GRAESE : Groupe de Recherches Asie de l'Est et du Sud Est

ETUDES ET DOCUMENTS DU GRAESE

Perennial crop systems in Dak Lak province, Vietnam: Practices and socio-economic analysis

PHAN Thi Thuy

N°21/2022

Perennial crop systems in Dak Lak province, Vietnam: Practices and socio-economic analysis

PHAN Thi Thuy

TABLE OF CONTENTS

PRESENTATION OF THE AUTHOR

Dr PHAN Thi Thuy works as a lecturer at Central Highland University (TNU), where she carries out research and teaching activities. She fulfilled a Bachelor of Business Administration from Central Highland University in 2010 and International Master in Rural economics and Sociology (IMAREST) from a collaborative training program between University of Liège and Vietnam National University of Agriculture, Vietnam in 2015. In 2021, she completed a doctoral fellowship in the field of economics of agriculture at the Gembloux Agro-Bio Tech, University of Liege, Belgium. Her thesis "Socio-economic analysis of perennial crop systems in Dak Lak, Central Highlands, Vietnam" explores the socio-economic benefits of perennial crops systems based on a systematic survey of a Vietnamese village, key informant interviews and participatory observation. With 11 years in both teaching and research, she has experience in team building, professional development, strategic implementation, and publishing papers. Her research interests are the following fields: Economics, rural development, agriculture.

ABSTRACT/TOM TẮT

Perennial crops play a valuable role in agricultural economics, as they provide goods for export and jobs for the workforce as well as contribute significantly to economic prosperity at the national level. Vietnam has a high potential for perennial crop development, and thereby achieve an explosive growth in agricultural commodities. In terms of perennial crops, Vietnam now ranks among the top five international exporters of coffee, pepper and cashew. Vietnam is the second-largest producer of coffee worldwide, while it is the leading exporter of pepper globally.

Dak Lak province has favorable conditions of soil (1,450 ha of basaltic soils of volcanic origin, which equals two thirds of the total basaltic soil area nationwide), as well as weather and amount of arable land, which creates an advantageous situation for the culture of perennial crops. Over the years, perennial crops have changed considerably being usual dynamics of requirements. Despite its advantages and positive development trends, provincial perennial crop production has faced numerous constraints due to price fluctuation, unpredictable climatic trends, and incidence of pests and diseases.

The results provide critical references for farmers and policymakers on implementation or decision to plant a particular perennial crop and strategies. The findings show that the type of crop that was planted by the farmers evolved considerably in terms of crop types, crops grown, farm size, type of system and an increase of total cultivated surface. In addition, under driving forces including socioeconomic transformation, political changes and ecological movement, perennial crop systems are well changed. Indeed, for many years, perennial crop systems have experienced an evolution through five stages, namely large-scale coffee and rubber plantations; perennial crop systems which are state-owned farms and cooperatives; intensified perennial crop systems; mixed crop systems, and the specialized and diversified perennial crop systems.

At present, perennial crop systems are put into practice which take into account climate change, marketing and losses of fertile lands. These systems include monocultures and intercropping, which are two representative models of perennial crop systems which are investigated in this study. Simultaneously, a comparative assessment of the socio-

economic benefits between two monocultures (coffee and pepper mono cropping) and an intercropping system (coffee and pepper intercropping) is presented in which the intercropping is more efficient than the monoculture under the context of constraints on key resources, risk and uncertainty. Respectively, intercropping is not only demonstrated to have high economic returns and limitations of economic risk due to the volatile market but also to have the benefits of extended seasonal employment and attraction for women as farmworkers on small farms. In other words, coffee and pepper intercropping is the most desirable option to obtain socio-economic benefits in perennial crop systems. In addition, the classifications in different approaches and groups producing are also organized to clarify these economic performances by cost-benefit analysis.

This study supplies information that will allow farmers to develop productive planning with respect to choosing suitable perennial crop systems, and assist policymakers in forming small-scale perennial crop production strategies in Dak Lak province. In addition, the factors highlighted here are taken into account in the development of perennial crops.

Cây lâu năm đóng vai trò quan trọng trong kinh tế nông nghiệp, bao gồm cung cấp hàng hóa cho xuất khẩu, tạo việc làm cho lực lượng lao động cũng như đóng góp đáng kể vào sự thịnh vượng của đất nước.

Việt Nam có tiềm năng lớn để phát triển cây lâu năm và sản phẩm nông nghiệp, lĩnh vực đã đạt được sự tăng trưởng đáng kể. Hiện nay, các sản phẩm xuất khẩu như cà phê, hồ tiêu và điều của Việt Nam đứng top 5 trên thế giới về sản lượng sản xuất. Trong đó. Việt Nam là quốc gia đứng thứ 2 thế giới về sản xuất cà phê và một trong những nước dẫn đầu của thế giới về sản xuất hồ tiêu.

Tỉnh Đắk Lắk có nhiều thuận lợi về thổ nhưỡng, thời tiết và đất đai để phát triển cây lâu năm. Những năm qua, canh tác cây lâu năm đã có sự thay đổi mạnh mẽ để thích ứng với những yêu cầu. Mặc dù có những lợi thế và xu hướng phát triển tích cực, sản xuất cây lâu năm của tỉnh đang đối mặt với nhiều khó khăn do giá cả bấp bênh, thời tiết thất thường và dịch bệnh.

Nghiên cứu được thực hiện nhằm đánh giá thực trạng phát triển và thực hiện phân tích lợi ích kinh tế xã hội của mô hình sản xuất cây lâu năm tại tỉnh Đắk Lắk bao gồm hệ thống trồng độc canh và trồng xen canh tập trung vào cây cà phê và hồ tiêu. Ngoài ra, các yếu tố ảnh hưởng đến việc chuyển

đổi mô hình canh tác cũng được tìm hiểu. Kết quả nghiên cứu cung cấp tài liệu tham khảo cho nông dân, những người thực hiện chính sách trong việc ra quyết định quy hoạch sản xuất và xây dựng chiến lược phát triển cây lâu năm.

