

Evaluating and Orienting the Agricultural Land use Systems to Serve the Land use Planning Progress in Viet-Yen District, Bac-Giang Province, Vietnam

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Abstract

Background/Objectives: The orientation and assessment of land use systems have an important role in the agricultural production development; restructuring of commodity product markets; improvements in income and living standards of the associated communities. Through this research, we aim to assess the potential of land in the Viet-Yen District (Vietnam) in order to provide the basis for boosting its agriculture. **Methods/Statistical Analysis:** Both primary and secondary data have been collected for this study, where, the primary data were collected through interviewing the farmers on the status and effectiveness of land use under their territory, while using sixty detailed questionnaires from six communes/territories of the District. **Findings:** Through this research, we came-up with the results of orientation and assessing processes of agricultural land use systems in the Viet-Yen District, while using the maps of land units and the technical efficiency of the farmers, in respect of different cropping seasons at various terrains. From that, the stakeholders can compare the characteristics of the land unit with the requirements of the land use type of the current situation, assess the appropriate extent. Through analyses, we have proposed agricultural and forestry land use and its effectiveness, in accordance with natural conditions, in order to improve land use efficiency. **Applications/Improvements:** The findings of this study can serve as the scientific basis for the formulation of land use plans and strategies for the district as well as for the country.

Keywords: Assessment, Bac-Giang Province, Land Use System, Orientation, Viet-Yen District

1. Introduction

Globally, the land resource is going to be extremely valuable, as spatial means of production for all sectors of an economy. Land use system is a measurement tool to reconcile the relationship between people and land¹. However, the fact that land use is a complex issue, influenced by many different factors²; where since long, the aim of human has been to solve land use issues. The goal is to use the maximum and effectively the entire land to serve the development of the social economy³. According to the rise of the social economy, the trend of agricultural land area in the developing countries is decreasing, due to less care of local authorities. In various territories the issues of land use had reduced land quality. Besides that

the pressure of population growth and infrastructural development, the agricultural land is facing the risk of decline in both quantity and quality⁴⁻⁶.

Therefore, the rational use of land, to preserve the ecological balance and biodiversity and environmental protection for sustainable development is a global issue. Therefore, to maintain and develop sustainable agricultural production to meet the demand for food, which is only possible with the rational exploitation of agricultural lands⁷. For rational use, efficient and sustainable agricultural land requires a scientific assessment of land use potential compared from its current exploitation, which can help to assess the suitability of the type of land use with land potential⁸. Therefore, given orientation of agricultural land use on the basis of efficient exploitation,

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rational and sustainable advantages of land resources in service of the elaboration of the land use plan of territory or country. Land use and sustainable efficiency are always desirable for the survival and development. That's why many researchers have suggested the appropriate solutions of land use conflicts in order to bring sustainability⁹⁻¹¹.

The agricultural production accounts for a large proportion in Vietnam's economic structure. Agriculture is not only contributing food demand, livelihood, but also creating lots of export products, which is a comparative advantage for the country¹². Even though this is one of the major sectors, but is ignored by the researchers; that is why a little literature is available on evaluation of land use system in Vietnam. Therefore, this study has been designed to evaluate agricultural land use, which might be rationally effective for the proposed land-use planning and strategic issues in the Viet-Yen District. The Viet-Yen District is located in the south midlands of Bac-Giang Province, with a total area approximately 17,135.42 hectares of natural land, including 11,117.19 hectares of agricultural land, accounting for 64.88% of the total natural area, with a total area of 8,977.91 hectares of arable land, average farmland area is 0.06ha/person, it is normal compared with other districts of the province¹³.

The economy of the district is developing slowly, people's income levels are still too low and people's lives are difficult. Because of less access to the information regarding either on new technologies or on the product markets. Thus, with the development of agricultural lands the economy can be developed, which can further improve people's living standards¹⁴. Thus, integration of the provinces and territories of the country requires the Viet-Yen District to have a comprehensively orientation of future plans. In the context of the industrial sector has been formed that took a lot of agricultural land, which has created many land related issues, so there is an urgent research needed to assess the potential of land and natural resources of the district to restructure the economy towards product diversification, while boosting its agriculture¹⁵. The current study assesses the prevailing agricultural land use circumstances and its potential, in order to determine the reasons and to recommend an effective agricultural land use system. Furthermore, the study can provide the basis for forthcoming research on land use management as well as it can help in the formulation of national land reform policy.

