Sustainable Coffee Supply Chain Management: A Case Study In Buon Me Thuot City, Daklak, Vietnam

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Sustainable Coffee Supply Chain Management: A Case Study in Buon Me Thuot City,
Daklak, Vietnam
Abstract
This paper aims to analyse and discuss the evolution towards sustainable coffee supply chain and its management in Vietnam. Coffee is a major agricultural export commodity of Vietnam with the export value accounts for 3 per cent of national GDP in 2014 and provides a livelihood for approximately 2.6 million people. However, the sector is facing enormous challenges as the current farming methods and processing infrastructure have been unsustainable resulting in many catastrophic impacts on the environment such as deforestation and soil degradation that have the potential to lead to a decrease in the quality of coffee beans. Using a case study in Buon Me Thuot City, Daklak, Vietnam, the paper analyses the key factors influencing the sustainable coffee supply chain management in Vietnam. Our analysis confirms that although productivity is high, and farmers have positive experiences in this sector, sustainability issues are emerging. For instance, the farmers have experienced soil erosion and a lack of water and as such are now more willing to incorporate sustainability initiatives in their production and processing.

Keywords
Coffee supply chain – Sustainability – Case study – Vietnam
1. Introduction

Coffee is a major agricultural export commodity of Vietnam with the export value accounts for 3 per cent of national GDP in 2014 and provides a livelihood for approximately 2.6 million people (Vietnam Customs, 2015). Following Brazil, since 2000 Vietnam has continuously been the world’s second-largest exporter of coffee, typically to EU and US markets, which shows a positive outlook for the future of this sector (Marsh, 2007). However, numerous challenges need to be overcome in order to make it happen. Due to the fact that current farming methods and processing infrastructure have been unable to keep up with the development of the sector, many catastrophic impacts on the environment – such as deforestation and soil degradation – have the potential to lead to a decrease in the quality of coffee beans. Less than 10 per cent of Vietnamese coffee is grown sustainably, compared with 75 per cent in Latin America (Mistiaen, 2012). With the increase in global demand, the supply of Vietnamese coffee is being threatened by unsustainable farming practices. Hence a sustainable supply chain is crucial to the development of the Vietnamese coffee industry. The government is aiming to reach 65 per cent of sustainable coffee production by 2018, which will help to preserve the environment, improve the living standards of the farmers and ensure a steady coffee supply for food processors (Mistiaen, 2012). The purpose of this paper is to study the current situation of the supply chain of Vietnamese coffee in Buon Ma Thuot City, Dak Lak Province, Vietnam, to examine the issues related to sustainable development and to build up a logistic model that will explain the correlation between those factors and the decision to join the sustainable coffee program. This study aims to improve the supply chain practices of sustainable coffee in Vietnam and to increase the competitive advantages of the commodity, as well as to help coffee farmers to be more flexible in a constantly changing market.

This research investigates the opinions of local farmers through quantitative surveys. Qualitative interviews are also used to interview 23 local collectors and the staff of five famous
large coffee manufacturing companies to provide an overview of the situation. SPSS was used to analyse the data and run the logistic regression model. The data were complemented by documentary analysis, including internal data and interview documents.

The paper provides empirical research about the sustainable supply chain in coffee farming methods in Buon Me Thuot City. The study found that although productivity is high, and farmers have positive experiences in this sector, sustainability issues are emerging. The farmers have experienced soil erosion and a lack of water. A logistic regression model is established based on the collected data to explain the relationship between the dependent variable ‘Certificate ownership’ and the independent variables ‘Productivity’, ‘Local support’ and ‘Experience’ to help sustainable coffee organisations forecast the probability of farmers obtaining a sustainability certificate in their current situation; this will help to choose promising candidates to develop sustainable programs.

The research has some limitations. For instance, it does not measure the financial benefits of sustainable coffee; therefore, future research should focus more on the financial aspects of sustainable coffee farming.

Nevertheless, the paper helps to consolidate the position of the Vietnamese coffee brand on the international market, to improve the livelihood of famers and to conserve the environment in Vietnam and will help fulfil the goal of improving the supply chain of Vietnamese coffee to develop sustainable practices.
2. Literature review: Sustainable supply chain management

Interest in sustainable supply chain management has increased significantly in both academic research and industrial practices since the minimisation of the adverse impacts of human activities and the maintenance of sustainable social development have become central concerns globally (Beamon, 1999; Prokesch, 2010). First, sustainability is defined as the capability to meet current demands without compromising the ability of future generations to meet their needs (World Commission on Environment and Development, 1987). Thus, a policy of sustainability has gradually been adopted and considered in business strategies. Linking sustainability and supply chain management means managing a complete supply chain lifecycle, from product design and consumption to return and disposal, with the explicit considerations of sustainable development factors such as economic, environmental and social elements (Kolk & Tulder, 2010). A sustainable supply chain is essential for competitiveness with regard to price, quality, dependability, flexibility and responsiveness (Markley & Davis, 2007). It also can bring higher customer satisfaction, innovation, efficiency, trust, flexibility and environmental conservation, as well as better living standards (Ageron, Gunasekaran, & Spalanzani, 2012; Brammer, Hoejmose, & Millington, 2011). Moreover, a rising number of significant issues on sustainability and sustainable supply chain management have been seen as impacting on the enterprise’s upstream relationships (Beske, Koplin, & Seuring, 2006) and its downstream customer satisfaction (Ageron, Gunasekaran, & Spalanzani, 2012).