Kết quả nghiên cứu chỉ ra rằng, dưới tác động của các yếu tố gồm sự chuyển dịch kinh tế, thay đổi chính sách, chuyển đổi sinh thái, hệ thống cây lâu năm thích ứng mạnh mẽ bao gồm thay đổi quy mô canh tác, loại hình hệ thống cũng như tăng về diện tích canh tác. Cụ thể, hệ thống cây lâu năm trải qua quá trình chuyển đổi gồm 5 giai đoạn, quy mô lớn-đồn điền (chủ yếu đồn điền cà phê và cao su); nông trường và hợp tác xã do nhà nước quản lý; hệ thống sản xuất thâm canh; hệ thống trồng xen cây ngắn ngày; và hệ thống xen canh và chuyên môn hóa.

Hai hệ thồng trồng thuần và trồng xen, đại diện cho mô hình cây lâu năm được khảo sát ở nghiên cứu này cho thấy mô hình xen canh ở quy mô nhỏ mang lại hiệu quả kinh tế cao hơn cũng như tạo ra lợi thế cho lao động mùa vụ, thu hút lực lượng lao động phụ nữ. Hay nói cách khác, hệ thống xen canh cây lâu năm dường như là lựa chọn phù hợp nhất để đạt được lợi ích kinh tế, xã hội. Hơn nữa, các yếu tố ảnh hưởng đến việc lựa chọn mô hình canh tác gồm tập huấn, lợi nhuận, tình hình dịch bệnh.

Nghiên cứu không những cung cấp thông tin cho phép người nông dân phát triển kế hoạch sản xuất trong việc lựa chọn hệ thống canh tác cây lâu năm phù hợp mà còn giúp các nhà hoạch định chính sách hình thành chiến lược phát triển cây lâu năm ở quy mô nhỏ tại tỉnh Đắk Lắk. Ngoài ra, các yếu tố ảnh hưởng đến việc theo đuổi mô hình canh tác nào cũng cần được quan tâm nhằm phát triển hệ thống cây lâu năm hiệu quả.

1. INTRODUCTION

Perennial crops were introduced in Vietnam mainly at the end of the nineteenth century. These products have currently become major commodities and driving forces for economic growth and export revenue. Statistically, in 2018, the perennial crop growing area reached over 2.2 million hectares (ha). Of which approximately 1.8 million ha produced over 4 million tons including coffee, pepper, rubber, cashew and tea, concentrated largely in the Central Highlands, namely the provinces of Dak Lak, Dak Nong, Gia Lai, Lam Dong, and Kon Tum provinces thanks to the favourable conditions (GSO, 2020) Over the past quarter-century, the agricultural sector developed such significance that many countries tried to learn from these Vietnamese successes, in the perennial crop sector, which achieved an explosive growth of export earnings, accounting for approximately 10 billion USD in 2018. Since the 2000s, Vietnam ranked among the top five global exporters of perennial crops products. Nevertheless, changes in driving forces such as ecological, technical, socio-economic, political issues resulted in challenges to agrarian systems and perennial crop production. Presently, perennial crop systems have consisted of two systems, which include specialization and diversification systems.

Dak Lak province, the place of study, exhibits the unique features with high immigration rates, a diversified ethnicity and abundant resources. These create provincial economic development, agricultural growth and influence perennial crop dynamics. Unfortunately, provincial agriculture, and the perennial crop ector has, in Dak Lak experienced enormous challenges for a long time. Additionally, many previous studies have demonstrated that perennial crop production has faced many difficulties such as high production cost, susceptibility to natural disasters, and vulnerabilities from trade fluctuations (Slater et al., 2007; Ha and Shively, 2008; Thuy et al., 2019) Consequently, farmers have faced debt, as it is difficult to repay loans. This has also had a large effect on socio-economic stability. Thus, farmers have recently had to practice strategies to reduce risks, cope with uncertainty, replacement of coffee plantations with other crops have been natural responses of farmers to secure production under vulnerable conditions. Diversification is not only a risk management strategy (e.g.

separating risks and creating buffers), but it is also a response to price changes (FAO, 2018). In other words, traditional farming of coffee and pepper has now been transitioning from mono-culture systems (separating coffee and pepper) to the intercropping system, where coffee and pepper are intercropped. That is why, there must be an accurate understanding of alterations to these cropping systems. Going forward, practices of perennial crop systems and measurement of socio-economic benefits of different systems focusing on coffee and pepper are essential analyses in order to provide empirical evidence for farmers so that they can choose appropriate systems and essential for policymakers to assist in the management and development of strategies for perennial crops.

Research objectives

The study intends:

To accurately understand the evolution of perennial crop systems during specific distinct stages in Dak Lak province

(i) To provide an overview of perennial crop practice in Dak Lak province and evaluate the socio-economic practicability of selected perennial crop systems involving coffee and pepper

(ii) To identify the primary factors affecting a farm's decision to adopt specific perennial crops

(iii) To propose adequate advice and recommendations to farmers and Dak Lak province as a basis for perennial crop development strategy.

2. PERENNIAL CROP SECTOR IN VIETNAM

Perennial crops are a major contributor to agriculture in Vietnam. According to statistical data, these planted areas reached over 2.2 million ha and produced around 4 million tons in 2018. Around 90% of this is accounted for by the Robusta variety thanks to suitable conditions while Arabica accounts for only 40,000 ha. Since 2013, the coffee yield per ha has decreased steadily because of the increasing age of coffee tree stock, heavy rain and drought. Regarding rubber, it has occupied the highest area under cultivation compared to other crops, accounting for about one million ha in 2018, concentrated mainly in the Southeast and Central Highlands (ICC, 2019). Nonetheless, due to falling prices and climate change, the area and output have gone down considerably since 2015. Cashew and pepper grown by many households occupied a smaller proportion of the total perennial crop area.

