BENEFITS OF JOINING THE GREEN SUPPLY CHAIN IN COFFEE PRODUCTION: RESEARCH OF TAY NGUYEN, VIET NAM

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Abstract

This paper aims to analyze and discuss the benefits of coffee growing households when participating in the green supply chain in the production. Coffee is the main produced in Tay Nguyen, Viet Nam, accounting for 94% of agricultuaral land. Due to the increasingly strict demands of consumers, they demand a higher level, to meet the needs of customers, coffee growers in Tay Nguyen, Viet Nam must change the way of production according to " Green" coffee. The reseach confirms that: when participating in the green supply chain in coffee production, there are economic, social and environmental benefits.

Keywords: *Green supply chain, coffee, economic, social, environmental.*

1. Introduction

Coffee production as well as export Viet Nam ranks second in the world for many years. However, the export price of Viet Nam's coffee is always lower than that of other countries in terms of coffee production. Vietnamese coffee so far has not had its own brand on the world coffee exchange: Coffee quality and export prices are inferior to coffee products of many countries. Vietnamese coffee products are always at the low end of the global value chain when exported and are often not classified according to their own standards. According to the International Coffee Organization (ICO), every year, over 1,5 million bags of unqualified coffee are rejected at 10 European ports, of which Vietnam's coffee accounts for 72%.

Due to consumer demand, products must meet specific standards. To meet the needs of customers, the international market. Coffee growers need to chainge from traditional production to green supply chain production. The benefits of green supply chain production are: Clean coffee, reduced input materials, no chemicals. Reduced costs in coffee production.

2. Literature Review

2.1. Green suppy chain

Johnny (2009) assert that green supply chain is the process of adding elements of " green" elements to an existing supply chain and creating a recall supply chain as a way to rebuild the resulting system. This includes not only the pursuit of efficiency, but also supply chain innovation with regard to costs, profits and the environment.

Dadhich, Genovese, Kumar & Acquaye, (2015) stated that green supply chain are limited in natural resources, rising raw material and energy prices cause irreparable damage, raising concerns about carbon, gas waste, resource scarcity, climate change and waste generation have become challenges facing business environment.

2.2. Green supply chain coffee

The green coffee supply chain is a coffee production chain from production to consumers, the coffee production process with the goal of reducing input materials, reducing chemical fertilizers, reducing irrigation water, and reduce greenhouse gas emissions. Without, affecting the environment, recycling coffee pods to make microbial fertilizers to use as fertilizer, reduces labor costs, and reduces greenhouse gas emissions to the surrounding environment.

3. Method

3.1. Comparative method

To compare the effectiveness of coffee growers who have joined the supply chain and have not jet applied to participate in the supply chain to find out what causes they have not joined the supply chain.

3.2. Expert method

Consult directly or indirectly with officials and experts with long -term expericnce from central to local levels related to coffee, agricultural departments of 5 provinces to analyze and evaluate chain development. Green supply chain in coffee production, which is the foundation to perfect policies for the development of green supply chains.

3.3. LCA Method

Calculating greenhouse gas emissions at all stages of the green supply chain in coffee production in Tay Nguyen, such as preparation, cultivation, and processing.

4. Results

4.1. Enviromental Efficiency

a) Input stitch

Table 1: Greenhouse gas emissions during preparation

Unit: kgCO_2tđ/ha

Unput Stitch	TRADITIONAL				GREEN SUPPLY CHAIN			Difference
	GHG	*Quantily*	*Coefficient*	*Quantily GHG*	*Quantily*	*Coefficient*	*Quantily GHG*	
Land plowing machine	CO_2	3,9	74100	10,779	3,8	74100	10,779	-
	CH_4	3,9	10	39	3,9	10	39	-
	N_2O	3,9	0,6	2,34	3,8	0,6	2,28	**0,06**
Hole Digger	CO_2	7,9	74100	21,835	8	74100	22	**0**
	CH_4	7,9	10	79	7,9	10	79	
	N_2O	7,9	0,6	4,74	8	0,6	4,8	**0,06**
Lime powder	CO_2	26,3	0,13	3,419	23,8	0,13	3,094	**0,325**
Manure	CH_4	260,1	0,005	0,017	209,9	0,014	0,017	-
	N_2O	260,1	0,005	0,003	209,9	0,003	0,003	-
N		5	3,63	18,15	5	3,63	18,15	-
Total				**179,28**			**179,24**	

