the closest propensity score. There are several variations of the NNM matching method, namely NNM "with substitutes" and NNM "without substitutes". The use of NNM "with substitutes" is when cases are found where the distribution of trend score data in the treatment and control groups is very different. For example, many participants in the treatment group have high propensity scores, but only a few participants with high scores in the control group. Under these circumstances, the matching process and quality will decrease, and bias will increase. This can be overcome by doing a "replacement", which will reduce the number of different non-participants, increasing the variance (Caliendo & Kopeinig, 2008).

3 RESULT AND DISCUSSION

3.1 DATA AND STATISTICS

During the interview, we collected data consisting four aspects of coffee producer households. First of all, this study identified socio-economic household characteristics that may including age and gender of the farmers, education level, number of family members, period of stay in village, housing structure and respondent's main occupation. Age, gender and educational level show the human resources as the main labor forces in Aceh coffee production. Number of family members indicates the households' dependency level and economic power in the family. Period of stay in the village indicates the interaction periods between the famers and coffee environment in the study areas. Housing structure and main occupation show the economic status in the community.

The certification scheme is also strongly related with coffee farming characteristics. The scheme normally required data on land size and productivity, labor capacity, and land status during the feasibility study phase. Experience in coffee cultivation is also important since it may reflect the farmers' ability to digest the benefit and cost of joining the certification. Price of coffee (cherry) is purposively in a unit of can (1 can = 1.2 kg) so that the farmers can easily detect the price difference using their selling tradition method.

We also measure the connectedness between coffee farming and supporting access. The access consisted of physical (distance to main road and agricultural inputs market), technological (internet access and financial digitalization), and services (credit and agricultural extension). We expect that the more connected between coffee producers and the supporting access, the more influence in the coffee certification decision making.

Lastly, we identified variables to measure the living standards including income, expenditure, and asset ownership. It was a challenge to measure the coffee producers' income since their revenue from selling depended on harvesting periods per year. The amount received from selling also varied from time to time. Similarly, the expenditure was also sensitive case since most the households might refuse to answer. We were also aware of the respondents' trap that the total expenditure might be higher than the total income within the same period.

There are several fundamental differences between the characteristics of the certified and the non-certified coffee farmers, as well as among the certified coffee farmers, as shown in Table 2. Certified coffee farmers are generally male with the position of head of household who have lived longer periods in their village and have a longer coffee farming experience. Certified farms also have larger sizes of coffee areas but lower productivity. Furthermore, coffee prices, labor capacity, access to input markets, and access to an agricultural extension are significantly different for the certified coffee than the non-certified.

On average, Fairtrade farmers possessed larger sizes of coffee areas and received higher prices on their coffees. On the other hand, organic farmers have slightly higher productivity, are closer to extension services access, and have higher labor capacity.

