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AN OVERVIEW OF PERENNIAL CROPPING SYSTEM DEVELOPMENT AND ECONOMIC PERFORMANCE OF PERENNIAL CROPPING SYSTEMS IN DAK LAK PROVINCE, VIETNAM

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Contents



Introduction



Methodology



Results



Conslusions and Discussions

I. Introduction



Changes of agricultural and cropping systems resulted in various factors. (Alexander et al. 2015; Araya et al. 2012; Galati et al. 2016; Hatfield & Walthall 2014; Nguyen 2017)

I. Introduction (cont)

- Cropping systems changed along the time, the local, the regional and international economic situation, but also sustainably adapted to the specific conditions.
- The changes require to move to another place or to develop new practices for survival (Darnhofer et al. 2010; Hatfield & Walthall 2014; FAO 1999; Fresco & Westphal 1988; Lebailly et al. 2015).



- The major trends and trajectories of different farm types-> apply appropriate strategies -> protecting natural resources, securing households' income by enhancing productivity (Jayne et al. 2014).

Protection of natural resource

Enhancement



Determining the evolution of cropping systems to support future research and extension might be enclosed to the best service of the rural communities (Herridge et al. 2019).



Economic performance is the key in determining the resilience and sustainability of farming systems because economic change caused the threads to agricultural lands and natural resources (Barbier et al. 2010; Zinnanti et al. 2019).



A study about the development of cropping systems and its economic performance is essential.

Vietnam had become the biggest exporter of black pepper and the second largest for coffee from 2011 to 2013 (ICC 2019; OECD 2015).