Source: Author's calculation from actual survey results, 2020

Before growing coffee, household in Tay Nguyen used a plow to plow the soil, and used a excavator to dig holes for coffee instead of using human strength. Apply formula 1 to calculate greenhouse gas emissions caused by Dieswel, in which the CO_2 emission factor is 74100kg CO_2. TJ. The N_2O emission factor is 0,6 kgN_2O TJ (*Table 2.5, Chapter 2, GL 2006)*. According to the survey results of 392 coffee producing households, the average pit excavator is 3,8-3,9 liter of oil, 1 liter is equal to 37,3 MJ, the coefficient of CO2 emission due to Deisel oil is 74100, the coefficient is 74100, N2O emission is 0,6. The amount of lime used for fertilizing in coffee planting holes, based on the results of subjects, the author surveyed 161 households growing traditional coffee, 131 households participating in the green supply chain. Using lime to fertilize before planting coffee trees, to increase the resistance of coffee, 1 ha of coffee fertilize 400kg of lime on average. The emission factor of using lime fertilizer is taken according to IPCC National GHG Invenrory Guidelines (2006), this study selects the emission factor of using Dolomite as a Coffee liner with the value 0,13 C/kg of lime (*GL 2006, Vol. 4, Chapter 11, P 29)*

Planting and taking care of coffee

Table 2: GHG in coffee growing and tending

Unit: kgCO_2tđ/ha

Growing and tending	**TRADITIONAL**				**GREEN SUPPLY CHAIN**			**Difference**
	GHG	*Quantily*	*Coefficient*	*Quantily GHG*	*Quantily*	*Coefficient*	*Quantily*	
N	CO_2	213	3,63	773,19	189	3,63	686,07	87,12
P2O5	CO_2	200	0,13	26	52,3	0,13	6,8	19,2
K2O	CO_2	104	0,56	58,24	65,5	0,56	36,68	21,56
Deisel Oil	CO_2	29	74100	80,15	18	74100	49,75	30,4
	CH_4	29	10	290	18	10	180	110
	N_2O	29	0,6	17,4	18	0,6	10,8	6,6
Pesticides	CO_2	1,04	25,5	26,52	0	25,5	0	26,52
Manure	CH_4	785,8	0,05	0,052	587,1	0,05	0,039	0,013
	N_2O	785,8	0,05	0,01	587	0,05	0,007	0
Total				**1.272**			**970**	301

Source: Author's calculation from actual survey results, 2020

Fertilizer N: The amount of fertilizer in the period of basic economic development, households usually use fertilizer with a ratio of 16-16-8, showing the amount of greenhouse gas emissions due to the amount of N fertilizer, traditional production by households 773,190 kgCO2tdd/ton, produced by green supply chain, emissions 686,040 kgCO2tđ/ton, difference in greenhouse gas emission reduce 87.12 kgCO2tđ/ton. GHG emissions P2O5, conventional production GHG emissions is 26 kgCO2tđ/ton, greenhouse production green supply chain emissions 6,8 kgCO2tđ/ton. The difference between the amount of greenhouse gas green supply chain emissions are reduced by 19,2 kgCO2tđ/ton compared to the traditional model. K_2O emissions from traditional production 58,240 kgCO2tđ/ton. Green supply chain production, greenhouse gas emissions 36,680 kgCO2tđ/ton. The results show that when participating in a green supply chain, greenhouse gas emissions are reduced by 21,560 kgCO_2tđ/ton compared to households participating in the tradional model.

+ **Electricity**: CH_4 greenhouse gas emissions, for traditional production, 0,006

kgCO2tđ/ton, production in the direction of a green supply chain, emissions 0,000544 kgCO2tđ/ton. Compared to using electicity when participating in the green supply chain, it reduces 0,006 kgCO_2tđ/ton.