In today’s world agriculture has to be more intensive to feed a booming world population, but it also needs to be both sustainable and ethical. Sustainable agricultural supply chain management can be understood as managing resources and risks to create a more effective, efficient and productive supply chain network in order to produce more valuable and competitive agriculture commodities from the same land area while reducing negatively
environmental impacts and increasing contributions to environmental improvements and the development of societies (Pretty, Toulmin, & Williams, 2011). Furthermore, cross-border supply chains are admittedly becoming increasingly popular in agriculture. Local farmers in developing countries have connections with traders in developed countries to sell their products at higher prices, achieving a vertical cross-border supply chain network (Jaffee & Siegel, 2008). Cross-border supply chains not only make profit for individuals or separate companies, but can also stimulate the development of local agriculture, boost the economy, reduce the unemployment rate, develop the sustainability of the societies and environment, and secure global food security (Roekel, Willems, & Boselie, 2002). However, when a cross-border supply chain becomes more popular in the agricultural sector, the supply chain will experience increasing risks. For this reason, managing a sustainable supply chain is vital in order to maintain long-term business relationships and stabilise the economic development of the world (Farina & Reardon, 2000). According to the Department for Environment, Food and Rural Affairs (Department for Environment, Food and Rural Affairs, 2002), sustainable agricultural supply chain management can be understood as managing resources and risks to create a more effective, efficient and productive supply chain network in order to produce more valuable and competitive agriculture commodities from the same land area, while reducing negative environmental impacts and increasing contributions to environmental improvements and the development of societies.

2.1 The introduction of certified sustainable coffee

This paper aims to investigate the management of the sustainable coffee supply chain. According to (Giovannucci & Koekoek, 2003), sustainable production practices are the best solution to improve the situation and bring better quality coffee to customers. Sustainable production is a relatively new initiative for the coffee industry, but growing numbers of
customers are willing to purchase certified sustainable coffee. There are also significant benefits for approximately three quarters of a million farm households around the world and society more generally. Certified coffees are currently defined as those that consider at least one aspect of sustainability, including farming in a good-quality environment, providing economically viable for farmers and promoting social equity among farmers and workers (Giovannuccia & Ponte, 2005). It helps stakeholders in the coffee supply chain network to preserve the environment, appreciate human and social rights, and offer customers traceable and high-quality products (Wahyudi & Jati, 2012). The certifications for sustainable coffee are verified by third-party auditors to ensure that coffee is produced in accordance with the guidelines. Producers or buyers have to pay different fees related to certification, but will receive a higher economic benefit through premiums paid when they sell their coffee (Lentijo & Hostetler, 2011). Currently, the most common and famous types of certifications including Organic, Fairtrade, Rainforest Alliance, Bird Friendly, UTZ certified, Starbucks C.A.F.E Practices and 4C. General criteria for common certification programs for coffee are presented in Table 1 (Lentijo & Hostetler, 2011).

### Table 1: General criteria of common certification programs for coffee

| Certification Seal       | Environmental Criteria | Social Criteria | Economic Criteria | Quality Standards |
|--------------------------|------------------------|-----------------|-------------------|------------------|
| Organic                  | ✓                      |                 |                   |                  |
| Fairtrade                | ✓                      | ✓               |                   | ✓                |
| Rainforest Alliance      | ✓                      | ✓               |                   | ✓                |
| Bird-friendly            | ✓                      |                 |                   |                  |
| UTZ Certified            | ✓                      |                 |                   |                  |
| Starbucks C.A.F.E        | ✓                      |                 |                   | ✓                |
| 4C                       | ✓                      | ✓               |                   |                  |

Moderate criteria - ✓: Very Strong criteria

Source: (Lentijo & Hostetler, 2011)

#### 2.2 The supply chain and sustainable issues of Vietnamese coffee
According to (TechnoServe, 2013) in Vietnam, approximately 95 per cent of coffee growers are smallholder farmers, and coffee brings highly profitable incomes for them. Moreover, Vietnamese coffee has the highest yields and the lowest farming cost in the world that means Vietnamese coffee is very potentially competitive in the world market (The Voice Of Vietnam, 2014; Minot, 1998; Ward & Nguyen, 2014). But the high yields also result from intensive farming practices deployed with the fact of over-fertilisation for coffee tree that could lead to the very detrimental decline in the future production (Vietnam Briefing, 2014).
Figure 1: General supply chain of Vietnam’s coffee

Figure 1 illustrates the supply chain of Vietnam’s coffee. In this chain, supporting industries play roles as input providers, including coffee seedling providers, plant protection sellers and fertiliser sellers.

According to (Le, 2013; D'haeze, Deckers, Raes, & Loi, 2005), although they are well experienced in planting coffee, Vietnamese farmers’ lives have not been improved due to the high risk of the production environment and market conditions. The added value they gain remains the lowest in the entire chain of coffee production (Le, 2012). There are some major risks faced by farmers, which could make the supply chain unsustainable. These are listed in Table 2 (Minot, 1998).