2. Research Methods

Both Primary and secondary data have been used in this study. The secondary information on natural and socioeconomic conditions as well as land use status have been gathered from the Department of Natural Resources and Environment, the Department of Agriculture, and from the Statistical Division of the country.

Besides secondary data, the primary data have also been collected through interviewing the farmers on the status and effectiveness of land use under their territory, while using sixty detailed questionnaires from six communes/territories of the Viet-Yen District. The questionnaire was comprised over social, economic and environmental effects of land use types, land use systems. For example: (i) Economic sustainability evaluation through economic efficiency, income and capital efficiency, compared with table decentralized economic efficiency of land use types to conclude, (ii) Social sustainability assessment based on attracting labor, solution of employment issues, income and labor's demand on various types of land use, where, (iii) Environmental sustainability measured through the ability to maintain and improve the fertility of agricultural land and ensure production targets long term ecological perspective and sustainable development of all types of land use. The data also collected through arial views by using Landsat, where the arial picture have been treated by Geographic Informative System (GIS) (Map Info Professional 8.0 Version) in order to build land map units (LMU).

3. Results

The results of this study are divided into following sub-sections, while answering the questions regarding the current land use of the Viet-Yen District and its agriculture efficiency; as well as the suitability of future land use of the district based on the comparative advantage.

3.1. Land use potential assessment

3.1.1. Land Mapping Units

Based on the documents have been collected, fieldwork survey, land formation processes, and the following analytical framework, we have selected seven indicators (see Table 1) for decentralization in order to build maps

of land units, including: land type (G), topography (E), soil texture (T), soil depth (D), irrigation (I), drainage (F) and slope (S).

Table 1. Target of hierarchical mapping land units in Viet-Yen District

Targets	Decentralization	Symbol
Land type (G)	Eutri - Haplic- Fluvisol (sediment accretion)	G1
	Eutri - Haplic- Fluvisol (non-sediment accretion)	G2
	Distri-Stagnic- Fluvisols	G3
	Albic Acrisols	G4
	Dystri-Plinthic-Acrisols	G5
	Hyperdytri-Haplic-Acrisol	G6
	Hyperdytri-Stagnic-Acrisol	G7
	Skeliti - Haplic- Leptosol	G8
Topography relatively (E)	High	E1
	Medium	E2
	Low	E3
Soil texture (T)	Soil texture: Light	T1
	Soil texture: Medium	T2
	Soil texture: Heavy	T3
Soil depth (D)	Soil depth > 100 cm	D1
	Soil depth 50 - 100 cm	D2
	Soil depth < 50 cm	D3
Irrigation (I)	Proactive	I1
	Semi-proactive	I2
	Depending rainwater	I3
Drainage (F)	Proactive	F1
	Less-proactive	F2
Slope (S)	From 3° to 8°	S1
	From 8° to 15°	S2
	From 15° to 25°	S3
	From 25°	S4

Source: Natural Resources Environment Faculty, Bac-Giang Agriculture & Forestry University

Furthermore, the land of the Viet-Yen District has been shown in the following maps, where the Figure 1 (a) shows the current land in possession with the District, while (b) shows the land of the district fragmented in

various economic activities. The figures are developed through GIS in order provide the view of the study area to the researchers, which might serve as a baseline for forthcoming studies.

Through the above graphs it is shown that the number of land units is 46, the plots are 252 and the average acreage of each plot is 42.42 hectares.

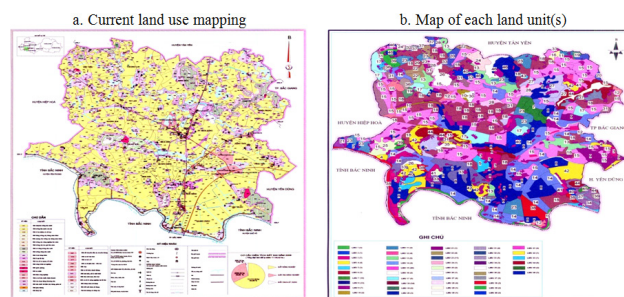


Figure 1. Land use map of the Viet-Yen District.

3.1.2. Efficiency of Agricultural Land use Systems

In order to assess the effects and efficiency of land use system in the district, first, we have conducted subgroup land mapping units (LMU) in districts into three groups according to their topography (see Table-2).