3. STUDY SITE AND METHODOLOGY

3.1. The study site

The total area of the province is 1,303,048.53 ha, equal to 3.9% of the total area of the whole nation. Dak Lak province contains 15 administrative districts (Buon Ma Thuot City, Cu Mgar, Cu Kuin, Ea H'leo, Krong Nang, Krong Pak, Krong Bong, Krong Buk, M'Drak, Ea Kar, Ea Sup, Buon Don, Krong Ana, Lak and Buon Ho Town (Figure 1). Most areas have a moderate elevation, and about 35% is highlands and mountains. In addition, Dak Lak province can be divided into six agro- ecological zones defined by elevation, including the areas of Ea Sup plateau subregion (28.4%); Buon Me Thuot–Ea H'Leo plateau subregion (16.2%); M'Drak hill and plateau subregion (15.8%); the plateau subregion along with the Krong Ana–Srepok river (14.5%); Chu Yang Sin mountainous area (4.0%); and Rlang Dja mountainous area, respectively (GSO, 2019).

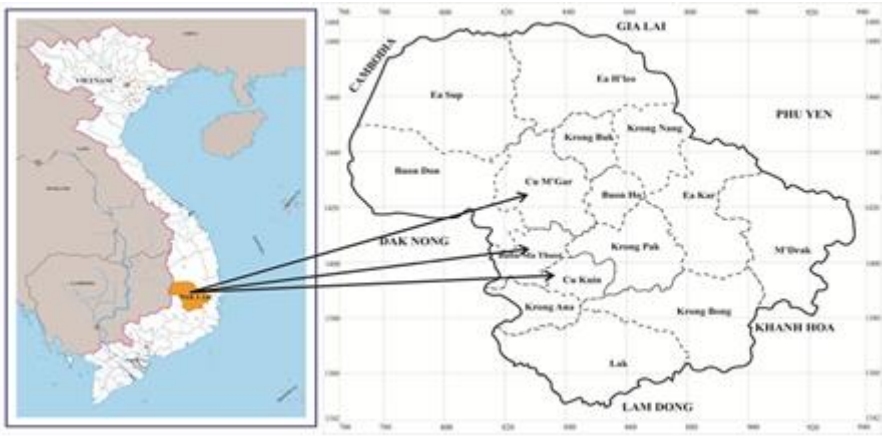

Figure 1: Map of research sites

Source: Political Map of Vietnam

3.2. Methodology

3.2.1. Selection of study sites

This study was conducted in Buon Ma Thuot city, CuMgar and CuKuin districts of Dak Lak Province which have similar fertility and suitable weather (the largest of the coffee areasis CuMgar; the third largest of the

pepper areas is CuKuin; and Buon Ma Thuot city has a long history of perennial crop production). Additionally, the two districts are near Buon Ma Thuot city and so that have favourable market conditions, transportation, agri-services (Map). Moreover, based on other sources including formal documents (VAST, 2015) (see map), and discussions with key informants and agricultural experts at provincial and district levels, the region can be divided into three zones by fertility capacity classification as shown in Figure 2.

Zone 1: Area highly favourable for perennial crops, such as Buon Ma Thuot city, CuMgar, Cu Kuin, Krong Ana, Krong Buk, EaHleo, Krong Ana, Krong Pak districts (dark orange and orange sites).

Zone 2: Area moderately favourable for perennial crop growing (light orange sites) Zone 3: Area unfavourable for perennial crops (purple and other sites).

Figure 2. The development of perennial crops in three fertility zones

Source: Dak Lak Provincial People's Committee, 2019

3.2.2. Collection of data at surveyed households and plots

- **Sampling**

The sampling was carried out by the randomly. (Salvatore and Reagle), 2002) argued that the sample size could be collected based on the population, with the number of households (n) = 0.1 N (population size) and statistical units having the same probability of being selected. Accordingly, from the list of households, 86 interviews were selected. Because each household often owns more than one plot in the surveyed

region, the total number of households (86 heads) was smaller than the total surveyed plots. 90 plots were selected from the list.

The additional information about the initial investment of MCS, MPS and CPI in the first three years needed to be obtained through a supplementary interview of thirty-seven farms from the selected list of 86 households (who also holds farms were from one to three years old) by random sampling (Table 1).

Table 1: The distribution of sample in supplementary interview

Regions	MCS	MPS	CPI	Total sample
Buon Ma Thuot	5	4	4	13
CuMgar	4	6	3	13
CuKuin	3	4	4	11
Total	12	14	11	37

- **Data analysis**

In this study, farm profile, cost-return, and comparative analysis were used to examine the differences in economic efficiency, in addition to descriptive statistical analysis (means, percentages, charts, and growth rate). Many indicators such as production cost, revenue, value added, and profit indicate which cropping systems have the best economic performance for households. The Kruskal–Wallis and Mann–Whitney methods were applied to the test results (Hoàng and Chu, 2008; Adenuga, Muhammad-Lawal and Rotimi, 2013).