Table 2: Major risks to Vietnamese coffee supply chain
**Production risks**
- Drought
- Pest and disease outbreaks
- Erratic rainfall

**Market risks**
- Coffee price volatility risk
- Steep and prolonged price fall
- Input price volatility
- Counterparty risk
- Exchange rate & Interest rate volatility

**Enabling environment risks**
- Reputational risk
- Theft

Source: (International Bank for Reconstruction and Development/ The World Bank, 2011)

Data from the (International Coffee Organisation (ICO), 2015) showed that only 9 per cent of total exported Vietnamese coffee is sustainable. It also revealed different challenges for coffee industry in different countries, as shown in Figure 2.

![Figure 2: Challenges of coffee industry in different areas](image)

Source: (International Coffee Organisation (ICO), 2015)

**Figure 2: Challenges of coffee industry in different areas**

State-owned (provincial) farms, which account for just 15 per cent of the coffee-growing area, are organised and managed by governmental cooperation (Nguyen, 2010). They produce high-
quality coffee with professional farming techniques. The private farms accounted for 85 per cent of the total area operated by household farmers (less than 5 ha per household). Although they receive some support from local authorities, their farming methods are still below certification standards for coffee. However, sustainability programs have concentrated mainly on high-yield farmer segmentation. Therefore, many problems that needs to be tackled in order to increase the production of sustainable certified coffee in Vietnam.

2.3 Conceptual framework to manage the supply chain of sustainable coffee

Similar to the work of (Iakovou, Vlachos, Achillas, & Anastasiadis, 2014), this research is based mainly on the methodological framework for sustainable supply chain management in agricultural business, as shown in Figure 3. The framework helps to deal holistically with all aspects of the chain. This framework is then modified to fit the objectives of the research in Vietnamese coffee.

Source: (Iakovou, Vlachos, Achillas, & Anastasiadis, 2014)

**Figure 3: Conceptual framework for sustainable supply chain management for coffee**

Six main factors need to be focused upon to build up a sustainable supply chain network:
• **Sustainable farming.** This relates to the replacement of chemical pesticides and fertilisers with bio-fertilisers for weed and pest control. The management of waste-disposal processes, controlling the source and amount of water consumption for irrigation and the use of energy-saving systems could also draw a lot of attention.

• **Supply chain management:** This pays attention on the innovation of supply chain and logistics management to reduce energy consumption and control the pollution levels from the transportation and production process, especially for those agricultural products that need timely and cold delivery. The support of information systems also proves to be crucial with regard to this aspect.

• **Marketing:** This focuses on pricing policies of companies for premium products; product differentiation in terms of labelling, promotion strategies, etc.; consumers’ attitudes and awareness of sustainable products; and the strategic development of the product life-cycle.

• **Environmental management:** This concentrates great attention on biodiversity; soil quality; natural resources; climate change; air and water quality; and emission reductions in production and logistics activities.

• **Reverse logistics:** This relates to the recycle of containers, packaging materials and the use of environmentally friendly materials.

• **Corporate social responsibility (CSR):** This concerns the harmony of using natural and local human resources to tackle inequality, poor living standards and low education levels in the rural area.

### 3. The methodology and model

#### 3.1. Research design

Due to the nature of the research, an empirical multiphase mixed methods approach was used to examine different perspectives of the coffee supply chain to investigate sustainability
implementation and its effects on the coffee supply chain in Vietnam. A plausible explanation for this design is that different groups of interviewees require different methodologies in order to fully access the most available information and achieve the goal of the research.

3.1.1. **Qualitative research methodology**

A qualitative methodology was utilised to examine the opinions of experienced professionals in well-known coffee manufacturing companies and local coffee collectors. They have good knowledge about the research topic and high educational levels that ensure the accuracy and reliability of the responses. It helps to provide an in-depth investigation of the real impacts of sustainable certification practice on their business, which quantitative questions cannot access and evaluate precisely.

3.1.2. **Quantitative research methodology**

A quantitative methodology was utilised to examine the current circumstance of sustainable behaviours and how sustainability certification practices are measured in terms of farming methods, social security and the knowledge of sustainable coffee production by farmers. They have experience of the current situation and the basic knowledge to answer these simple and clear questionnaires. The information produced by quantitative research is then used to run the regression, and run an ANOVA analysis to check the relationships among the variables.

3.2. **Research population and sampling**

3.2.1. **The population of the research**

The population of the research is a collection of key stakeholders including coffee farmers, local coffee collectors and five coffee manufacturing companies in Buon Ma Thuot City. The population excludes the participation of final customers because 95 per cent of Vietnamese coffee production is exported to developed countries and consumption of sustainable coffee has increased significantly, as mentioned in the literature review section. Hence it is quite clear
that customers show considerable support for sustainable coffee, and the development of sustainable coffee depends mainly on the collaboration of the listed stakeholders.

3.2.2. Research sample

To fit with the research design, the sample of the research comprised a group of approximately 140 private coffee farmers in Buon Ma Thuot City whose coffee is partly or wholly sold to well-known coffee processing companies and the local collectors for these farmers. It also included 23 participants from five large coffee processing companies to examine their opinions and experience with the purpose of analysing the current sustainability practices of the coffee supply chain and identifying weaknesses in order to make improvements.