3.2 ESTIMATION RESULT

(a) Factors influencing the certification decision

We begin this analysis by examining the factors

Table 2: Summary statistics by certification scheme

	Pooled sample		By certification scheme	
	non-certified (N = 166)	certified (N = 321)	Fairtrade (N = 205)	Organic (N = 116)
Household Characteristics				
Age (years)	42.373 (11.44)	44.289* (11.52)	44.160 (12.18)	44.517 (10.27)
Education (years)	11.102 (3.86)	10.704 (3.70)	10.565 (3.72)	10.948 (3.66)
Gender (female = 0;male = 1)	0.385 (0.48)	0.542*** (0.49)	0.492 (0.50)	0.629*** (0.48)
Status of Respondent (dummy)	0.373 (0.48)	0.551*** (0.49)	0.512 (0.50)	0.620*** (0.48)
Household size (members)	4.186 (1.29)	4.242 (1.43)	4.219 (1.34)	4.284 (1.59)
Years staying in village	26.253 (17.07)	30.647*** (15.50)	30.414 (15.95)	31.060 (14.74)
House structure (dummy)	0.349 (0.47)	0.398 (0.49)	0.414 (0.49)	0.370 (0.48)
Main job (dummy)	0.891 (0.31)	0.878 (0.32)	0.882 (0.32)	0.870 (0.33)
Farm characteristics				
Land size (ha)	0.984 (0.74)	1.237*** (1.03)	1.248* (0.95)	1.217 (1.15)
Productivity (kg ha^{-1})	1374.12 (385.53)	1284.28** (364.09)	1297.26 (373.18)	1261.35* (347.84)
Price (IDR/can)	6849.39 (1131.46)	8688.47*** (1707.38)	8946.34*** (1657.44)	8232.759 (1706.03)
Experience in coffee farming (years)	18.243 (12.42)	21.52*** (10.71)	21.292 (11.14)	21.948* (9.94)
Land status (dummy)	0.963 (0.18)	0.968 (0.17)	0.960 (0.19)	0.982 (0.13)
Labor capacity	2.926 (0.86)	3.111* (1.04)	3.052 (0.96)	3.217** (1.17)
Access supports				
Access to extension (times/year)	1.680 (2.26)	2.305* (3.90)	1.873 (2.28)	3.068*** (5.67)
Access to credit (dummy)	0.349 (0.47)	0.389 (0.48)	0.375 (0.48)	0.413 (0 .49)
Access to input market (km)	3.385 (2.38)	4.074** (3.77)	4.048 (3.66)	4.120 (3.97)
Access to main road (km)	2.077 (3.01)	2.136 (2.95)	2.078 (2.40)	2.238 (3.74)
Number of family member with internet access (persons)	1.632 (1.26)	1.660 (1.39)	1.624 (1.33)	1.724 (1.49)
Access to financial digitalization (dummy)	0.174 (0.38)	0.183 (0.38)	0.156 (0.36)	0.232* (0.42)
Access to internet (dummy)	0.771 (0.42)	0.788 (0.40)	0.795 (0.40)	0.775 (0.41)

Continued from previous page

Living Standard Characteristics				
Income per capita (IDR/ month)	1668464 (619936.6)	1758879 (800831.5)	1770000 (708584.4)	1739224 (945143.3)
Expenditure per capita (IDR/day)	34266.98 (15051.79)	32111.81 (15588.03)	32658.45 (14543.95)	31145.75 (17304.14)
Cattle ownership (dummy)	0.439 (0.49)	0.492 (0.50)	0.482 (0.50)	0.508 (0.50)
Motorcycle ownership (dummy)	0.951 (0.21)	0.953 (0.21)	0.946 (0.22)	0.965 (0.18)
Fridge ownership (dummy)	0.801 (0.40)	0.937*** (0.24)	0.921* (0.26)	0.965*** (0.18)

Notes: Mean values are shown with standard deviations in parentheses. Mean values across schemes are tested for statistically significant differences; *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ when compared to non-certified farmers

Table 3: Logit model estimate for participants in the certification scheme

	Pooled sample	Fairtrade	Organic
Household Characteristics			
Age (years)	-0.038 (0.03)	-0.120** (0.05)	0.040 (0.05)
Education (years)	-0.124 (0.09)	-0.223 (0.13)	-0.033 (0.13)
Gender (female = 0;male = 1)	0.425 (1.32)	0.820 (1.68)	-0.633 (1.78)
Status of Respondent (dummy)	1.016 (1.38)	0.866 (1.74)	2.123 (0.98)
Household size (members)	0.006 (0.28)	-0.031 (0.37)	0.145 (0.44)
Years staying in village	0.063** (0.02)	0.140*** (0.04)	0.057* (0.03)
House structure (dummy)	-0.518 (0.66)	-0.833 (0.99)	-0.171 (1.04)
Main job (dummy)	-0.491 (1.04)	-1.539 (1.52)	-1.057 (1.50)
Farm characteristics			
Land size (ha)	-0.198 (0.36)	-0.344 (0.417)	-0.652 (0.47)
Productivity (kg ha^{-1})	-0.001 (0.00)	-0.000 (0.00)	-0.002* (0.00)
Price (IDR/can)	0.003*** (0.00)	0.004*** (0.00)	0.003*** (0.00)
Experience in coffee farming (years)	0.026 (0.03)	0.029 (0.04)	0.016 (0.05)
Land status (dummy)	-1.056 (1.35)	-2.048 (1.63)	-0.101 (1.98)
Labor capacity	0.054 (0.43)	-0.417 (0.56)	0.318 (0.57)