4. RESULTS

4.1. The evolutionary process of perennial crop systems in Dak Lak province

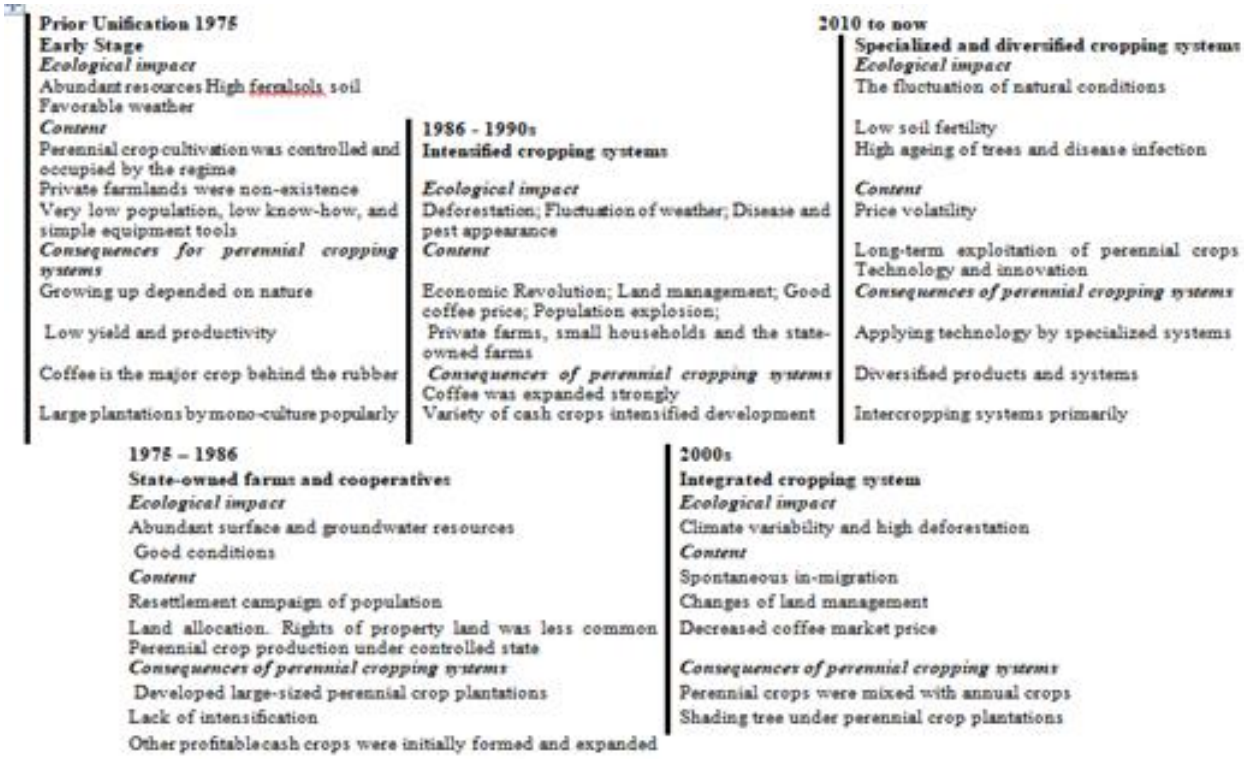

Figure 3: Important historical milestones and consequences of perennial crop production

Source: Author's own elaboration

4.2. Practices and socio-economic analysis of selected perennial crops

4.2.1. Economic results of the selected perennial crop systems

4.2.1.1. Economic performance of selected perennial crop systems

a. The cost analysis of three selected perennial crop systems

- ***Start-up cost***

Table 2: The start-up cost of selected perennial crop systems in the 2016/2017 crop year

Items	MCS		MPS		CPI		Sig
	Mean (*n* = 12)	SD	Mean (*n* = 14)	SD	Mean (*n* =11)	SD	
Total	**38.5**	**22**	**147.5**	**102**	**65.3**	**31.5**	**0.00***
1. Preparation of land	4	2.8	4.9	7.5	3.3	5.7	0.3
2. Materials costs	19.5	11.3	130.5	98	42.3	28.8	0.00*
5. Labor	15	10	12.3	4.2	19.7	7	0.00*

Note: Kruskal wallis Test ***,**,N/S Significance level at 99%, 95% and Non-significance.

Source: Authors' own calculation

This startup cost is estimated at 38.5 million for MCSes, 147.5 million for MPSes, and 65.3 million VND per hectare for CPI. It includes various costs such as land preparation, materials, and labor. Therefore, these costs amount to 4 million for MCSes, 4.9 million for MPSes and 3.3 million VND per ha for CPI (Table 2).

Regarding labor costs, this included costs for cleaning, preparing plantations, digging holes, planting nursery plants, and setting pillars. MPSes had the highest hired labor cost, at 3.2 million VND per ha. MPSes were recorded as using more male workers to set the wooden and concrete pillars (Table 2). Probably because setting wooden and concrete pillars requires labor involving heavy lifting. In contrast, CPIs had higher family labor and lower hired labor costs than MCSes and MPSes, accounting for 18.4 million and 1.3 million VND/ha.

- ***Annual cost***

Table 3: Production cost of three selected perennial crop systems in 2016/2017

(Unit: Million VND per ha)

Items	Farming System						Sig.
	MCS (*n* = 32)		MPS (*n* = 28)		CPI (*n* = 30)		
	Mean	SD	Mean	SD	Mean	SD	
Annual cost	**43.6**	**11.1**	**86.7**	**39.3**	**86.3**	**23.3**	**0.00***
Intermediate cost (IC)	**18.5**	**6.8**	**38.7**	**25.4**	**28.5**	**12.2**	**0.00***
Labor cost	**21.5**	**4.7**	**39.2**	**13.7**	**45.8**	**13.6**	**0.00***
Loan interest [1]	**1.9**	**3**	**2.6**	**4**	**2.9**	**4.3**	**0.82**
Depreciation [2]	**1.8**	**0.9**	**6.1**	**2.4**	**5.5**	**4**	**0.00***

Note: Kruskal wallis Test ***,**,N/S Significance level at 99%, 95% and Non-significance.