Although the size of the sample seems small, it is still representative and controllable to ensure the generalisability of the results. Most private coffee farms are planted using the same farming methods (Nguyen, 2010). The companies that were examined were the major and best-known coffee processing companies in Vietnam, accounting for nearly 25 per cent of the market share (Ipsos Business Consulting, 2013). The companies also have experience in developing certified sustainable coffee. They were awarded a UTZ Certificate for sustainable coffee cultivation in coordination with local coffee farmers in Eatul commune, Cư Mgar district, Dak Lak Province.

This is a purposive and controlled sample, so the surveyed participants needed to have a number of characteristics:

• In the interview with the coffee processing companies, interviewees had to be staff or former staff in the purchasing department or in coffee processing factories in both Ho Chi Minh City and Buon Ma Thuot City. They all had a good understanding of the supply chain network and sustainability practices in the coffee processing industry.

• The survey of farmers had to be random and include both male and female workers. The surveyed farmers could plant either sustainable certified coffee or normal coffee.
• All the surveyed coffee growers and collectors had to wholly or partly sell their product to the factories of these companies.

3.3. Conceptual framework for the research

Based on the conceptual framework mentioned in the literature review, three different interview stages were conducted.

Firstly, 137 close-ended quantitative survey questionnaires were given to local coffee farmers in Buon Ma Thuot City, Dak Lak Province to investigate the current farming methods, environmental issues and social attainment in this research area. These questions were simple and required little time to finish, encouraging interviewees to complete the survey. The author strictly monitored and followed up the quantity and quality of the responses. The questionnaires concentrated mainly on current farming methods; environmental issues; social attainment and the sustainability knowledge of surveyed farmers.

![Figure 4: Conceptual framework to interview coffee farmers](image)

Open-ended questionnaires were then used to ask 23 experienced representatives of five major coffee processing companies and local coffee collectors about experience and to elicit information. For the collectors, questionnaires were focused on reverse logistics, supply chain management issues and the knowledge of sustainability. For the coffee processing companies, questionnaires concentrated on organisational-level issues, including supply chain
management; reverse logistics; corporate social responsibility (CSR); and environmental management. These frameworks are presented in Figures 5 and 6 below.

Figure 5: Conceptual framework to interview local coffee collectors

![Diagram 5](image)

Figure 6: Conceptual framework to interview staff of coffee manufacturing companies

![Diagram 6](image)

4. Data analysis and findings

4.1. Current farming methods

According to the survey results, coffee growers in the surveyed area have considerable experience (more than 10 years) in cultivating coffee, but they are mainly small household coffee farmers (2–5 ha), which conforms to the previous figures in literature review. Furthermore, coffee trees in this area are mostly mature (11–20 years) – a very important factor to the productivity of
crops. Moreover, the data prove the coffee farms are highly productive in comparison with the average yield of Vietnam.
Table 3: Descriptive statistics about the coffee farming (data collected from the survey)

|                                | N  | Minimum | Maximum | Mean  | Std. Deviation |
|--------------------------------|----|---------|---------|-------|---------------|
| Years of experience           | 137| 1.00    | 4.00    | 2.4453| .96953        |
| Total area                     | 137| 1.00    | 3.00    | 1.8102| .64777        |
| Productivity                   | 137| 1.00    | 4.00    | 2.4891| 1.03694       |
| The years of coffee farm       | 137| 1.00    | 3.00    | 1.7883| .62345        |
| Valid N (listwise)             | 137|         |         |       |               |

(With years of experience: ‘1.00’: < 5 years, ‘2.00’: 5-10 years, ‘3.00’: 10–15 years, ‘4.00’: >15 years; total area: ‘1.00’: < 2ha; ‘2.00’: 2-5 ha; ‘3.00’: >5ha; productivity: ‘1.00’: < 2 tons/ha, ‘2.00’: 2-4 tons/ha, ‘3.00’: 4–6 tons/ha, ‘4.00’: >6 tons/ha; and years of coffee farm: ‘1.00’: < 10 years, ‘2.00’: 11–20 years, ‘3.00’: > 20 years)

However, just 43.1 per cent (59 of 137) of surveyed farmers stated that they were currently planting shade trees to protect their farms against soil degradation. Furthermore, 57.7 per cent of samples (79 of 137) said they were using both organic and chemical fertilisers, with only 38.7 per cent (53 of 137) stating that they only use organic fertilisers. A total of 70.1 per cent (96 of 137) admitted that they had used large amount of pesticides for pest control in cultivating coffee. Another figure that should be noted is nearly 60 per cent of surveyed farmers who said they had diversified their coffee farms with other agricultural trees such as durians and avocados. Approximately half of participants (55.5 per cent, or 76 of 137) said they owned a coffee-hulling or roasting machine. The data also led to the finding that although there are some machinery supports for cultivation, coffee farmers still tend to use traditional farming practices to intensively cultivate their farms in order to increase the yields. They have not yet applied proper organic farming practices to maintain sustainability in their cultivation.

A Chi square test showed a positive relationship between certification ownership and experience of farmers, as surveyed farmers who owned sustainable coffee certificates were
more likely not to be more experienced than those who did not. The statistics also showed that the productivity of experienced farmers was significantly higher than the productivity of farmers with less than 10 years’ experience.