+ **Deisel Oil**: CO_2 greenhouse gas emissions, traditional production 80,15 kgCO2tđ/ton, green supply chain production, emissions 49,75 kgCO_2tđ/ton. The results show that greenhouse gas emissions when households participating in the green supply chain decrease by 30,4 kgCO_2tđ/ton compared to households participating in the traditional way. The amount of greenhouse gas emissions CH_4, produced in the traditional way is 260 kgCO2tđ/ton, produce under the green supply chain, the greenhouse gas emission CH4 is 180 kgCO2tđ/ton. It shows that households participating in green supply chains have reduced greenhouse gas emissions by 110 kgCO2tđ/ton compared to traditional production. N2O emissions, when engagel in traditional production with an emissions of 17,4 kgCO2tđ/ton, production in the green supply chain has N_2O emissions of 10,8 kgCO2tđ/ton. The difference in traditional production is 6,6 kgCO_2tđ/ton compared to production in the green supply chain.

+ **Pesticides:** CO_2 greenhouse gas emissions of fertilizers, traditionally produced emissions 0,052 kgCO2tđ/ton, households participating in the green supply chain do not use pesticides, so the amount of gas emitted greenhouse gas emissions are 0.

+**Manure:** CH4 emission of manure, traditionally produced greenhouse gas emissions is 0,052 kgCO2tđ/ton, households participating in the green supply chain have greenhouse gas emissions of 0,039 kgCO2tđ/ton. The difference when participating in the green supply chain, the amount of greenhouse gas emissions reduced by 0,013 kgCO2tđ/ton compared to traditional production. N2O emissions of manure, for traditional production is 0,010 kgCO2tđ/ton, GHG production in green supply chain is 0,007 kgCO2tđ/ton. It shows that the amount of GHG of traditional production households is 0,003 kgCO2tđ/ton more than households participating in the green supply chain.

+ **Collection point**

- Greenhouse gas emissions

The amount of greenhouse gas emissions from using oil for agricultural vehicles to transport coffee from the field to home is 43 kgCO_2tđ/ton for traditional production; for households that transport by buggy or trailer, the GHG is 0. For households participating in the green supply chain, the GHG amount is 26,64 kgCO2tđ/ton. The difference between the amount of GHG for households producing traditionally is more than 16,36 kgCO2tđ/ton with households participating in the green supply chain.

The amount of CH4 GHG in the process of coffee milling for traditional households is 0,065 kgCO2tđ/ton, households producing in the green supply chain are 0,09

kgCO2tđ/ton.

Table 3: Coffee GHG in Tay Nguyen

Unit: KgCO2tđ/ton

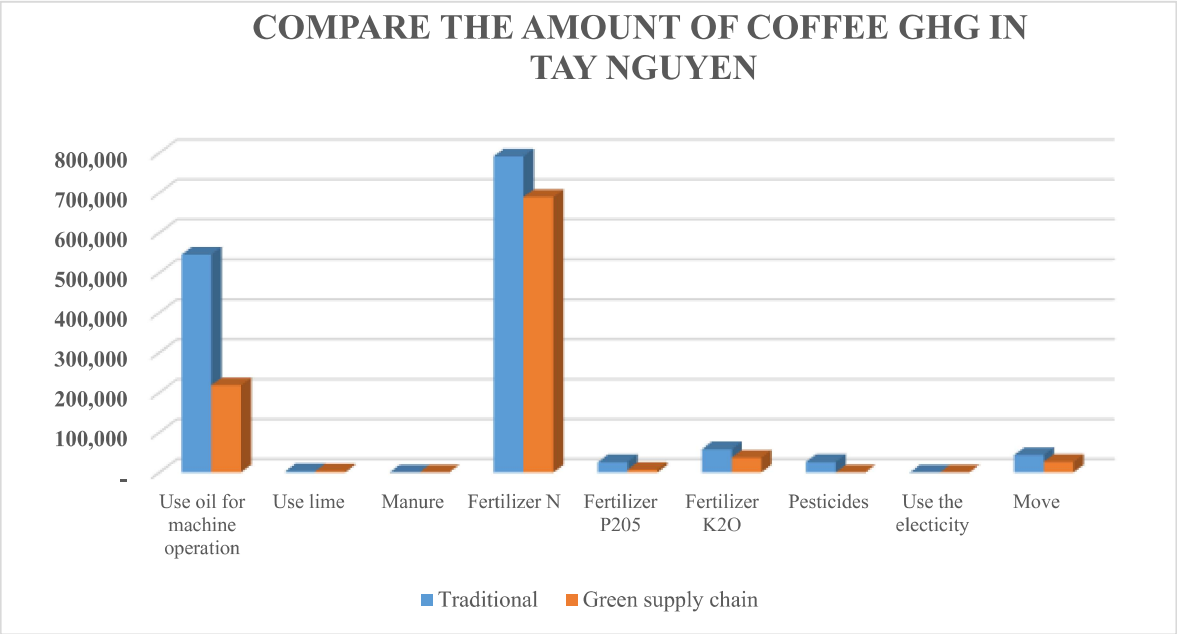
	Sources GHG	GHG	TRADITIONAL	Green supply chain
1	Use oil for machine operation	CO_2	112,768	32,614
		CH_4	408	167,751
		N_2O	24,480	17,880
2	Use lime	CO_2	3,419	3,094
3	Manure	CH_4	0,070	0,056
		N_2O	0,013	0,011
4	Fertilizer N	CO_2	791,340	689,700
5	Fertilizer P205	CO_2	26	6,8
6	Fertilizer K2O	CO_2	58,240	36,680
7	Pesticides	CO_2	26,520	0
8	Use the electicity	CO_2	0,071	0,09
9	Move	CO_2	43	26,64
Carbon footprint (kgCO2tđ/ton)			1.494	981

