

ESTIMATING THE CRITERIA AFFECTED TO AGRICULTURAL PRODUCTION: A CASE OF CHAU THANH DISTRICT, VIETNAM

Pham Thanh Vu^a †, ^a † College of Environment and Natural Resources, Can

Vo Quang Minh^a, Tho University, Vietnam

Phan Chi Nguyen^a,

Tran Van Dung^b, ^b College of Agricultural, Can Tho University, Vietnam

Nguyen The Cuong^c, ^c Mekong Delta Rice Research Institute, Vietnam

Ngo Thi Phong Lan^c

† ✉ prvu@ctu.edu.vn (Corresponding author)



Corresponding author

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ABSTRACT

The study aimed to assess the current agricultural production and to identify the criteria affecting the agricultural cultivation and overcome the limitations in agricultural production of Chau Thanh, A district of the Mekong Delta, Vietnam. The study collected primary from farmers using Participatory Rapid Appraisal tool, and discuss directly with experts and local agricultural managers. The results showed that economic development mainly based on agriculture (of which the paddy and fruit trees land were the most 13.577 ha (98,8%)). The five criteria were identified (techniques, physical, social, economic, and environment) and twenty-six sub-criteria, in which the production scale (0.084), infrastructure (0.071), total income (0.075) and profit (0.062) were the most important factors. The AHP analysis assisted in proposing several solutions such as infrastructure construction and non-structural solutions to cover the output of products to develop sustainable agricultural production. Therefore, the case study of Chau Thanh A district was used to support the development of agriculture production.

Contribution/ Originality

This study identified the important factors affected agricultural production. Based on these factors, we propose and prioritize the suitable solutions and recommendations for policy-makers to develop sustainable agricultural production in the future effectively.

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1. INTRODUCTION

In recent years, natural conditions in the Mekong Delta in general and Chau Thanh A district, in particular, have been strongly influenced by the agricultural production activities of the farmer in the district as well as prolonged drought, erratic rainfall, unseasonal rain and flooding (Ha and Nguyen, 2016; Nguyen and Truong, 2014). In land use, the determination of natural, socio-economic and environmental factors is also a factor affecting land use efficiency. The above issues pose challenges to managers, researchers, local authorities and communities in new research, rational models, adaptive solutions and policies for social balance and Economic output, environmental benefits this becomes urgent and complex. Especially, the physical conditions in the Mekong Delta are facing many challenges (Nguyen and Van, 2014). This is one of the areas most severely affected by climate change and sea-level rise (Smajgl *et al.*, 2015). The physical conditions have also affected by the change in market prices (Phan *et al.*, 2017, Du *et al.*, 2018 and Viaggi *et al.*, 2013) as well as soil degradation due to excessive use of pesticides (Nguyen and Do, 2015). The policy of restructuring agricultural sector of the district was aims to build the concentrated production areas (People's Committee of Hau Giang Province, 2016), at the same time re-evaluates the situation of agricultural production in recent years of the district, which has faced with rapid changes from specialized rice land to high economic value-added cropland (People's Committee of Chau Thanh A District, 2017). Therefore, agriculture is a very complex issue. To solve these issues, AHP is a useful method of decision-maker support. The Analytical Hierarchy Process (AHP) is a multi-criteria analysis method applied in many fields and suitable for many studies (Jacek, 1996; Thirumalaivasan *et al.*, 2003; Gloria *et al.*, 2007). The method, which enables the evaluation of group decisions with a specific systematic and logical approach, is used to choose the best alternative among the determined alternatives for a specific purpose to consider different criteria (Saaty and Peniwati, 2008; Saaty, 1980; Chiranjit and Kishore, 2016; Ali *et al.*, 2019).

The study objective is to identify the current status of agricultural land use and the factors affecting agricultural production for the remedial proposal sustainable agricultural development, which improves the efficiency of land use and people's life in the district.

2. MATERIALS AND METHODS

2.1. Data collection

For analysis purpose, the data is collected by different means, details given below.

2.1.1. Secondary data

Available maps of land use of the study area in 2017 were collected at the Department of Natural Resources and Environment and the Department of Agriculture and Rural Development of the Chau Thanh A district, Hau Giang province. In addition, statistical - inventory data on land use, land use planning report and relevant physical, socio-economic data were collected according to the census data available at the Statistical Department and the People's Committee of the district. Such data were the main base to assess the land use current and affecting factors.