In order to evaluate the overall economic efficiency of land use system (LUS), where LUS is understood to include three main systems: Cropland use system, livestock-land use system and forestry land use system. We have conducted an economic analysis in the manufacturing processes for the land use system of crop and livestock on the specific terrain types of the district with the help of some indicators like: the total value of product, labor cost, material cost, net revenue and cost-effective (see Table-3). In fact, we found that in sub-regions with high terrain (type of land) use of vegetables (from 3 to 4 seasons) with the targets of economic efficiency is highest. The results indicated that at the sub-region of medium terrain, the economic indicators of the land use specialized in vegetables exceeded than the other land use. Besides that, the land use type of two rice crops and one soybean crop, and one rice crop and two soybean crops per year also

Table 2. Topographical Grouping LMUs

Terrain	Number of LMU	LMUs specific	Area (ha)	Proportion (%)
1. High	13	14, 19, 20, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 42, 43, 44, 45, 46	1,453.82	13.60
2. Medium	19	1, 2, 3, 4, 5, 15, 16, 17, 18, 21, 22, 23, 24, 25, 26, 27, 28, 39, 41	5,417.11	50.7
3. Low	14	6, 7, 8, 9, 10, 11, 12, 13, 40	3,819.34	35.7

bring high economic efficiency. In which, the main type of land use is spring rice-winter rice-onions, garlic or spring rice-winter rice-legumes. In the sub-region with lowland, the type of land use is spring rice-fish, it brings the highest economic efficiency.

In the Table 3 the total income equals to the total value of the product minus the cost of material; the net income equals to gross income minus labor cost; and the co-costs effective equals to total income divided by cost of material. Whereas, the unit for calculation was: 1.000.000 VND/ha/LUS.

Table 3. Economic efficiency of cropland users in Viet-Yen District

Total income	Net income	Co-costs effective	Level	Symbol*
> 58	> 32	> 1.45	Very high	VH
42 – 58	22 – 32	1.00 – 1.45	High	H
28 – 42	13 – 22	0.80 – 1.00	Medium	M
12 – 28	9 – 13	0.50 – 0.80	Low	L
< = 12	< = 9	< = 0.50	Very low	VL

* VH: very high H: high M: medium, L: low, VL: very low

Farmers in the study area kept the cattle and poultry (livestocks), aimed to meet the need of traction,

fertilizer and improved livelihood. It was found that the average income from livestock brings to the households was around 14,960,000 to 50,006,000 VND annually. Additionally, the growers had a lower revenue from their forestry production (nearly 24.50 million VND/ha/year). They arose mainly, the acacia, eucalyptus, dracontomelon, canarium, bamboo, neohouzeaua (bamboo), dendrocalamus, etc. The forestry production in the district brings low economic efficiency because of many different reasons, which is mainly less suitable soil conditions, inefficient market. The agroforestry can have higher efficiency if grown scientifically in Vietnam, like the other developing countries¹⁶.

Through above analyses (see Table-4), we have found that two rice crops-one soybean crop in sub-region medium terrain and rice-soybean crop in high terrain ensure environmental and social efficiency. In the lowland, the type of rice-fish is assessed as sustainable. While, the collective farms, the specialized farms, Garden-pond-barn (GPB), Garden-pond-barn-forest (GPBF), and Agroforestry farms had very high socioeconomic and environmental efficiency. Those farms are contributing to solve employment, increased density and land cover time, limiting degradation, runoff and soil erosion.

Table 4. Economic, social and environmental efficiency of farm types

Targets	Unit	Type of farm			Average
		Aggregate	Specialized	Other	
1. Economic efficiency					
- (Gross Output) average per one farm employee	1,000,000VND	40.26	64.34	42.16	48.06
- (Value added) average per one farm employee	1,000,000VND	18.20	26.90	19.90	21.32
- (Mix income) average per one farm employee	1,000,000VND	12.06	19.22	12.48	14.34
- Average product value per one farm	1,000,000VND	187.50	391.06	136.52	233.28
- Average profit per one dollar invested	1,000,000VND	0.31	0.15	0.52	0.33
- Average profit per one hectare of agricultural land farm	Times	0.31	14.75	23.00	16.77
2. Social efficiency					
- The number of employees with regular jobs on farms	Person	206	195	112	438
- The number of seasonal workers in farms	Person	245	192	224	521
- Number of employees with vocational training	Person	166	165	82	358
3. Environmental Efficiency					
- Forest cover in farms	%	45.00	55.00	23.00	41.40
- Percentage of farms using clean water	%	77.50	73.30	86.67	78.99
- Percentage of farms using the new fuel (biogas)	%	17.50	16.67	56.57	29.00
- Percentage of farms affect the residential living environment	%	27.50	10.00	60.00	32.00