Source: Author's calculation from actual survey results, 2020

- **Compare the amount of coffee GHG in Tay Nguyen**

Table 3 shows that coffee production in Tay Nguyên is produced in a traditional way with an output of 1 ton of fresh coffee, with a GHG amount of 1,494 *KgCO2tđ/ton.* Production in green supply chian GHG amount is 981 *KgCO2tđ/ton.* According to green supply chain production reduces greenhouse gas emissions compared to the traditional 512,89 *KgCO2tđ/ton.*

Table 3: Compare the amount of coffee GHG in Tay Nguyên



- **Economic efficiency**

According to the survey results of the author, to harvest 1 ton fresh coffee includes the following costs:

Thus, the total cost of growing coffee to harvest 1 ton of fresh coffee is 5,880,000 VND

Table 4: Coffe Production Costs When Participating In Green Supply Chain

Unit: VND/Ton

Costs	Green supply chain coffee
Coffee tree	275.000
Watering system**	130.000
Labor cost	417.000
Fertilizer cost *	4.158.000
Manure cost	500.000
Energy cost	400.000
Total	**5.880.000**

The amount of fertilizer 3 years from the production stage to the start of harvest

When participating in the green supply chain, it is necessary to bring the most practical efficiency to facilitate the development of the green supply chains bring to coffee

procers are shown in table 4.

Table 5: Economic Benefits Of Joining A Green Supply Chain

Unit: VND/Ton

Saving money on watering system	70,000
Saving labor cost	183,000
Reduce inorganic fertilizers	12.006,000
Reduce organic fertilizers	200,000
Saving time converting to money	130,000
Saving time, convert to money	85,000
Cost	2.500,000
Reduced energy	400,000
Sell carbon credits	25,383
Tatol	**15.416,566**

Source: Author's calculation from actual survey results, 2020

Traditional coffee production has a greenhouse gas emission of 1,494 KgCO2tđ/ton, after joining the green supply chain, greenhouse gas emissions decrease to 981 KgCO2tđ/ton. The selling pric of carbon credits is 981 KgCO2tđ/ton. The money is 25,383 thousand VND.

- Using time – saving in coffee irrigation, each year saves 130,000 VND
- Saving money on treatment of diseases caused by environmental pollution is 85,000 VND/ year.
- When participating in the green supply chain, cost of buying 1kg of coffee increases by 2,5 thousand VND/kg compared to the traditional. Join the green supply chain with a profit of 2,5 million VND/ton of fresh coffee.
- Joining a green supply chain, cost such as electricity and oil are reduced by 40,000 VND compared to the traditional.
- Using inorganic fertilizers when participating in the green supply chain brings benefits of 12,006 million VND. Manure benefits when participating in the supply chain is 200,000 VND.