2.1.2. Survey data

A random survey of 70 farmers appropriately represent the whole population of the district was conducted to investigate the situation of agricultural production, criteria affecting the farming process and affected by agricultural production.

2.1.3. Interview experts

Forty-five experts (agricultural management officials, scientists and related organizations) were interviewed to identify the criteria and sub-criteria affecting agricultural production and impact level of each criteria.

Detail of criteria and sub-criteria are shown in Table 1.

Table 1: The criteria and sub-criteria affecting agricultural production

Criteria (C1)	Sub-criteria (C2)
Techniques	Seasonal calendar, seed varieties, Tech-application, Type product, Fertilizer, Pesticides
Physical	Weather, Drought, Flood, Amount of rain
Economic	Income, Cost, Profit, Benefit/cost
Social	Policy, Labour, Capital, Knowledge, Infrastructure, Experts, Scale
Environment	Soil pollution, Water pollution, Salinization, Acidification, Disease

2.1.4. Participatory rapid assessment method – PRA

The research conducted 10 rural assessments at district administrative units to verify the collected data and to synthesize ideas from the producers directly as well.

2.1.5. Multi-criteria valuation method

This method was used to evaluate the impact of the criteria affecting agricultural production people in Chau Thanh A district, Hau Giang province. Hierarchical analysis in group decision making (AHP-GDM) (Saaty and Peniwati, 2008; Saaty, 1980) was used to limit the subjective bias of experts. The multi-criteria evaluation method was performed with 03 basic steps (Lu et al., 2007): (1) pair matching; (2) weighting; and (3) determine the consistency ratio (CR%).

2.1.6. Mapping method

The method was used to synthesize and standardize the VN 2000 / WGS 84 zone 48 coordinate system (6 Degree), digitize, adjust, edit using Mapinfo software and create the thematic maps.

3. RESULTS AND DISCUSSION

3.1. The current status of agricultural production of the study areas

The actual situation of the study area until 2017 shown that the agricultural land area accounts for over 86% of the natural land area (People's Committee of Chau Thanh A district, 2017). This shown that Chau Thanh A district was a pure agricultural zone with diverse types of agricultural land use (Figure 1, 2).

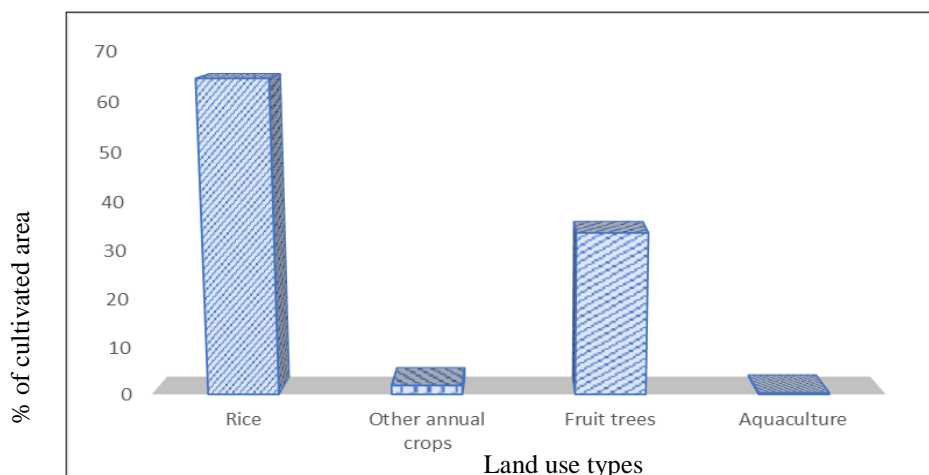


Figure 1: Uses of agricultural land in Chau Thanh A district in 2017

Source: Office of Agriculture and Rural Development of Chau Thanh A District, 2017