Table 4: The relationship between productivity and years of experience

| Count | Years of experience | Total |
|-------|---------------------|-------|
|       | <5 years | 5–10 yrs | 10–20 yrs | >20 years |
| Productivity <2 tons/ha | 19 | 9 | 0 | 0 | 28 |
| 2–4 tons/ha | 16 | 23 | 3 | 0 | 42 |
| 4–6 tons/ha | 1 | 2 | 20 | 16 | 39 |
| >6 tons/ha | 1 | 1 | 10 | 16 | 28 |
| Total | 37 | 35 | 33 | 32 | 137 |

Chi-Square Tests

| Value | df | Asymp. Sig. (2-sided) |
|-------|----|-----------------------|
| Pearson Chi-Square | 1.202E2⁺ | 9 | .000 |
| Likelihood ratio | 143.572 | 9 | .000 |
| Linear-by-linear association | 81.480 | 1 | .000 |

N of valid cases | 137

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.54.
4.2. Environmental management

Turning to concerns about environmental management, as mentioned earlier, coffee growers still mainly use traditional farming practice to cultivate their farms, which can only reach higher yields but cannot achieve sustainability status. Base on the collected information, 47.4 per cent (65 of 137) of surveyed farmers agreed that they had experienced soil erosion within the past year and 65.7 per cent (90 of 137) of surveyed farmers said they had experienced a shortage of water for irrigation during farming times. Moreover, 73.7 per cent (101 of 137) of participants said they had to dispose of solid waste by themselves instead of waiting for local companies to collect it, resulting in very negative effects for the environment, such as pollution and soil degradation.

According to the results of the Chi-square test, surveyed farmers who had been granted sustainable coffee certificates were more likely not to use pesticides to control pests and to plant shade trees to protect soil from deterioration than those who did not hold such a certificate.

Table 5: The relationship between certificate ownership and the use of pesticides

| Count | Certification ownership | Pesticides | Yes | No | Total |
|-------|-------------------------|------------|-----|----|-------|
| Certified | No | 29 | 12 | 41 |
| Yes | 37 | 59 | 96 |
| Total | 66 | 71 | 137 |

Chi-Square Tests

| Value | df | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|-------|----|-----------------------|----------------------|---------------------|
| Pearson Chi-Square | 11.924* | 1 | .001 |  |
|                | Certification ownership |        |        |        |
|----------------|------------------------|--------|--------|--------|
|                | Yes                    | No     | Total  |
| Pesticides     |                        |        |        |
| No             | 29                     | 12     | 41     |
| Yes            | 37                     | 59     | 96     |
| Continuity Correction b | 10.669      | 1      | .001   |
| Likelihood Ratio | 12.170     | 1      | .000   |
| Fisher’s Exact Test |            |        |        |
| Linear-by-Linear Association | 11.837 | 1 | .001 |
| N of Valid Cases b | 137         |        |        |

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 19.75.

b. Computed only for a 2x2 table

**Table 6: The relationship between certificate ownership and planting shading trees**

|                | Certification ownership |        |        |
|----------------|------------------------|--------|--------|
|                | Yes                    | No     | Total  |
| Shade trees    |                        |        |        |
| No             | 33                     | 45     | 78     |
| Yes            | 33                     | 26     | 59     |
| Total          | 66                     | 71     | 137    |

**Chi-Square Tests**

|                      | Value  | df | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|----------------------|--------|----|-----------------------|----------------------|----------------------|
| Pearson Chi-Square   | 2.498  | 1  | .114                  |                      |                      |
| Continuity Correction b | 1.982  | 1  | .159                  |                      |                      |
| Likelihood Ratio     | 2.503  | 1  | .114                  |                      | .124                 | .080                |
| Fisher’s Exact Test  |        |    |                       |                      |                      |
| Linear-by-Linear Association | 2.479  | 1  | .115                  |                      |                      |
| N of Valid Cases b   | 137    |    |                       |                      |                      |

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 28.42.
| Certification ownership | Yes | No  | Total |
|-------------------------|-----|-----|-------|
| Shade trees             | 33  | 45  | 78    |
|                         | 33  | 26  | 59    |

b. Computed only for a 2x2 table

On the other hand, local collectors and supervisors from the coffee processing companies agreed that they did not pay enough attention to the management of waste disposal. Although it is said that processing factories strictly follow the current waste disposal instructions and regulations of the Vietnamese government, there is a failure to monitor suppliers’ waste-disposal processes because of a lack of awareness of farmers and collectors. It is not even possible to control the use of fertilisers and pesticides if the farmers do not participate in any certified coffee programs and do not follow their instructions. However, they believe that if farmers and local collectors join a sustainable coffee program, their waste-disposal processes, and use of fertilisers and pest control are controlled and managed properly due to the introduction of related actors to train and educate farmers on the benefits of sustainable and safe farming practices.

4.3. Supply chain management

The information in this section is based on qualitative interview with local collectors and staff of a well-known coffee processing company. When asked, senior purchasing executives and the production supervisors of the coffee processing factory in Buon Ma Thuot City said that all the factory’s products were sourced only from reliable local collectors, who had a very good relationship with the company. The company deals mainly with these collectors rather than individual farmers, although they know that purchased coffee needs to go through at least two lower tiers before them, which could increase the production cost and reduce the value for farmers. However, because of coffee growers are small household farmers, it takes more time
to collect at their farms and they have to accept the need to pay more to go through intermediaries. Chi square test results show that farmers who held a sustainability certificate could more readily sell their coffee directly to coffee manufacturing companies than those who did not hold the certificate.