Source: Authors' own calculations

The annual cost of MCSes was 43.6 million, the cost of MPSes was 87.6 million, and the cost of CPI was 86.3 million VND per ha. These costs had higher intermediate and labor costs, which were the two main components.

Regarding labor, perennial crop systems require high inputs in this area. Most labor costs are for harvest, with MPSes at 39.2 million VND per hectare (45.5% of annual costs) and CPI at 45.8 million VND per hectare (58% of annual costs), with both being more labor-intensive than MCSes (Table 3). This creates labor pressures, especially during the pepper harvest season, and especially since the harvest time isn't expandable due to pepper growth characteristics. CPI has the greatest number of family labor days compared to the other systems, making up about 213 days over the year. In summary, the available evidence shows that MCSes incurred the lowest production costs, whereas MPSes had the highest.

b. A profitability assessment of three selected perennial crop systems

Table 4: Net return of MCSes, MPSes and CPI in 2016/2017 crop year

Items	Farming System						Sig.
	MCSes (*n* = 32)		MPSes (*n* = 28)		CPI (*n* = 30)		
	Mean	SD	Mean	SD	Mean	SD	
Total Output (millions VND)	80.8	19	253.5	89	285.4	82.7	0.00*
Value added (millions VND)	62.4	15.7	214.7	71.5	256.8	81.9	0.00*
Net farm income (millions VND)	55.4	13.3	166.7	59	200	77	0.00*
Profit (millions VND)	37	12	135	51.3	165	76	0.00*

Note: Kruskal wallis Test ***,**,N/S Significance level at 99%, 95% and Non-significance.

Source: Authors' own calculation

The output of MCSes, MPSes, and CPI reached about 81 million, 254 million, and 286 million VND per ha respectively (where total output equals the coffee and/or pepper yield multiplied by the coffee and/or pepper price). Net farm income was about 54.5 million for MCSes, 197 million for MPSes, and 235 for CPI, whereas profit figures were 37 million, 165 million, and 201 million VND per ha, respectively (Table 4). This means that CPI had the best performance for the above indicators among the three systems due to the presence of scope economies of coffee and pepper.

c. Cost and return analysis of perennial crop production by the approach type

Table 5: Cost-benefit analysis of different approaches

(Million VND per ha)

Items	MCFs (N=32)		ICFs (N=30)		Sig	MPFs (N=28)		IPFs (N=30)		Sig
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
1. GO	70.2	31.3	68.2	22.7	NS	120.0	51.0	93.0	42.0	0.04**
2. NFI	39.6	30.2	46.4	23.0	NS	70.0	55.0	66.0	41.0	NS
3. Profit	18.8	29.7	30.5	21.6	0.05**	35.0	62.0	44.0	40.0	NS

Note: [1] Exchange rate: 1 USD = 23,000 VND. [2] The cost is not included the family labor. Excluding family labor cost. Mann-Whitney U Test ***,**,N/S Significance level at 99%, 95% and Non-significance

Source: Author's calculation

The analysis reveals that intercropped farms are a suitable alternative for perennial crop production, whereas lower variable costs and higher return rates were observed with mono-crop approaches. It should be seen as preferable to operate, ICFs and IPFs, considering that they are financially and economically profitable.

d. Comparison of economic efficiency of perennial crop production according to group in two crop seasons

- ***The change of input costs between two farm groups***

Table 6: The variance of input cost of the two farm groups during the period of 2016/2017–2017/2018

(*Unit: Million VND/ha*)

Items	GpC (n = 62)			GpP (n = 58)		
	2016/2017	2017/2018	Sig	2016/2017	2017/2018	Sig
	Mean	Mean		Mean	Mean	
Variable cost[2]	**23.2**	**26.2**	**0.04****	**42.0**	**38.4**	**NS**
Intermediate cost (IC)	15.6	18.0	NS	26.7	22.3	NS
Hired labor cost	3.5	3.2	NS	8.5	7.8	NS
Interest cost	1.0	1.6	NS	1.4	3.0	NS
Depreciation	3.2	3.2	NS	5.3	5.3	NS

Note: [1] Exchange rate: 1 USD = 23,000 VND. [2] Family labor is not included in the cost. Mann-Whitney U Test ***,**,N/S Significance level at 99%, 95% and Non-significance.

Source: Author's own calculations

The results indicated that GpC demonstrated lower variable costs. GpC is therefore considered to be preferable for smallholders who rarely have available savings and face considerable difficulties in accessing credit. Unfortunately, the average cost of pesticides, herbicides, and stimulants for GpP is several times higher than that of GpC.

Taking everything into consideration, GpP is likely to require more input items and labor for farmers, as opposed to GpC. Labor resources should be taken into account when choosing a suitable crop farming system, to ensure an adequate supply of labor, especially during the harvest season.

- ***The variance of profit between two groups***

Table 7: The change of economic efficiency of the GpC and the GpP over two crop years of 2016/2017 and 2017/2018

(Unit:Million VND/ha and Million VND/ton)

Items	GpC (n = 62)		Sig	GpP (n = 58)		Sig
	2016/2017	2017/2018		2016/2017	2017/2018	
	Mean	Mean		Mean	Mean	
1. Gross output (GO)	80.7	69.2	0.00*	224.7	106.5	0.00*
2. Price selling	37.0	34.5	-	110.0	56.0	-
3. Value Added	65.0	51.0	0.00*	198.0	84.0	0.00*
4. Net farm income (NFI)	57.0	43.0	0.00*	183.0	68.0	0.00*
5. Profit	40.7	24.6	0.00*	157.6	39.8	0.00*
6. Labor Productivity	0.7	0.5	0.00*	1.4	0.7	0.00*

Note: [1]Exchange rate: 1 USD = 23,000 VND. All comparisons are statistically significant (les than 5%) in the Mann–Whitney U Test

Source: Author's own calculations

Although GpP shows higher indicators than GpC in both crop years, the amount of decrease greater for GpP than that of GpC. The findings show that GpC yielded lower economic performance for various indicators than GpP did.