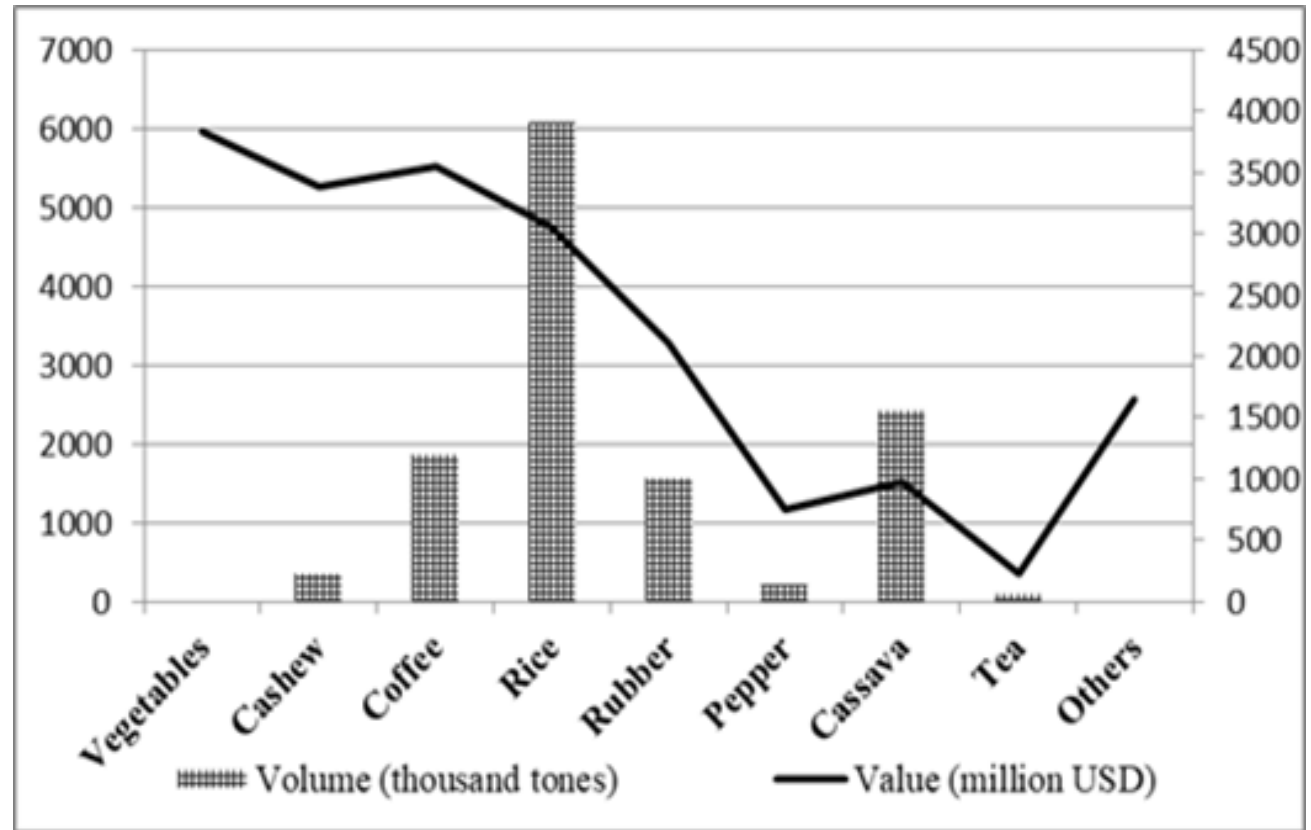


Figure 1: Perennial crops situation

Source: GSO, 2019



Table 1: The proportion of coffee and pepper in Dak Lak
Unit: thousand tones

Regions	Coffee	Percent	Pepper	Percent
Vietnam	626.2	100 %	107.2	100 %
Central Highlands	583	93 %	94.5	88.2 %
Kon Tum	13.5	2.4 %	-	-
Gia Lai	82.5	13 %	16.2	15.1 %
Lam Dong	162	25.8 %	-	-
Dak Nong	135	21.5 %	33.2	31 %
Dak Lak	190	30.3 %	42.5	40 %