Continued on next page

Access supports			
Access to extension (times/year)	0.186 (0.12)	0.027 (0.45)	0.264* (0.15)
Access to credit (dummy)	0.993 (0.65)	2.063** (0.94)	0.260 (1.03)
Access to input market (km)	0.263* (0.14)	0.461** (0.22)	0.472* (0.26)
Access to main road (km)	-0.501*** (0.15)	-1.156*** (0.35)	-0.684** (0.27)
Number of family member with internet access (persons)	-0.059 (0.35)	-0.234 (0.55)	-0.239 (0.50)
Access to financial digitalization (dummy)	1.174 (0.91)	0.349 (1.26)	1.923 (1.35)
Access to internet (dummy)	-0.142 (1.02)	-0.166 (1.60)	-0.676 (1.49)
Living Standard Characteristics			
Income per capita (IDR/ month)	-6.64e (5.07e)	-1.27e* (7.50e-)	-3.26e- (7.92e-)
Expenditure per capita (IDR/day)	0.000 (0.00)	0.000 (0.00)	0.000 (0.00)
Cattle ownership (dummy)	-0.411 (0.62)	0.375 (0.88)	-1.180 (0.95)
Motorcycle ownership (dummy)	-0.473 (1.58)	0.354 (2.32)	-0.572 (2.29)
Fridge ownership (dummy)	1.660 (1.00)	2.526* (1.37)	2.040 (1.55)

Notes: Coefficient estimates are shown with standard errors in parentheses. The base category consists of farmers without any certification. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

that influence farmer participation in coffee certification schemes and the estimation results are shown in Table 3

Under pooled data, farmers' tendency to participate in coffee certification schemes is influenced by the period of stay in the village (inheritance factor), coffee prices, access to input markets, and access to main roads. The longer the period of stay in the village, the more likely they are to participate in a coffee certification scheme. The price of certified coffee also increases the likelihood of certification participation. Proximity to the main road will facilitate access while minimizing the costs of marketing, increasing the likelihood of farmers participating in certification. The need for special inputs in sustainable coffee cultivation affects the tendency to join the certification.

Prices remain consistent in increasing farmers' likelihood to join fairtrade or organic. Similarly, it applies to input market access and main roads. Access to agricultural extension seems essential for organic farmers, while access to credit affects farmers' likelihood to participate in fairtrade.

(b) Impact of certification

The average treatment effect on the treated is estimated into several models. We applied the certification schemes as the treatment (T = 1 if coffee is certified; T = 0 if coffee is not certified). In the case of fairtrade vs. organic, we applied T = 1 for fairtrade and T = 0 for organic. Here, the outcomes include coffee price, daily per capita expenditure, and monthly per capita income. The estimation result is illustrated in Table 4.

First, we compared certified coffee farmers with non-certified farmers. The result shows that coffee certification impacts coffee prices, which is IDR 1,654.20 per can (24.15 %) higher than the average price of non-certified coffee. In general, the monthly per capita income of certified coffee farmers is also higher at IDR. 384,112.1 or about 23.02 % higher than the average per capita income of non-certified farmers. However, the impact on per capita expenditure is insignificant.

This study found that certification was significant on coffee price variables, both in fairtrade and organic schemes, when comparing non-certified farmers to each certification scheme. Participation in fairtrade increases the price by IDR. 1,878.04 per can (27.41 % higher than

Table 4: Average Treatment effect for household coffee producer certification

Treatment	Output	ATT	S.E	t-values
all certified vs non-certified	coffee price (IDR/can)	1654.20***	351.86	4.70
	income per capita (IDR/month)	384112.1**	119953.4	3.20
	expenditure per capita (IDR/day)	1268.17	5611.49	0.23
Fairtrade vs non-certified	coffee price (IDR/can)	1878.04***	349.25	5.38
	income per capita (IDR/month)	144390.2	184934	0.78
	expenditure per capita (IDR/day)	3638.27	5110.95	0.71
Organic vs non-certified	coffee price (IDR/can)	1405.17**	394.44	3.56
	income per capita (IDR/month)	-173706.9	653086.7	-0.27
	expenditure per capita (IDR/day)	-5908.77	11393.96	-0.52
Fairtrade vs Organic	coffee price (IDR/can)	78.53	110.44	0.71
	income per capita (IDR/month)	209816.8**	82527.45	2.54
	expenditure per capita (IDR/day)	3610.39	1913.07	1.89