In addition, these senior purchasing executives also mentioned that they were trying to set up a traceability supply chain network for all coffee products, but this had not yet been put into practice. Only few premium and high quality Arabica coffee products use this system to harmonise with the requirements of certified coffee production in the project, coordinating with Utz Association. Finally, the production supervisors said they were planning to gradually change packaging of the final product from plastic materials to paper and recyclable materials up until 2020.

Local collectors are the main dealers who sell coffee bean to exporters or coffee factories, and they said they tried to find reliable coffee beans from farmers. According to the Chi square test, collectors or traders examined the planting process more often with regard to farmers who held a sustainability certificate than in relation to those who did not have a certificate.

Table 7: The relationship between certificate ownership and the percentage of coffee sold directly

| Count   | Percentage of your coffee sold directly |   |   |   | Total |
|---------|----------------------------------------|---|---|---|-------|
|         | 0–30% | 30–50% | 50–70% | 70–100% |       |
| Certification ownership | Yes  | 14 | 10 | 18 | 24 | 66 |
|                     | No    | 52 | 7  | 5  | 7  | 71 |
| Total              | 66    | 17 | 23 | 31 | 137 |
Table 7: The relationship between certificate ownership and the percentage of coffee sold directly

| Count | Percentage of your coffee sold directly | Total |
|-------|----------------------------------------|-------|
|       | 0–30% | 30–50% | 50–70% | 70–100% |
| Certification ownership |       |        |        |         |
| Yes   | 14    | 10     | 18     | 24       | 66     |
| No    | 52    | 7      | 5      | 7        | 71     |

Chi-Square Tests

| Value               | Df | Asymp. Sig. (2-sided) |
|---------------------|----|-----------------------|
| Pearson Chi-Square  | 3  | .000                  |
| Likelihood Ratio    | 3  | .000                  |
| Linear-by-Linear Association | 1  | .000                  |
| N of Valid Cases    | 137|                       |

*a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 13.97.

Table 8: The relationship between certificate ownership and quality examination

| Count | Collectors or traders examine the planting process and quality frequently | Total |
|-------|--------------------------------------------------|-------|
|       | None | 1–2 times/crop | 3–5 times/crop | > 5 times/crop |
| Certification ownership |       | | | | |
| Yes   | 2    | 12       | 38       | 14       | 66     |
| No    | 25   | 40       | 6        | 0        | 71     |
| Total | 27   | 52       | 44       | 14       | 137    |

Chi-Square Tests

| Value               | Df | Asymp. Sig. (2-sided) |
|---------------------|----|-----------------------|
| Pearson Chi-Square  | 3  | .000                  |
| Likelihood Ratio    | 3  | .000                  |
| Linear-by-Linear Association | 1  | .000                  |
Table 7: The relationship between certificate ownership and the percentage of coffee sold directly

|                | 0–30% | 30–50% | 50–70% | 70–100% | Total |
|----------------|-------|--------|--------|---------|-------|
| Certification ownership |       |        |        |         |       |
| Yes            | 14    | 10     | 18     | 24      | 66    |
| No             | 52    | 7      | 5      | 7       | 71    |
| N of Valid Cases | 137   |        |        |         |       |

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.74.

Finally, the representative of a coffee bean-collecting company commented that the logistics costs in her company were due mainly to transportation and storage. It was necessary to arrange different collection times for each farm as the harvest times varied considerably from farm to farm. Everything the farmers did to improve practices relied on experience, as they had not yet attended any training to optimise their operations.

4.4. Reverse logistics

For the reverse logistic issues, data were analysed based on the opinions in the interviews about the current situation. Local collectors said they just improved their work by experience; there was no training to assist them with the most effective recycling strategies. For example, in the case of an examined private coffee bean collecting enterprise, the manager said the packages of products were bought from other suppliers and the enterprise failed to address concerns about the origins of the material. Furthermore, they still often used new PVC sacks instead of packages made from environmentally friendly materials or recycled sacks.

Most production supervisors of the coffee processing company thought the company was currently paying more attention to its recycling policies. It mainly used packaging produced by Tetra Pak, a global environmentally friendly package producer. Moreover, in the factory and
their main office, they separated production waste to dispose of or recycle it. One supervisor also stated that his company was now considering a training plan to guide farmers and local collectors to apply green supply chain and effective reverse logistics in the next financial year.

4.5. Social attainment and corporate social responsibility

From the statistical numbers in the survey, it is worth noting that only 66 out of 137 farmers had joined a sustainable certified coffee program, which accounted for 48.2 per cent of those surveyed. These figures prove that few coffee growers have good knowledge of sustainable coffee. Furthermore, only 53.3 per cent (73 of 137) of farmers said they often received support from local associations and 32.8 per cent of those surveyed agreed that local associations and coffee companies often offered supportive scheme to encourage them.

The Chi square result showed a positive relationship between holding a certificate and support from local associations, with those farmers who held a sustainability certificate receiving support more often than those who did not have a certificate.