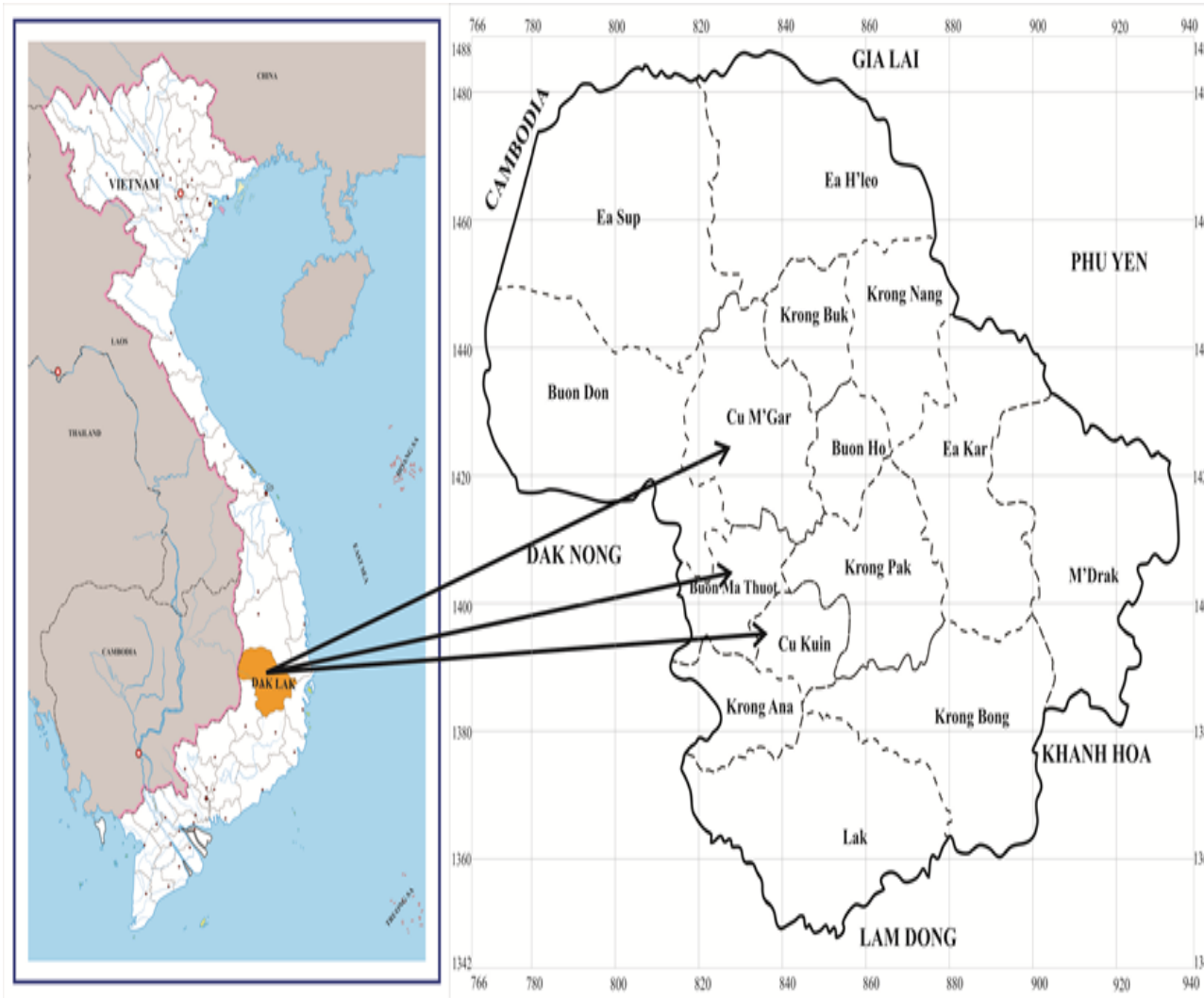


The objectives:

- 1/ A real picture of the temporal and spatial transformation in perennial crop systems at distinct stages.
- 2/ An analysis of the economic efficiency of two representative perennial crop systems provides empirical evidence and opportunities for practices.



2. Methodology



2.1. Study area
Dak Lak Province with advantageous conditions for agricultural development. Three regions are heterogeneous

Based on fertility criterion

- Zone 1: Highly favorable for perennial crops growing (including Buon Ma Thuot City, Cu M'gar, Cu Kuin, Krong Ana, Krong Buk, Ea H'leo, Krong Ana, Krong Pak Districts)- very suitable area
- Zone 2: Moderately favorable for perennial crop growing- suitable area
- Zone 3: Unfavorable for perennial crop- unsuitable area



Data collection

Both qualitative and quantitative data from primary and secondary sources

Qualitative data: Visual observation, key informant interviews (KIs), Focus Group Discussion (FGDs).

(1) the history of changes of local perennial crop systems regarding coffee and pepper; (2) current cropping patterns and changes of perennial crop systems overtime; (3) key driven forces of change related to adopt the current perennial crop systems.

Quantitative data: household surveys through questionnaires by using simple and stratified random sampling of perennial crop households.

(1) profile of perennial crop system such as area, yield, age; (2) the cropping calendar (timing of plot care crops and harvesting); (3) annual cost (inputs, labor); sale of crops and revenues.

Table 2. The distribution of surveyed samples by research sites

Region	Commune	MCSes	MPSes	CPI	Total Samples
BMT	Ea Kao	12	9	9	30
Cu Mgar	Cu Sue	12	8	15	35
Cu Kuin	Ea Ktur	8	11	6	25
Total samples		32	28	30	90

Data analysis

Analysis of the evolution of perennial crop systems



The historical analysis was obtained by hierarchy, chronology and timeline methods

Economic analysis



Economic analysis: Cost and benefit analysis

Results

3.1. The development of perennial cropping systems in Dak Lak province

Ecological impact

Abundant resources
High ferralsols soil
Favorable weather

Content

Perennial crop cultivation was controlled and occupied by the regime
Private land and farm were non-existence
Very low population, low know-how, simple equipment tools

Consequence for perennial cropping systems

Growing up depended on nature
Low yield and productivity
Coffee are the major crop behind rubber
Large plantations by mono-culture popularly

Prior Unification 1975

● **Early Stage**

Ecological impact

Deforestation; Fluctuation of weather
Disease and pests appearance

Content

Economic Revolution ; Land management
Good coffee price, Population explosion
Small households and the state-owned farms
Consequence of perennial cropping systems
Coffee was expanded strongly
Other perennial crops developed

1986 - 1990s

● **Intensified cropping systems**

Ecological impact

Fluctuation of natural conditions
Low soil fertility
High aging of trees and diseases infection

Content

Price volatility
Long term exploitation of perennial crops
Technology and innovation

Consequence of perennial cropping systems

Applying technology
Diversified products and systems
Intercropping systems primarily