Notes: Coefficient estimates are shown with standard errors in parentheses. The base category consists of farmers without any certification. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

the average price of non-certified coffee), while participation in the organic scheme increases the coffee price by IDR. 1,405.17 (20.51 % higher than the average price of non-certified coffee). When we compared fairtrade and organic, participation in fairtrade increases per capita income by IDR. 209,816.8 per month or 12.06 % higher than the average per capita income of organic coffee farmers. However, no significant impact was found on prices and expenditure per day.

3.3 DISCUSSION

Participation in the coffee certification scheme is mainly correlated with cooperative membership. Unlike in other coffee producing countries, coffee certification participation in Indonesia is a collective decision. Participation in coffee certification is mainly influenced by local collectors. Collectors are closely connected with the farmers and understand each coffee farmer's socio-demographic living under their territory. The producer-collectors relationship in Indonesia is not limited to coffee trades but includes a capital provision, non-financial support, and market information dissemination.

Additionally, a collector also acts as a cooperatives' right hand and is placed to each village or sub-district to deal with new certification member recruitments, extending cooperatives' networks, and manage existing coffee production under cooperatives. However, collectors may not always sell their coffee to the cooperatives. Cooperatives provide exclusive services for their members. However, non-certified farmers who do not belong to the cooperative can also sell their coffee.

Traditional coffee practices in Aceh rely on natural fertilizer such as coffee compost. Therefore, the conversion process to certification (especially organic) was relatively straightforward because the pre-existence condition has already been fulfilled. However, recent trends show discontentment on their production results, forcing traditional farmers to apply extra inputs, e.g., chemical fertilizers and pesticides, to boost production. This production change is mainly caused by external factors (e.g., pests/diseases, climate change). This phenomenon leads to cases where coffee farmers resign from certification schemes, either voluntarily or due to certification requirements violation.

External or hired labor in Aceh Tengah and Bener Meriah increases dramatically during the harvest through September-April. Each sub-district has its distinct characteristic on the intensity of labor use. In most cases, additional labor comes from relatives or neighboring dwellers. Unlike other coffee-producing countries, Aceh Gayo coffee landowners manage contacts of the designated labor from neighboring provinces. The landowners treat the laborers as part of families by providing living spaces to live in, referring to a kinship. These additional laborers typically experienced in other plantations, e.g., rubber or palm oil. They willingly migrate and stay for an extended period to harvest coffee because coffee provides higher earnings compared to their original crops. However, the Covid-19 pandemic has raised concern about these external labor demands. However,

no strict policy was found in the surveyed areas, and the decision for accepting the external laborers differs from each coffee farmer.

Female coffee farmers played important roles in the coffee cultivation especially during the harvesting periods. However, traditional norms in study areas direct female farmers to give authority for decision making to their spouses. Many female farmers were reluctant to give their opinion during the interview. Although female farmers were closely involved in the coffee production, they were willing to represent their opinion represented by the male farmers. We found a solid coffee cooperative/exporter that fully consisted of female members in the study area. This female coffee cooperative managed the whole coffee production and the decision making was made through collective discussions by female representatives. However the number of this female cooperative is still limited.

The food standards application in the global coffee trade leads to an increasing trend in the certified coffee market (Nugroho, 2014). This attraction is then enforced in various ways into coffee-producing countries, where most of the agricultural structure consists of 80-90 percent of smallholder coffee farmers. Hopefully, the application of coffee standards will be able to increase their living standards. For that, we have analyzed the impact of coffee standards implementation and certification schemes on the Aceh Gayo Arabica coffee farmers' living standards in Aceh Province, Indonesia. The results showed that, in general, certified coffee farmers received more promising prices than non-certified farmers. This price improvement was also followed by an increase in the farmers' monthly per capita income. However, the application of the coffee standards has no impact on the daily per capita expenditures.