- **Social efficiency**

Joing a green supply chain in coffee production in Tay Nguyen, in addition to environmental benefits, also has social benefits such as reducing the burden on wonmen and the elderly in coffee production, watering, saving time for children and the elderly to spend

time working more gently, suitable for each age. Saving a lot of time, men can do other jobs to increase family income, women can spend that time talking care of the family.

Through the survey, people who have participated in green supply chain in coffee production are shown as follows:

Improving the quality of life for workers: After surveying households/farms involved in coffee production that have joined the green supply chain. They use drip irrigation technology instead of watering in the traditional way of pulling the rope to the root, saving 100% of irrigation manpower, saving 9 labor/time/ton. 27 labor/ha/ year. The current labor price is 260.000 VND/ day, increasing income is 7,020,000 VND/ha/year, for coffee producing households that have not joined the green supply chain. The time thay save is used by them fof social activities, looking for alternative jobs to increase their living income, such as village activities (100%), talking care of the family 52%. Increase income 60%, read books 13%. According to the comments of coffee farms/ households, since joining the green coffee supply chain, thay have more time to take care of their families, study and children, and have time to do other jobs.

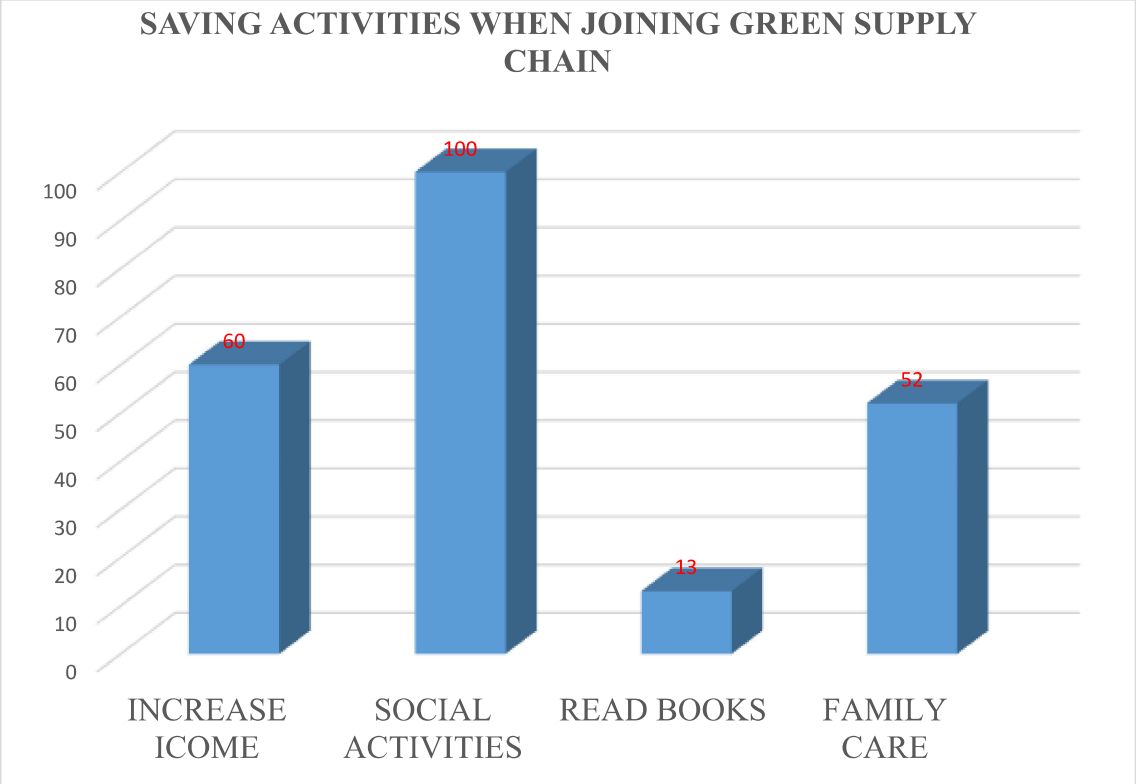


Figure 1: Saving activities when joining green supply chain

Improving people's health: Of which 131 households and participants in the green supply chain, 125 households (accounting for 97,2%), believe that participating in the green supply chain can reduce diseases caused by environmental pollution. In addition, health