2010 to now

● **Specialized and diversified cropping systems**

1975 - 1986

● **State-owned farms and cooperatives**

Ecological impact

Abundant surface and groundwater resources
Good weather

Content

Resettlement campaign
Land allocation. Rights property land was less common
Perennial crop production under controlled state

Consequence of perennial cropping systems

Developed large scale of perennial crop
Lack of intensification
Other profitable cash crops was initially planted

2000s

● **Integrated cropping system**

Ecological impact

Climate variability and high deforestation

Content

Spontaneous in-migration
Land management policy changes
Decreased coffee market price

Consequence of perennial cropping systems

Perennial crops were intercropped with annual crops
Shading tree under perennial crop plantations

Figure 2: Important historical milestones and consequences of perennial crop systems

Consequences of perennial crop systems

- *Large -scale plantations of perennial crop systems under the regime*

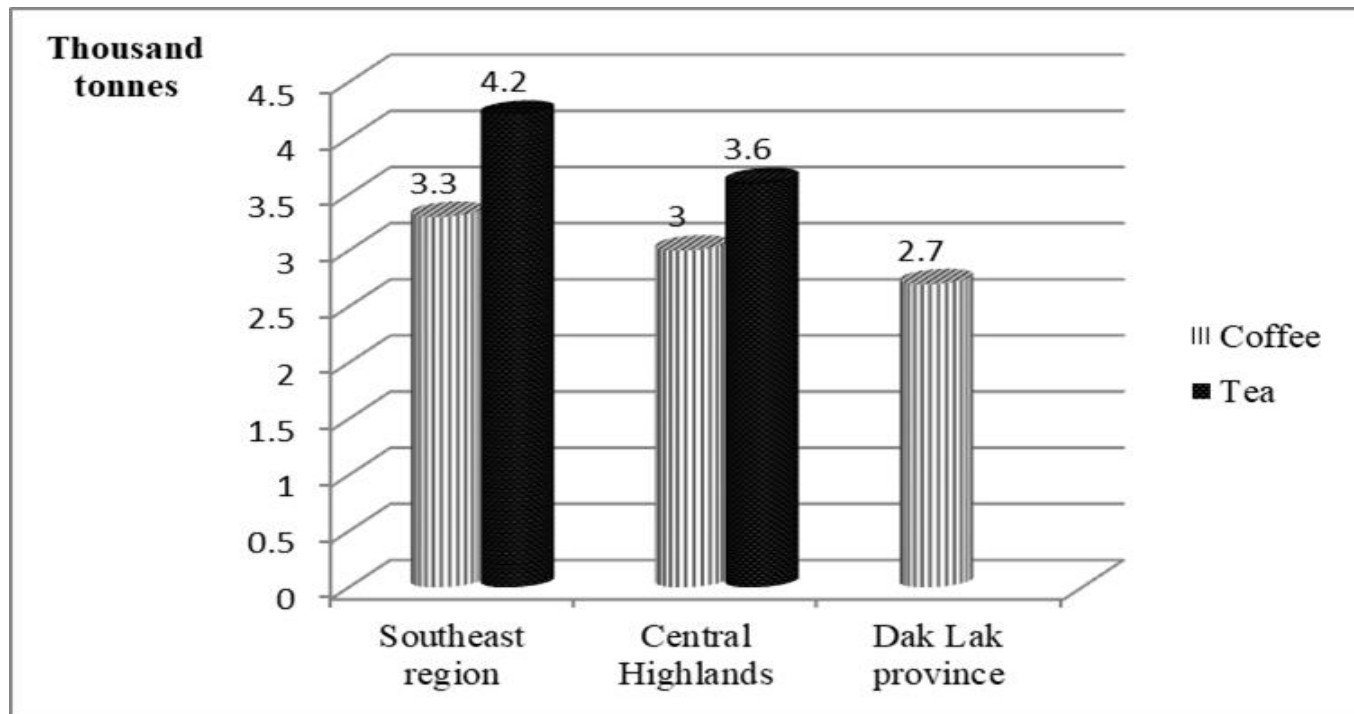


Figure 3: The perennial crop productivity in 1967

Existence of state and cooperative owned farms of perennial crop systems

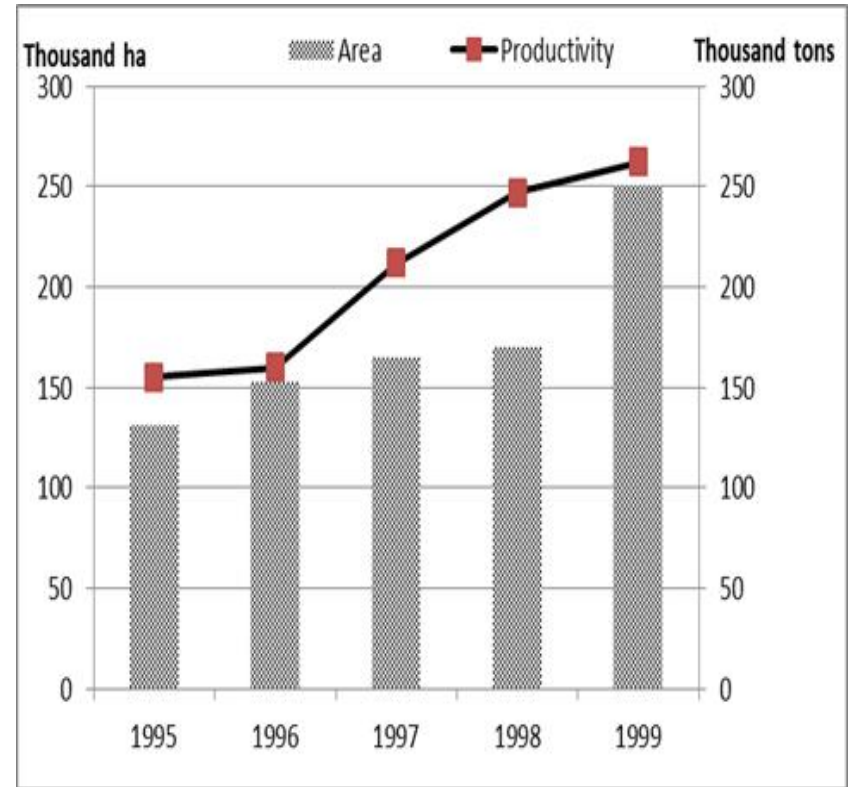
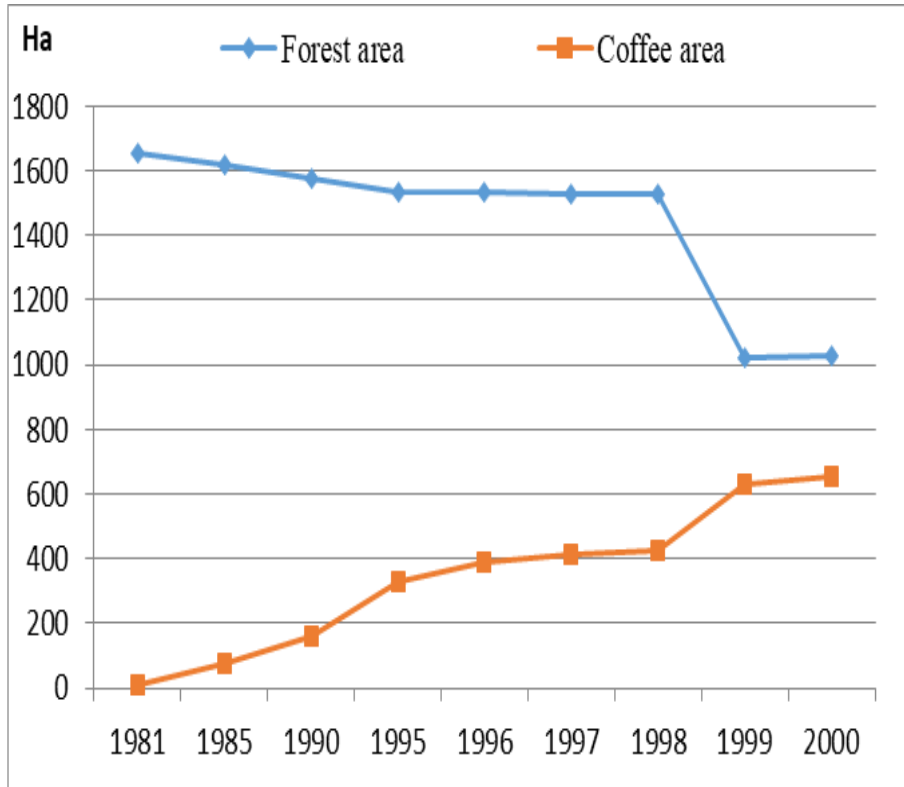
Table 4: The number of farms and producers participated in owned state and cooperative production