This study also has analyzed the impact of each certification separately. The results remain consistent that fairtrade provided higher coffee prices than the organic scheme. However, this study could not find significant impacts on improving per capita income or consumption expenditure per capita of coffee farmers. We argue that this weakness is due to the limitation of the sample size.

Several reasons may explain the strong relationship between the impact of coffee certification and coffee price. First, smallholder coffee farmers, who own limited coffee areas, seem difficult to increase coffee yields or productivities. The productivity of non-certified coffee is 90 kg ha^{-1} higher than certified coffee. Therefore, a higher selling price of coffee under the certification schemes allows smallholder coffee farmers to obtain equal or even better revenues than non-certified coffee. Generally, the average price of fairtrade coffee is reported to be higher than non-certified coffee prices (Arnould et al., 2009; Bacon, 2005; Raynolds et al., 2004; Ruben & Zuniga, 2011). Second, the smallholder coffee farmers prefer immediate cash payments rather than turning into further coffee processing stages. Thereby, certified coffee farmers have been satisfied by the guaranteed price. Moreover, these farmers perceived that either coffee processing costs or the investment in equipment are greater than the benefits. Normally, only large-scale farmers or collectors own coffee processing equipment and sell the processed coffees. Third, the financial relationship between smallholder coffee farmers and collectors along the coffee chain is based on kinship. However, both coffee farmers (borrowers) and collectors (lenders) prefer immediate returns on their capital to manage the capital turnover. Thus, cash received by the coffee farmers can be used directly to repay for loans/debts.

The conflicts between coffee quality and yield, as they were discussed in Chiputwa (2015) as well as in Barham and Weber (2012), indicate that coffee certification has failed to formulate the promises of coffee standards into the improvement of farmers' living standards. In the case of coffee in Indonesia, farmers mostly sell coffees in the form of coffee cherries. Therefore, coffee quality is often neglected, and farmers end up with prices that are not significantly different. Considering the tremendous role of certification, there should be efforts to improve the smallholder coffee quality. In coffee farming, individual farmers are responsible for managing the quality of their coffees. Therefore, as indicated by this study, the improvement in coffee prices may not reflect either the improvement of coffee quality or the improvement of smallholder coffee farmers' income and welfare.

4 CONCLUSION

To conclude, two valuable lessons can be taken from this research. First, the environmental conditions of Aceh Gayo Arabica coffee farming have been suitable with the requirements of global coffee certification standards. Minimized transformation efforts are needed to change the traditional cultivation system into a more sustainable coffee production system. Second, smallholder coffee farmers view the certification scheme as an opportunity to improve prices. The impact of certification schemes on price improvements has been validly proven in the estimation results. However, the role of certification schemes in collectively improving coffee quality is still questionable. An increase in coffee price allowing for improvements in certified farmers' income and living standards is still not clear. Therefore, it is expected that the partici-

pation of smallholder coffee farmers in the certification scheme is temporary. Most of the farmers perceived that the overall benefits have little impact on their economy.

This research provides a better understanding to certification scheme proponents that the role of certification in improving smallholder coffee farmers' living standards may still need to be improved. The current relationship between coffee certification regimes and local coffee cooperatives disregarded the role of local government and higher education institution. This study recommends that local government as a policy maker may develop interventions and regulation to protect the vulnerable farmers from being excessively exploited by the certification regime. The certification regimes were failed to provide reasonable price during the Covid-19 pandemic due to export restriction and cross border trade closure. Rural coffee producer households have less bargaining power during this situation and were forced to sell their coffee under the market.

The certification scheme also disregarded the coffee farmers' capacity to deal with future challenges due to climate change. There are two difficult options available for Aceh Gayo coffee producers: moving toward higher altitude, or changing the variety which more reliable to climate change. Both options might seem beyond the local coffee producer household's capacity. Therefore, local universities and research institutes are recommended to work together with the coffee certification bodies to mitigate future climatic risks on coffee production in Indonesia.