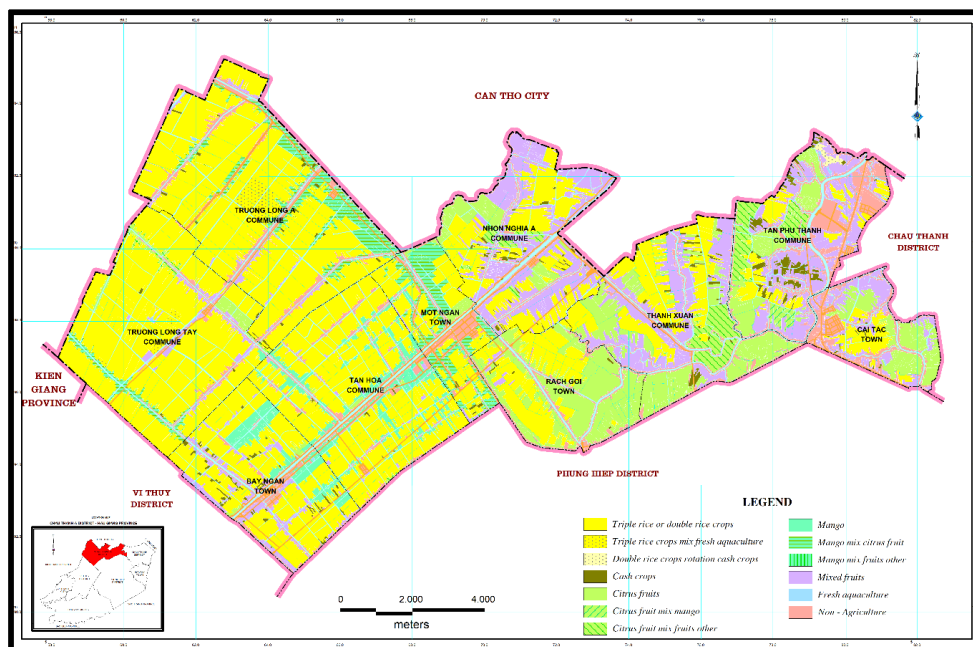


Figure 2: The current agricultural land use in Chau Thanh A district in 2017

According to the Land inventory statistics report (2017) and the field surveys showed that the agricultural farming status in Chau Thanh A district mainly consists of two main crops: rice and fruit trees with various types of land uses such as three rice crops, the combination of three rice crops and fish, double rice crops, rice - cash crops, cash crops and fruits (mainly salt-bearing crops such as oranges, grapefruit and lemon seedless and mango). However, in recent years, the area of fruit trees has grown massively and quickly on a small scale, which makes agricultural managers difficult to ensure planning due to the impact of market prices. Since, it made the difficulties in crop disease management and technology transfer, as well as the management of agricultural output and the quality of agricultural products.

3.2. The criteria affecting agricultural production in the study area:

The results of interviews with farmers, direct exchanges with experts as well as a rapid assessment of rural areas have identified five criteria (C1) affecting the agricultural production process of people in the study area, including physical, social-economic (Khoza et al., 2019), environment and farming techniques. According to experts shown the agricultural farming process in the district, the main influencing criteria is the social factor (weight 0.347) and followed by in the order of the physical (weight 0.188), economic (weight 0.165), environmental (weight 0.163), and techniques (weight 0.137), which were less impact on agricultural production (Table 2). The less impact of the technique on agriculture production is likely due to the district's traditional agriculture, long-term production experience, regular training in new techniques and application of new farming techniques in production. In recent years, the industrialization process has made the agricultural labour forces move to industrial zones which affecting agricultural production.

Table 2: The weight of criteria and sub-criteria affecting agricultural production

Criteria	Weight of criteria (W1)	Sub-criteria	Weight of Sub-criteria (W2)	Total weight W=W1*W2
Techniques	0.137	Seasonal calendar	0.122	0.017
		Varieties	0.096	0.013
		Tech-application	0.148	0.020
		Type product	0.199	0.027
		Fertilizer	0.201	0.027
		Pesticides	0.234	0.032
Physical	0.188	Weather	0.247	0.046
		Drought	0.166	0.031
		Flood	0.295	0.055
		Amount of rain	0.292	0.055
Economic	0.165	Income	0.452	0.075
		Cost	0.076	0.013
		Profit	0.376	0.062
		Benefit/cost	0.096	0.016
Social	0.347	Policy	0.064	0.022
		Labor	0.155	0.054
		Capital	0.121	0.042
		Knowledge	0.147	0.051
		Infrastructure	0.205	0.071
		Experts	0.065	0.023
		Scale	0.243	0.084
Environment	0.163	Soil pollution	0.126	0.020
		Water pollution	0.150	0.024
		Salinization	0.262	0.043
		Acidification	0.255	0.041
		Disease	0.208	0.034