Year	State owned Farms		Cooperatives	
	Number (Farms)	Producers (People)	Number (Farms)	Producers (People)
1978	12	3 930	17	9 121
1981	19	23 885	122	40 600
1985	28	43 521	184	58 728

Source: People's Committee of Dak Lak 1986

Intensified perennial crop systems

Figure 4. The coffee growing area during 1986-2000



Source : Dak Lak PSO 1986, 2011

Mixed perennial crop systems

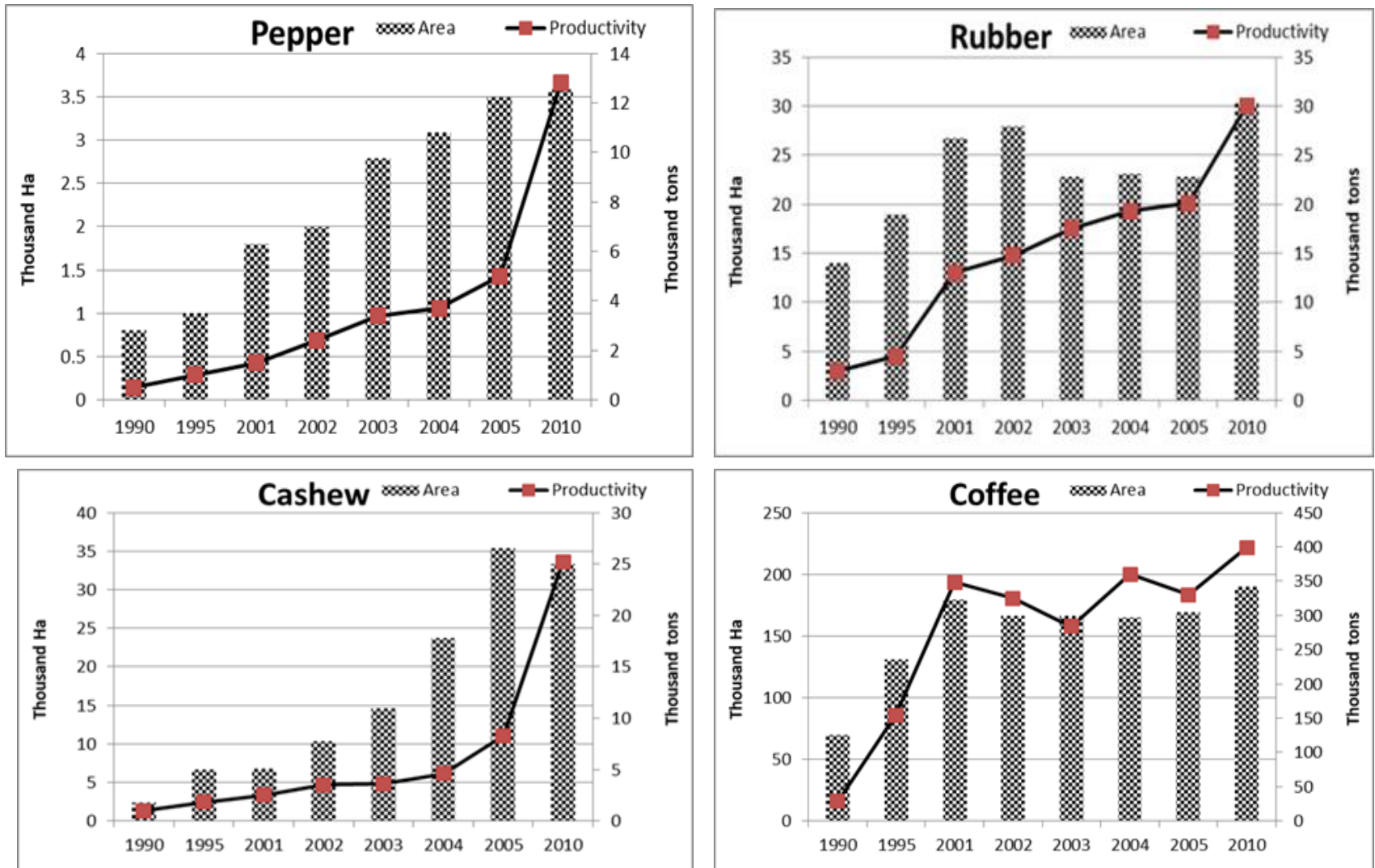


Figure 5. The expansion of perennial crops

Specialized and diversified perennial crop systems

Table 3. The area and number of producers by certificate in Dak Lak Province