**Table 9: The relationship between certificate ownership and support from local association**

| Count | Support from local associations | | | |
|-------|---------------------------------|----------------|----------------|----------------|
|       | Never | Rarely | Often | Very often | Total |

| Certification ownership | Yes | 8 | 2 | 41 | 15 | 66 |
|--------------------------|-----|---|----|----|----|----|
| Total                    | 32  | 32| 56 | 17 | 137|

**Chi-Square tests**

| Value       | Df | Asymp. Sig. (2-sided) |
|-------------|----|----------------------|
| Pearson Chi-Square | 54.403* | 3 | .000 |
Furthermore, only 45 out of 137 surveyed farmers (32.8 per cent) agreed that local traders ensured they would take their output production, and 65 of asked farmers (47.5 per cent) said they did not join any cooperative farming group to protect their rights and their production. The Chi square test result shows that there is a positive relationship between the certification ownership and farmers who are members of any cooperative farming group, with group members having more knowledge about sustainable coffee than those who were not group members.
Table 10: The relationship between knowledge about sustainable coffee and membership of a cooperative farming group

| Count | A member of any cooperative farming group | | |
|-------|-------------------------------------------|---|---|
|       | No | Yes | Total |
| Knowledge about sustainable coffee area | Never heard | 33 | 7 | 40 |
|       | Have heard but never joined | 29 | 37 | 66 |
|       | Have participated | 8 | 23 | 31 |
| Total | 70 | 67 | 137 |

Chi-Square tests

| Value | Df | Asymp. Sig. (2-sided) |
|-------|----|-----------------------|
| Pearson Chi-Square | 25.074a | 2 | .000 |
| Likelihood Ratio | 26.832 | 2 | .000 |
| Linear-by-Linear Association | 23.485 | 1 | .000 |
| N of Valid Cases | 137 | | |

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 15.16.

More importantly, 88.3 per cent of farmers said coffee farming was their main source of income and 82.5 per cent (113 participants) said their family had suffered poverty as a result of fluctuating coffee prices in the past. Only 37 out of 137 (27 per cent) surveyed farmers said the average profit from coffee farms was more than 120 million Vietnamese dong per hectare per year. Their average total income is between 5 and 10 million Vietnamese dong per month (US$250–500).

The Chi square result showed a positive relationship between the certification ownership and the profit from the coffee farms, with more people who held a sustainability certificate
achieving profit over 100 million Vietnamese dong/ha/year than those who did not hold a certificate.

Table 11: The relationship between certificate ownership and profit

| Count | Profit from the coffee farm |
|-------|-----------------------------|
|       | <80 million Vietnamese dong/ha/year | 80-100 million Vietnamese dong/ha/year | 100-120 million Vietnamese dong/ha/year | >120 million Vietnamese dong/ha/year | Total |
| Certification ownership | Yes | 4 | 7 | 24 | 31 | 66 |
|                         | No  | 25 | 30 | 10 | 6  | 71 |
| Total                   |     | 29 | 37 | 34 | 37 | 137 |

Chi-Square Tests

| Chi-Square Test     | Value   | Df  | Asymp. Sig. (2-sided) |
|---------------------|---------|-----|-----------------------|
| Pearson Chi-Square  | 52.048a | 3   | .000                  |
| Likelihood Ratio    | 56.584  | 3   | .000                  |
| Linear-by-Linear Association | 46.404 | 1   | .000                  |
| N of Valid Cases    | 137     |     |                       |

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 13.97.

Most farmers support one to three dependant family members, including one or two children of school age. A total of 86.1 per cent of farmers said they had to work between eight and 12 hours daily to cultivate their crops.

Most farmers had completed secondary education (27 per cent, or 37 people) or high school level (49.6 per cent, or 68 people) – a very positive figure to show that they have a good basis to learn new advanced farming practices to participate in the certified coffee project. Only
seven out of 137 surveyed participants were not willing to participate in training course about sustainable coffee development. The Chi square result showed a positive relationship between willingness to join a sustainable coffee development program and the main sources of income of farmers.

Table 12: The relationship between main source of income and willingness to join

| Count                                      | Is the coffee farm your main source of income? |
|--------------------------------------------|-----------------------------------------------|
|                                            | NO | YES | Total |
| Willing to join sustainable No coffee development program | 4  | 3   | 7     |
| Yes if have any supportive schemes        | 6  | 79  | 85    |
| Yes for sure                               | 6  | 39  | 45    |
| Total                                     | 16 | 121 | 137   |

Chi-Square Tests

|                        | Value   | Df | Asymp. Sig. (2-sided) |
|------------------------|---------|----|-----------------------|
| Pearson Chi-Square     | 15.905* | 2  | .000                  |
| Likelihood Ratio       | 10.492  | 2  | .005                  |
| Linear-by-Linear Assoc.| 1.380   | 1  | .240                  |
| N of Valid Cases       | 137     |    |                       |

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is .82.

Moreover, 132 out of 137 interviewees (96.4 per cent) agreed that they were willing to invest over 10 million Vietnamese dong to improve farming methods and certify their coffee. A total of 73 of 137 interviewees (53.3 per cent) said knowledge was the biggest challenge when it
came to developing sustainable coffee. The role of woman in society was also emphasised, as 62 per cent of farmers said women were fairly important in their family and 34.3 per cent said women were very important.

The local collectors said they were trying to support local farmers. They had found more coffee manufacturing companies and exporters to ensure a good output and price for farmers, but sometimes there were risks that they were unable to manage. However, all the interviewees said they never tried to use financial tools or insurance to limit the risk.