4.2.1.2. A sensitivity analysis of MCS, MPS and CPI with respect to profit under scenarios prices

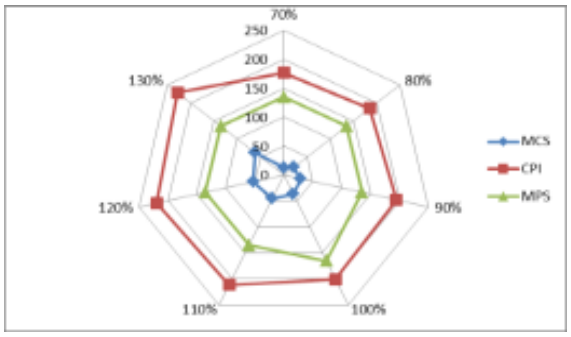

Figure 4: The changes of profits between three systems under different coffee price

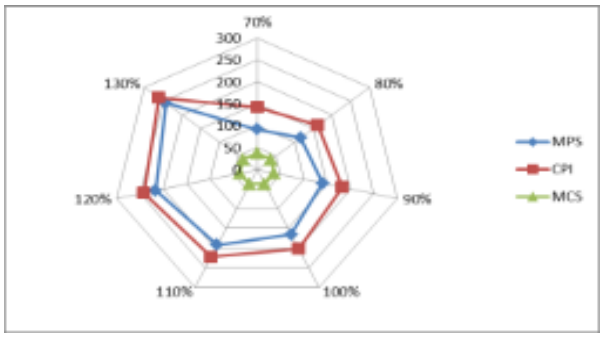

Figure 5: The changes of profits between three systems under different pepper price

Note: Different superscripts (a, b, c) denote a significant difference between means within rows ($p<0.10$)

Source: Author's own calculation

The results show that profits for MCSes, MPSes and CPI are relatively sensitive to price. Modelling with these variables shows that large effect of profits and its vulnerability with respect to the selling prices for MCSes, MPSes and CPI. With a change in the coffee and pepper selling prices under different scenarios, CPI is shown to have higher profit compared with MCSes and MPSes.

4.2.2. Social benefits among three selected systems

4.2.2.1. Job creation

Table 8: Labor allocation by activity in three selected systems

Workdays (days/hectare/crop season)	MCS (n= 32)	MPS (n=28)	CPI (n=30)	Sig
Weeding and fertilizer	20.0	31.0	24.0	NS
Pruning, bud breaking	20.5	24.0	30.0	NS
Irrigation and pesticide	18.0	22.5	21.0	NS
Harvesting	69.0	158.0	198.0	0.00*
Others	6.5	9.0	12.0	0.00*
Total	**134.0**	**245.0**	**286.0**	**0.00***

Note: Kruskal wallis Test $^{***,**,N/S}$ Significance level at 99%, 95% and Non-significance.

Source: Author's own calculation

CPI needed more laborers than MCSes and MPSes, estimated to be 286 workdays (Table 8). Next, MPSes ranked second in average employment demand, accounting for 245 working days. MCSes had the least needs for workers as compared to the others, totalling 134 laborers. Looking across operations, the largest proportion of workers was involved in harvesting, as well as in pruning and budding. These activities occupied 51 and 15%, for MCSes, 64 and 10% for MPSes, 69 and 10% respectively for CPI. Interestingly, CPI required the least proportion of agricultural workers for weeding, accounting for 12 working days.