(1): Number of certificate; (2): Area (thousand hectares); (3) Producers
(Thousand people)

Certificate	2013		2015			2017			2018		
	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
UTZ	16.8	14.5	29	19.5	14.5	17	15.6	11.0	7	6.2	5.6
4C	36.8	23.0		37.1	25.4	14	25.2	15.5	4	8.7	6.7
RFA	7.4	3.2	3	4.3		3	2.1	-	3	5.1	2.8
FLO	0.2	0.4	1	3.0	0.5	5	0.6	0.3	6	0.7	0.5
GI	-	-	10	-	-	12	-	-	12	-	-

Source: Provincial People's Committee of Dak Lak 2018

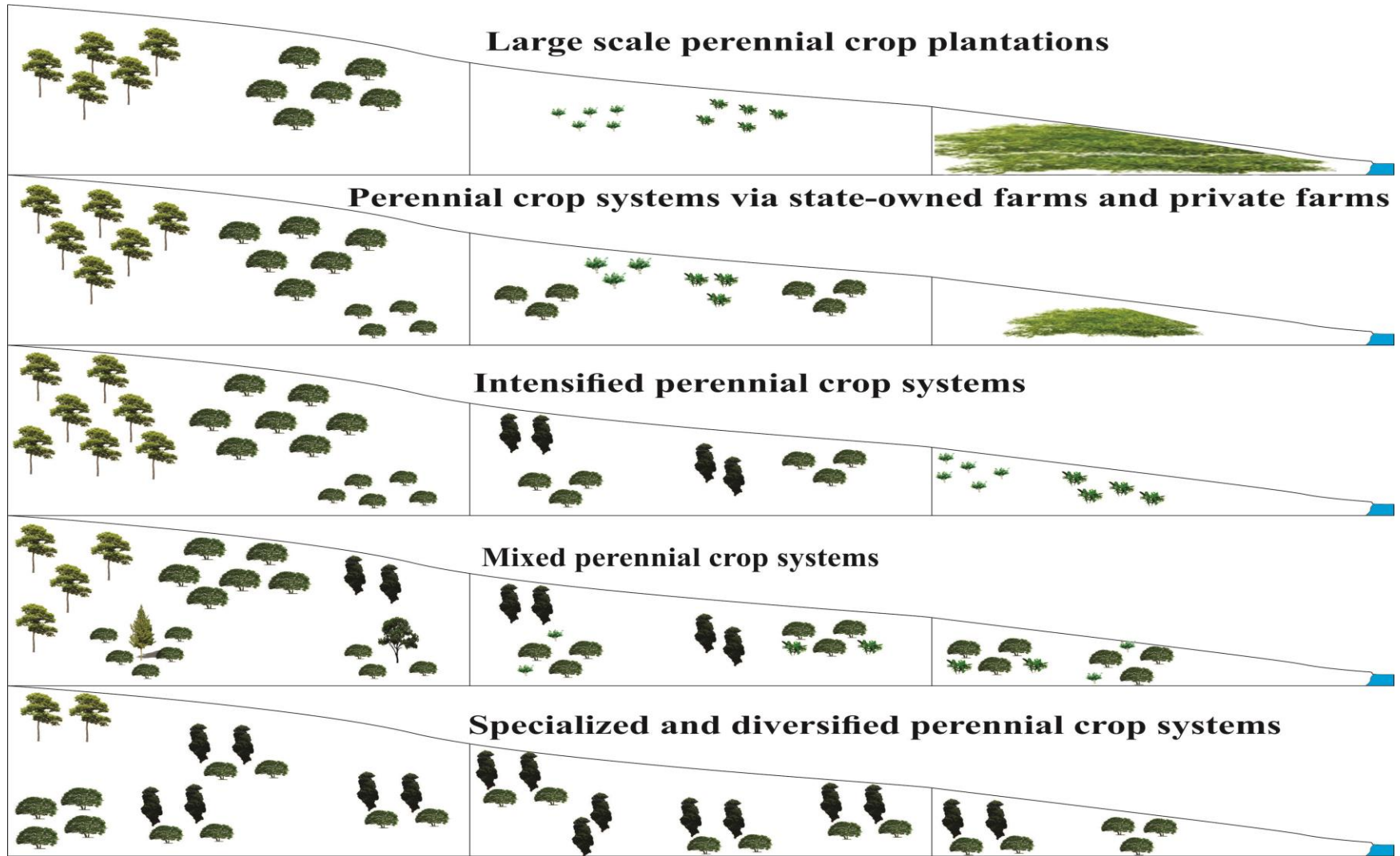
UTZ: Universal Trade Zone; RFA: Rain Forest Alliance (fair trade **coffee**)