4.1 ACKNOWLEDGEMENTS

This work was supported by the Universitas Syiah Kuala, the Ministry of Education, Culture, Research and Technology [grant number 268/UN11/SPK/PNBP/2020].

5 REFERENCE

Abdia, Y., Kulasekera, K. B., Datta, S., Boakye, M., & Kong, M. (2017). Propensity scores based methods for estimating average treatment effect and average treatment effect among treated: A comparative study. *Biometrical Journal*. https://doi.org/10.1002/bimj.201600094

Arifin, B. (2010). Global sustainability regulation and coffee sdupply chains in Lampung province, Indonesia. *Asian Journal of Agriculture and Development*. https://doi.org/10.37801/ajad2010.7.2.5

Arnould, E. J., Plastina, A., & Ball, D. (2009). Does fair trade deliver on its core value proposition? Effects on income, educational attainment, and health in three countries. *Journal of Public Policy & Marketing*, *28*(2), 186-201. https://doi.org/10.1509/jppm.28.2.186

Austin, P. C. (2011). An introduction to propensity score methods for reducing the effects of confounding in observational studies. *Multivariate Behavioral Research*. https://doi.org/10.1080/00273171.2011.568786

Azen, R., & Walker, C. M. (2011). Categorical data analysis for the behavioral and social sciences. In *Categorical Data Analysis for the Behavioral and Social Sciences*. https://doi.org/10.4324/9780203843611

Bacon, C. (2005). Confronting the coffee crisis: can fair trade, organic, and specialty coffees reduce small-scale farmer vulnerability in northern Nicaragua?. *World Development*, *33*(3), 497-511. https://doi.org/10.1016/j.worlddev.2004.10.002

Blackman, A., & Naranjo, M. A. (2012). Does eco-certification have environmental benefits? Organic coffee in Costa Rica. *Ecological Economics*. https://doi.org/10.1016/j.ecolecon.2012.08.001

Borsellino, V., Schimmenti, E., & El Bilali, H. (2020). Agri-food markets towards sustainable patterns. In *Sustainability (Switzerland)*. https://doi.org/10.3390/su12062193

Caliendo, M., & Kopeinig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys*. https://doi.org/10.1111/j.1467-6419.2007.00527.x

Central Bureau of Statistics. (2019). *Statistics of Indonesian Coffee 2019*. Central Bureau of Statistics, Jakarta.

Chiputwa, B., Spielman, D. J., & Qaim, M. (2015). Food standards, certification, and poverty among coffee farmers in Uganda. *World Development*, *66*, 400–412. https://doi.org/10.1016/j.worlddev.2014.09.006

Directorate General of Plantation (2018). *Coffee Production by Province in Indonesia*. Retrieved from www.pertanian.go.id

Directorate of Agriculture (2020). *Coffee Production by Province in Indonesia.* Retrieved from www.pertanian.go.id

Food and Agriculture Organization of the United Nations. (2018). FAOSTAT Database. Rome, Italy: FAO. Retrieved December 20, 2020 from http://faostat3.fao.org/home/E

Heinrich, C., Maffioli, A., & Vázquez, G. (2010). A Primer for Applying Propensity-Score Matching:Impact-Evaluation Guidelines. In *Technical Notes, No. IDB-TN-161*.

Helmsing, A. H. J. B., & Vellema, S. (2012). Value chains social inclusion and economic development: Contrasting theories and realities. In *Value Chains Social Inclusion and Economic Development: Contrasting Theories and Realities*. https://doi.org/10.4324/9780203816806

Henson, S., & Reardon, T. (2005). Private agri-food standards: Implications for food policy and the agri-food system. *Food Policy*. https://doi.org/10.1016/j.foodpol.2005.05.002

Ibanez, M., & Blackman, A. (2016). Is Eco-Certification a Win–Win for Developing Country Agriculture? Organic Coffee Certification in Colombia. *World Development*. https://doi.org/10.1016/j.worlddev.2016.01.004