4.2.2.2. Gender labor division

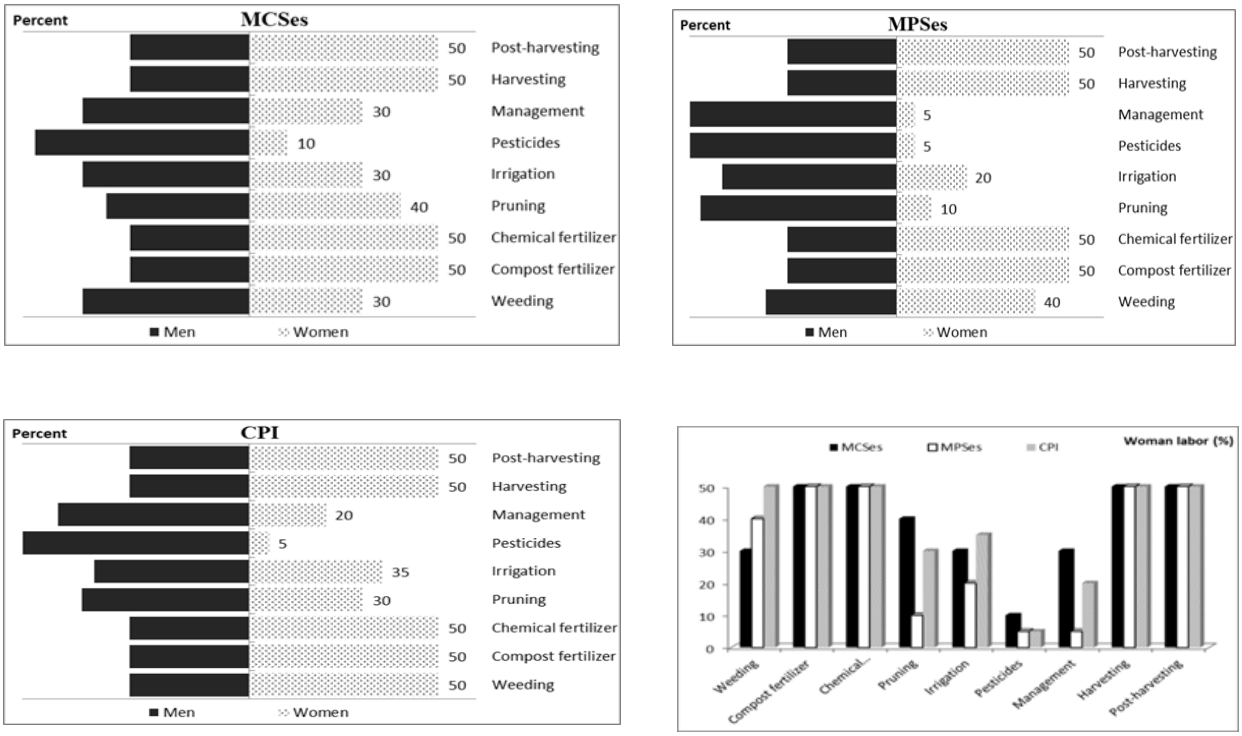

Figure 6: Gender allocation of each task

Source: FGDs and surveyed data, 2018

From the results, it can be seen that MCSes and CPI create more opportunities for women than MPSes do. For instance, while activities pruning, irrigation and management involved 40%, 30% and 30% of women's labor respectively for MCSes; these figures were 30%, 35% and 20% for CPI, but only reached 10%, 20% and 5% for MPSes (Figure 6). Perhaps it is possible that the specific cultivation requirements that attract

females, with the exception of some more common, established activities. In other words, for these labor activities, there was a higher gap between genders for MPSes compared to the other systems.

4.2.2.3. Extended employment for farm workers year-round

Table 9: External labor of three systems by daily wage

Items	MCS (n= 30)	MPS (n=26)	CPI (n=30)	Sig
Harvesting (People)	16.0	37.0	57.0	0.00*
Others (People)	5.0	11.0	16.0	0.00*
Total hired labor (People)	21.0	48.0	73.0	0.00*

Kruskal wallis Test ***,**,N/S Significance level at 99%, 95% and Non-significance.

Source: Author's own calculation

The empirical results in Table 9 show that most of the perennial crop systems experienced a labor shortage. That implies that labor availability in the local region is an element in decisions when considering the application of technological solutions (such as weed control by tractor or drip irrigation). In reality, the micro-irrigation isn't widespread due to high establishment cost and security (loss due to theft).

4.2.2.4. Labor use efficiency

Table 10: Labor use efficiency of MCS, MPS and CPI

Items	MCS (n= 30)	MPS (n=26)	CPI (n=30)	Sig
Labor-use efficiency (USD/person)				
Labor productivity	0.02	0.04	0.04	0.00*
Return to family labor	0.013	0.035	0.04	0.00*

Note: Kruskal wallis Test ***,**,N/S Significance level at 99%, 95% and Non-significance.

Source: Author's own calculation

As mentioned labor productivity, varies greatly between three cropping systems. MCSes have the smallest labor productivity, with 0.02 USD while

MPSes and CPI had 0.04 USD per worker. Looking at family labor return for CPI, it was measured to have the highest wage rate, about 0.04 USD while the lowest ratio of return to labor was found in MCSes (0.013 USD per person). These findings were produced from many reasons, but as per the information in this research, higher output, profitability, and women's participation in CPI are indicative.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusion

Perennial crops have undergone rapid development in Dak Lak during recent decades. Consequently, the dynamics and practices of perennial crop systems in Dak Lak province are required to be sustainably adapted to be appropriate for agro- ecological and socio-economic transformation. In doing so, the development of perennial crops can vary in a wide range of ways including types of crops, systems, production location, farm size and government support across time and space. Specific to this province, the evolution of perennial crop systems has undergone five stages involving three zones. In the early development stage (before reunification in 1975), perennial crop systems not only heavily focused on coffee and pepper on large-scale plantations but also primarily depended on natural resources. In other words, monocultures of the single crop-types were dominant, such as with coffee, cacao, tea and rubber. These were principally concentrated in the very high fertility region (Zone 1). At the time, coffee and rubber underwent the fastest expansion, while tea and cacao were only cultivated in limited areas. During the colonial era, the perennial crop plantations were most common in Zone 1 while the moderate soil fertility region (Zone 2) was used grow some annual crops like maize, beans and rice for subsistence purposes. Meanwhile, fallow land and forests covered a large area in the unsuitable region (Zone 3).

In terms of socio-economic benefits, intercropping systems (CPIs) demonstrate higher economic performance, thanks to the presence of economies of scope. As well, they have benefits with regard to potential employment creation, especially for women, and higher returns for labor. As well, they have benefits with regard to potential employment creation, especially for women, and higher returns for labor. Going forward, CPI enhances the ability to create diversified livelihoods relating to crops and cattle. Globally, CPI is particularly suited for limited-land availability and endowed households. With classification into groups and also with respect to farm types, analyses produce informative results concerning economic performance.

5.2. Recommendations

In this survey, all recommendations are centred upon answering the questions: How can perennial crop systems develop in a positive manner?; How can perennial crop systems overcome difficulties?; and How can perennial crop farms be helped to increase profitability and sustainability?

With respect to the dynamics and overview of perennial crop systems, empirical data provide policymakers information to construct guidelines on cropland use, organization, management and the marketing situation. Subsequently, policies should be implemented that promote the formulated guidelines for perennial crop production, and promulgate this guidance between a wide range of stakeholders and farmers to integrate Vietnam‘s sustainable development goals.

There should be less emphasis on maximizing output in the coming years, but rather than to help inspire confidence in CPI and assist sustainable development, the training programmes for technical training, density, and using live trees for pillars, should be taken into consideration. The performance of intercropping systems should be evaluated on large scales (conditions, sample size and diversity in systems) in order to collect a research database.