Source: Farm survey data of Viet Yen District in 2015

3.2. The Orientation for Agricultural Land use Systems

According to FAO guidelines, land use requirements for LUS are determined according to level: S_1 : Suitable high, with the lowest level of restrictions; S_2 : Suitable medium with a limited level, from low to medium; and S_3 : Less appropriate, a lot of drawbacks¹⁷. Thus the results of the requirements of prevailing land use systems (LUS) are given in the Table-5.

While recognizing the increasing demand of food worldwide, if the natural resource like land may not be

used properly, there might be the opportunity of land use conflicts¹⁰. Based on the above results it is recommended that how to make the agricultural farmlands more profitable and sustainable in the Viet-Yen District. Thus, the following table (Table-6) provides the findings regarding the current and recommended areas to be cultivated in each land use territory (LUT), in respect of their specialized economic activity.

The results shown that one crop season may be discouraged, while the economic efficiency of the forest, livestock and two crop seasons may be encouraged in the district. Thus, it will improve the efficiency of land use.

Table 5. Land use requirement indicators

LUS	Indicators	Symbol	Appropriate level		
			S_1	S_2	S_3
Two rice crops – special-ized crop	Land type	G	2	3,4	7
	Topography relatively	E	2	-	1
	Irrigation	I	1	2	3
	Drainage	F	1	-	2
	Soil texture	T	2	1	3
Two rice crops	Land type	G	2,3	4	7
	Topography relatively	E	2	3	1
	Irrigation	I	1	2	3
	Drainage	F	1	2	-
	Soil texture	T	2	3	1
Rice – Specialized	Land type	G	2,4	7	3
	Topography relatively	E	2,1	-	3
	Irrigation	I	1	2	3
	Drainage	F	1	-	2
	Soil texture	T	2	1	3
Specialized crops	Land type	G	4	1,2	5,6,7
	Topography relatively	E	1	2	3
	Soil depth	D	1	2	3
	Irrigation	I	1,2	-	3
	Drainage	F	1	-	2
	Soil texture	T	1,2	-	3
Rice - Fish	Land type	G	3	2	4,7
	Topography relatively	E	3	2	1
	Irrigation	I	1	2	3
	Drainage	F	1	-	2
	Soil texture	T	3	2	1
Fruit tree	Land type	G	5	4,6	7
	Slope	S	1	2	3
	Soil depth	D	1	2	3
	Soil texture	T	2,3	-	1

Source: Natural Resources Environment Faculty, Bac-Giang Agriculture & Forestry University

Table 6. Comparison scalability of LUT's area in current time and future

No.	LUTs (in hectares)	Current area	Recommended area	Increase (+) Decrease (-)
1	Two rice – specialized crop seasons	1,858.63	2,395.14	+536.51
2	Two rice seasons and one rice – specialized crop season	4,225.95	4,701.36	+475.41
3	One crop season	1,635.71	421.10	-1,214.61
4	Rice crop – Fish	528.64	622.02	+93.38
5	Specialized crops – Short day industry crop	1,156.28	1,297.19	+140.91
6	Fruit trees	99.85	135.79	+35.94

4. Conclusion and Recommendations

While using GIS overlay individual feature map, the land unit maps of 46 units and 252 land parcels of the Viet-Yen District has been built. At current, medium to low level economic efficiency has been observed, where only in three seasons land use system (vegetable crop-rice-fish) was found with high economic efficiency. The types of land use have high efficiency must be expanded acreage in the next phase as: two rice crops-specialized crop, two rice crops, rice-specialized, specialized crops, rice-fish and fruit tree. Land use for one crop season usually inefficient, do not ensure sustainability and need to switch to using land more efficiently. The farms can bring high socioeconomic and environmental efficiency. Thus, the district needs to create conditions to encourage the development and replication of the farm economy model. In parallel with the development of traditional livestock and poultry, the farmers need to study the development of livestock, which have high economic efficiency, such as: goats, snakes, frogs, trionychid, turtle, etc.

The results provide the scientific basis for rational land use and its efficiency, as well as it can serve in the construction of the land-use policy for the district or country. Since this district exercises agricultural practices, thus there is need of extension services in order to implement the effective and sustainable agriculture policies.

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