Ibnu, M., Glasbergen, P., Offermans, A., & Arifin, B. (2015). Farmer preferences for coffee certification: A conjoint analysis of the Indonesian smallholders. *Journal of Agricultural Science*. https://doi.org/10.5539/jas.v7n6p20

Ibnu, M., & Marlina, L. (2019). Sustainability standards and certification dan Ppathway Menuju Produksi Kopi Berkelanjutan di Indonesia (in Bahasa). *Suluh Pembangunan : Journal of Extension and Development*. https://doi.org/10.23960/jsp.vol1.no2.2019.21

International Coffee Organization (2019). *Monthly Export Statistics (Members & Non Members*. Retrieved from http://www.ico.org/trade_statistics.asp.

Jena, P. R., Chichaibelu, B. B., Stellmacher, T., & Grote, U. (2012). The impact of coffee certification on small-scale producers' livelihoods: A case study from the Jimma Zone, Ethiopia. *Agricultural Economics (United Kingdom)*. https://doi.org/10.1111/j.1574-0862.2012.00594.x

Kolk, A. (2013). Mainstreaming sustainable coffee. *Sustainable Development*. https://doi.org/10.1002/sd.507

Loureiro, M. L., & Lotade, J. (2005). Do fairtrade and eco-labels in coffee wake up the consumer conscience? *Ecological Economics*. https://doi.org/10.1016/j.ecolecon.2004.11.002

Macdonald, K. (2007). Globalising justice within coffee supply chains? Fairtrade, Starbucks and the transformation of supply chain governance. In *Third World Quarterly*. https://doi.org/10.1080/01436590701336663

Maertens, M., & Swinnen, J. F. M. (2009). Trade, Standards, and Poverty: Evidence from Senegal. *World Development*. https://doi.org/10.1016/j.worlddev.2008.04.006

Meemken, E. M., Spielman, D. J., & Qaim, M. (2017). Trading off nutrition and education? A panel data analysis of the dissimilar welfare effects of Organic and Fairtrade standards. *Food Policy*. https://doi.org/10.1016/j.foodpol.2017.07.010

Niemuth, S., Hamann, L., Luschnat, K., Smolarz, P., & Golombek, S. (2014). CSR in the coffee industry: Sustainability issues at Nestlé-Nespresso and Starbucks. *Journal of European Management & Public Affairs Studies*. https://doi.org/10.15771/2199-1618_2014_2_1_5

Nugroho, A. (2014). The Impact of Food Safety Standard on Indonesia's Coffee Exports. *Procedia Environmental Sciences*. https://doi.org/10.1016/j.proenv.2014.03.054

Rahmanulloh, A., & Mcdonald, G. (2020). Indonesia Coffee Annual Report 2020. *USDA Foreign Agricultural Service*. https://apps.fas.usda.gov/newgainapi/api/Report/

Raynolds, L. T., Murray, D., & Leigh Taylor, P. (2004). Fair trade coffee: building producer capacity via global networks. *Journal of International Development: The Journal of the Development Studies Association*, *16*(8), 1109-1121. https://doi.org/10.1002/jid.1136

Renard, M. C. (2010). In the name of conservation: CAFE practices and fairtrade in Mexico. *Journal of Business Ethics*. https://doi.org/10.1007/s10551-010-0584-0

Ruben, R., & Verkaart, S. (2012). Comparing Fair and Responsible Coffee Standards in East Africa. In *Value Chains Social Inclusion and Economic Development: Contrasting Theories and Realities*. https://doi.org/10.4324/9780203816806

Ruben, R., & Zuniga, G. (2011). How standards compete: comparative impact of coffee certification schemes in Northern Nicaragua. *Supply Chain Management: An International Journal*. https://doi.org/10.1108/13598541111115356

Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*. https://doi.org/10.2307/2335942

Stuart, E. A. (2010). Matching methods for causal inference: A review and a look forward. In *Statistical Science*. https://doi.org/10.1214/09-STS313

Tran, N., Bailey, C., Wilson, N., & Phillips, M. (2013). Governance of global value chains in response to food safety and certification standards: The case of shrimp from Vietnam. *World Development*. https://doi.org/10.1016/j.worlddev.2013.01.025