REFERENCES

Adenuga, A. H., Muhammad-Lawal, A. and Rotimi, O. A. (2013) 'Economics and technical efficiency of dry season tomato production in selected areas in Kwara State, Nigeria', *Agris on-line Papers in Economics and Informatics*, 5(665-2016–44983), pp. 11–19.

FAO (2018) *Regulating labour and safety standards in the agriculture, forestry and fisheries sectors*. Rome. Available at: http://www.fao.org/3/CA0018EN/ca0018en.pdf.

GSO (2019) 'Population and Employment'.

GSO (2020) 'Agriculture, forestry and fishing 2018', *The Isle of Man*, pp. 207–218. doi: 10.1525/california/9780520271814.003.0003.

Ha, D. T. and Shively, G. (2008) 'Coffee boom, coffee bust and smallholder response in Vietnam's Central Highlands', *Review of Development Economics*. doi: 10.1111/j.1467-9361.2007.00391.x.

Hoàng, T. and Chu, N. M. N. (2008) 'Phân tích dữ liệu nghiên cứu với SPSS-tập 1, 2 (Analysis data for research with SPSS)'. Hồng Đức.

ICC (2019) *Country Coffee Profile: Vietnam*.

Salvatore, D. and Reagle, D. (2002) 'Statistics and Econometrics, Schaum's Outline Series'. McGraw–Hill.

Slater, R. *et al.* (2007) 'Climate change, agricultural policy and poverty reduction–how much do we know', *Natural resource perspectives*, 109, pp. 1–6.

Thuy, T. P. *et al.* (2019) 'Economic Analysis of Perennial Crop Systems in Dak Lak Province, Vietnam', *Sustainability*. Multidisciplinary Digital Publishing Institute, 11(1), p. 81.

VAST (2015) *Đánh giá độ phì tự nhiên của đất Bazan bằng hệ thống phân loại độ phì tiềm năng (Assessment of natural fertility of Bazan soil in Dak Lak by FCC)*. Available at: http://ig-vast.ac.vn/vi/tin-tuc/danh-gia-do-phi-tu-nhien-cua-dat-bazan-tinh-dak-lak-bang-he-thong-phan-loai-do-phi-tiem-nang-fcc---40-fertility-capacity-classification--41--237.html (Accessed: 17 December 2019).

Woyesa, T. and Kumar, S. (2020) ‘Potential of coffee tourism for rural development in Ethiopia: a sustainable livelihood approach’, *Environment, Development and Sustainability*. Springer, pp. 1–18.

Yun, O. (2014) ‘Coffee tourism in Ethiopia: Opportunities, challenges, and initiatives’. University of Exeter.

GRAESE : Groupe de Recherches Asie de l'Est et du Sud Est

Le GRAESE (Groupe de Recherches sur l'Asie de l'Est et du Sud Est) regroupe des chercheurs concernés par les problèmes du développement en Asie Orientale et Sud Orientale. A son origine se trouvent des académiques et des chercheurs ayant participé à des projets de recherche, d'enseignement et de coopération dans cette région du monde depuis le milieu des années 1990. En Belgique, ces activités ont associé, dès le début, des chercheurs de l'UCL, des FUSAGX, et de l'ULG qui poursuivent une coopération régulière depuis une quinzaine d'années. En Asie ces activités ont concerné un grand nombre de chercheurs et d'académiques de diverses universités et institutions vietnamiennes, laotiennes, cambodgiennes, thaïlandaises et chinoises. L'Université Agronomique de Hanoi (UAH) est un partenaire privilégié depuis le début. Ces activités ont concerné particulièrement les projets de développement agricole, les composantes socio-économiques du développement rural, les rapports villes-campagnes et les politiques affectant ces différents domaines. En outre plusieurs thèses de doctorat ont été réalisées dans le cadre de ces activités, et sous diverses formes de partenariat entrer les universités belges et asiatiques concernées. Le **GRAESE** vise à donner une meilleure visibilité à ces diverses activités, à faciliter la circulation de l'information entre les chercheurs et centres de recherches concernés, et à appuyer et soutenir l'intérêt en Belgique et en Europe pour les problèmes du développement asiatique dans un public plus large.

En pratique le **GRAESE** a pour objectif :

1) de stimuler la recherche interdisciplinaire concernant les problèmes et les enjeux du développement en Asie orientale et sud orientale
2) de publier sous forme de Working Papers (format papier ou online) des résultats de recherche liés aux projets en cours et aux questions concernant les diverses thématiques du développement appliquées à l'Asie orientale et sud-orientale, avec une attention particulière aux thèmes évoqués ci-dessus.
3) de réaliser des publications scientifiques de divers types concernant ces problèmes et réalisées par des chercheurs des différents centres partenaires en Europe et en Asie.
4) de fournir un lieu de rencontres entre chercheurs concernés par ces thèmes, particulièrement dans le cadre des doctorats en cours.
5) d'organiser des activités d'enseignement et d'information sur les problèmes du développement de l'Asie de l'Est et du Sud Est, notamment à travers l'organisation de conférences et séminaires donnés par des académiques et chercheurs asiatiques de passage en Belgique.

En Belgique les activités du **GRAESE** sont coordonnées par Ph. Lebailly (UEDR-Gembloux-ULiège) et J.Ph. Peemans (CED-UCL). Le secrétariat du **GRAESE** est assuré par l'UEDR.

Centre d'Etudes du Développement, UCL, Louvain- la-Neuve
Unité d'Economie et Développement rural, Gembloux Agro-Bio Tech, ULiège
https://www.gembloux.ulg.ac.be/economie-et-developpement-rural/graese-2/