FLO: Fairtrade Labelling Organization

Very suitable zone

Suitable zone

Unsuitable zone



Picture: A more detailed view of the evolutionary perennial crop systems in Dak Lak
















































3.2. Current perennial crop systems comparison

Characteristics of *Mono-cropping and intercropping systems profile*

Table 4: General information of systems

Indicators	MCSes (n= 32)	MPSes (n=28)	CPI (n=30)
1. Average plot area (ha)	1.1	0.8	1.0
2. Density (tree/ha)			
Coffee	958	-	964
Pepper	-	1344	914
3. Average age of system (years)			
Coffee	17	-	13
Pepper	-	7.43	7.3
4. Yield (tons/ha)			
Coffee	2.1	-	2.3
Pepper	-	2.3	1.8
5. Crop losses	25	27	22
6. Distance (Km)	1.8	0.5	1.7

Cropping calendar

	Rainy season						Dry season					
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Irrigation											 	 
Fertilizing	 	 	 	 	 							
Pesticide			 									
Weeding	 											
Pruning and bud breaking	 	 	 	 								
Harvesting												
Processing												

Note: Coffee crop:



; Pepper crop:



Source: KIs, FGDs



Growers organize and make plans on human source

Table 5. Economic results of cropping systems. Unit: Thousands of VND/ha. Price of coffee and pepper in 2018

Items	Mono-cropping systems				Intercropping systems		Sig.
	MCS (n = 32)		MPS (n = 28)		CPI (n = 30)		
	Mean	SD	Mean	SD	Mean	SD	
1. Annual cost	43.6	11.1	86.7	39.3	86.3	23.3	0.00*
Intermediate cost	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	1.9	3	2.6	4	2.9	4.3	NS
Depreciation	1.8	0.9	6.1	2.4	5.5	4	NS
2. Gross Output	80.8	19	253.5	89	285.4	82.7	0.00*
3. N FI	55.4	13.3	166.7	59	200	77	0.00*
4. Profit	37	12	135	51.3	165	76	0.00*

Kruskall Wallis Test

Cost: These costs were higher intermediate and labor costs, which were the two main components. MCSes incurred the lowest production costs, whereas MPSes had the highest.

Returns

MCSes seem to have lower economic efficiency in revenue and profit criteria than the others. The CPI had the best performance among the three systems due to economic scope of coffee and pepper

Conclusions and discussion

- Under this circumstance, appropriate perennial crop systems were applied as an adoption for an institution, society, economy and environment.
- The perennial crop systems showed the trends: large -scale coffee and rubber plantations; perennial crop systems as state owned-farms and cooperatives paralleled production of individual rights thanks to land allocation; intensified by households' resource utilization; Mixed systems; and the specialized perennial crops and intercropping systems.
- Two major perennial crop systems have been existing including mono-cropping and intercropping systems. In this, intercropping systems demonstrated to be likely more returns than mono-cropping ones. In other words, significant output complementarity between coffee and pepper crops production was discovered thanks to the potential presence of economic scope.

Conclusions and discussion (cont)

Understanding the evolution of perennial crops and its economic performance, the government should enact policies that improve the sustainability.

MCSes is likely to be appropriate for the un-endowed families while CPI is more suitable for well-endowed families.

THANK YOUR FOR YOUR ATTENTION