diseases affect people due to side effects from organic chemical fertilizers, sprays for coffee trees when spraying in bathches, flowering before ioning the green supply chain. The reduction of envirmental pollution caused by pruning coffee branches and coffee husks increases the stench, since joning the green supply chain, talking advantage of coffee pruning to mank cooking firewood coffee husks for composting, fuel for coffee roasting. Each year on average. Each households/ farm seves about 459,300 VND/year on respiratory diseases… compared to before joining the green coffee supply chain.

Reducing the amount of flies, mosquitoes and insects when producing traditional coffee. According to the author's survey of 131 households/ farms, 47,2 of insects, ants and flies are completely reduced. 38,2% of households/farms reported that the amount of insects, files, and ants reduced slightly. Most of the farms take advantage off coffee husks before joining the green supply chain.

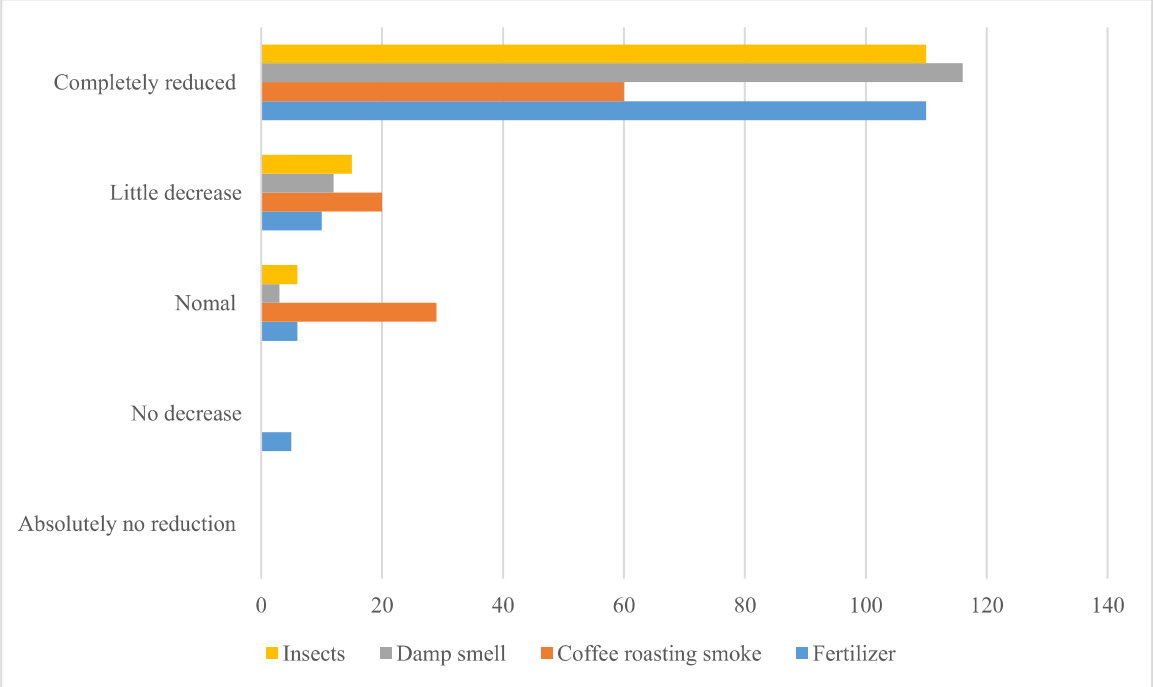


Figure 2: Air pollution reduction and insect counts after joining the green supply chain

5. Discussion

In recent years. Cofffee has been exported a lot in countries around the wworld, coffee growing households in Tay Nguyen, Viet Nam have joined the green supply chain in production, replacing the traditional production method. They found that, when participating in green supply chains, there are many economic, social and environmental benefits compared to traditiopal production.

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