The senior purchasing executive also explained that his company offered the best purchasing price for local farmers to support them in cultivating techniques. He agreed that his company also played a role as a bridge to connect farmers and coffee manufacturing companies when the companies organised volunteer trips or supportive schemes, and suggested that the company supported poor farmers and collected old clothes for them.

The coffee company representative said the company would like to coordinate with government, certifying association and processing companies to organise free training for farmers to join sustainable coffee programs in order to enhance the output of certified coffee. The assistant brand manager of the coffee manufacturing company said her company worked closely with other companies to promote Buon Ma Thuot coffee to international and domestic market.

In analysing the opinions of interviewees, it is plausible to note that coffee processing companies in Vietnam aim to develop a sustainable society. They coordinate to organise a study encouragement fund for poor students, and offer higher purchasing price policies for
local collectors to enable them buy coffee from local farmers at a higher price. In addition, by opening and expanding Coffee Village, one of those examined coffee process companies has created around 50 new positions per year for young people, and given them opportunities to promote their culture to tourists. This company also runs free English classes to teach staff to communicate with international tourists.

According to the production supervisor of this company, the factory in Buon Ma Thuot city currently offers jobs for approximately 270–300 workers, mainly from the local area. It also organises free training to teach farmers to cultivate their farms more effectively. The senior purchasing executive said the company was now planning to form a farmers cooperative association and provide free processing machines for them with the purpose of cutting down the number of links in the supply chain network and increasing the return to farmers. He added that the company always emphasised the role of farmers and tried its best to improve their living standards. The company is coordinating with local authorities to develop a Regional Development Plan until 2025.

4.6. Logistic regression for the dependent variable ‘Certificate ownership’

The research used the surveyed data to run logistic regression to explain the relationship between the dependent variable ‘Certificate ownership’ and independent variables ‘Productivity’, ‘Local support’ and ‘Experience’. It examined the probability of a farmer having a sustainability certificate with the given data of the independent variables. This helps sustainable coffee organisations to forecast whether or not a farmer will have a sustainable certificate with their current situation. The –2 Log likelihood is 72.26, showing that the model is appropriate to develop and the percentage of correct prediction will be 89.1 per cent, which means it is a reliable formula.
Table 13: Logistic regression model

Model Summary

| Step | -2 Log likelihood | Cox & Snell R Square | Nagelkerke R Square |
|------|-------------------|----------------------|---------------------|
| 1    | 72.263a           | .576                 | .768                |

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Classification table

| Observed | Predicted  |
|----------|------------|
|          | Certification ownership | Percentage correct |
|          | NO | YES | |
| Step 1  | Certification ownership | No | 62 | 9 | 87.3 |
|         | Yes | 6 | 60 | 90.9 |

Overall Percentage | 89.1 |

a. The cut value is .500

Variables in the Equation

| Step 1a | B   | S.E. | Wald  | df | Sig. | Exp(B) |
|---------|-----|------|-------|----|------|--------|
| PRODUCTIVITY | 2.015 | .450 | 20.064 | 1  | .000 | 7.502  |
| LOCALSUPPORT  | 1.300 | .374 | 12.069 | 1  | .001 | 3.668  |
| EXPERIENCE    | .934  | .378 | 6.110  | 1  | .013 | 2.544  |
| Constant      | -10.711 | 1.857 | 33.270 | 1  | .000 | .000   |

a. Variable(s) entered on step 1: PRODUCTIVITY, LOCALSUPPORT, and EXPERIENCE.

Because of the Sig of the variable data are less than 0.05 so we can deny the hypothesis that 
\[ \beta_{\text{productivity}} = \beta_{\text{local support}} = \beta_{\text{experience}} = 0 \] that means they have the statistical meaning.

The formula of logistic regression is as follows:

\[ -10.711 + 2.015 \times \text{Productivity} + 1.3 \times \text{Local support} + 0.934 \times \text{Experience} \]

Following the logistic model, if a farmer’s productivity is around 4–6 tons/ha/year, the farmer has five years’ experience and often receives local support, then he will have \( e^{-10.711 + 2.015 \times 3 +} \)
\[
\frac{1.3^3 + 0.934^2}{(1 + e^{-10.711 + 2.015^3 + 1.3^3 + 0.934^2})} = 0.75 \sim 75 \text{ per cent probability of having a sustainability certificate. Based on that model, we can consider which type of farmers should be focused on to develop the sustainability program, in order to help them to gain a sustainability certificate.}
\]

5. Summary and conclusions

Following the research, it is plausible to conclude that the development of sustainable coffee in Buon Ma Thuot City in particular, and in Vietnam in general, offers many opportunities but still encounters some difficulties that need to be overcome. Most importantly, the success of the improvement depends mainly on cooperation among stakeholders, both in the public and private sectors. They have to coordinate closely to improve current farming practices, and then manage the supply chain network as well as reverse logistic issues along with consider strategies to support sustainable development. The government should also consider more effective policies and laws to encourage investment in sustainable coffee production, and expand the market for this product. It should measure and prove the financial benefits for farmers to persuade them to join sustainable programs, and also provide them with agricultural engineers to help them manage the quality of their coffee farms. Finally, the government should choose farmers for the program based on the logistic regression model to achieve more success.

There are some limitations of this study that future research should consider. Due to the limitations of time and experience, the researchers were unable to study a larger sample, which could generate a more accurate result. In addition, the research did not measure the financial impacts of the sustainable coffee program.
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