3.3. The sub-criteria (C2) about techniques

Includes the seasonal calendar, seed varieties, techniques, production methods (Schreinemachers and Berger, 2011), methods of using fertilizers and plant protection chemicals (Figure 3) (Ada *et al.*, 1998; Sajesh and Padaria, 2019). The results showed that the pesticide and fertilizer were two important factors in farming techniques (Table 2); These two factors were important due to the resolution of crops disease problems and supply of nutrients under the continuing of local production, which reduces the soil nutrient quality and land availability (Le and Tran, 2013; Nasim *et al.*, 2018). The results also showed that the crops seed varieties factor was less important in agricultural production because most farmers in the area have used and selected pure varieties, and low quality. The results are in agreement with the findings of Ramasubramanian *et al.* (2014) for the quality seed availability.

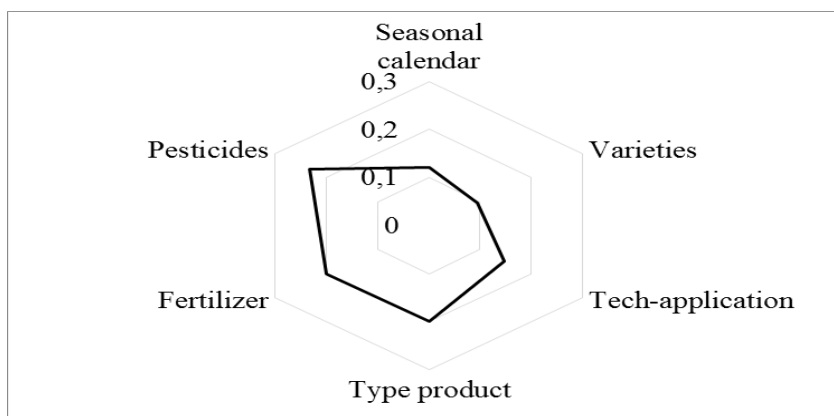


Figure 3: The chart for sub-criteria about techniques

3.4. The sub-criteria (C2) about physical

Properties are such as erratic weather changes, prolonged drought, flooding and rainfall (Figure 4). In the Mekong Delta, drought/flooding have played an important role in agricultural development (Das, 2005). Flooding and rainfall are two factors of high concern (Table 2) because local flooding affects crops; reducing productivity and product quality, and affecting harvest as well. Besides, during the time in the rice field or flowering of fruit trees, the rain causes a drop of the fruit and produces much less fruit, resulting in the low productivity and quality of agricultural products. The factor of the prolonged drought was less concerned because the district has many rivers and canal systems. Therefore irrigation demand is stable and irrigation water supply for the region's crops is adequate.

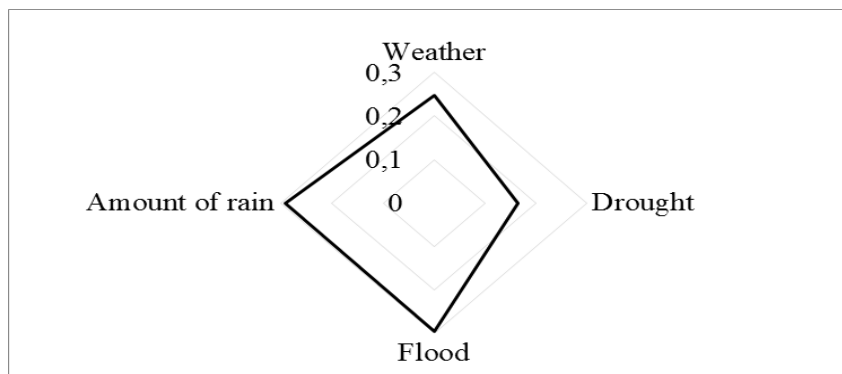


Figure 4: The chart for sub-criteria about physical

3.5. The sub-criteria (C2) about economic

Properties determined including the investment costs, model income, production profits, and capital efficiency in agriculture production diversifies (Bowman and Zilberman, 2013.) (Figure 5). In which, income and profit were the two factors that greatly affect agricultural production (Rajendra et al., 2019, Viaggi et al., 2013), followed by capital efficiency and investment costs (Table 2). The results showed that the local economic conditions, the production of the high-income land-use type were an important factor of decisive decision making on agricultural production. The profits were equally important at the same time. When production has brought about profits and high economic efficiency, people are only interested in the investment costs of the production land-use type.

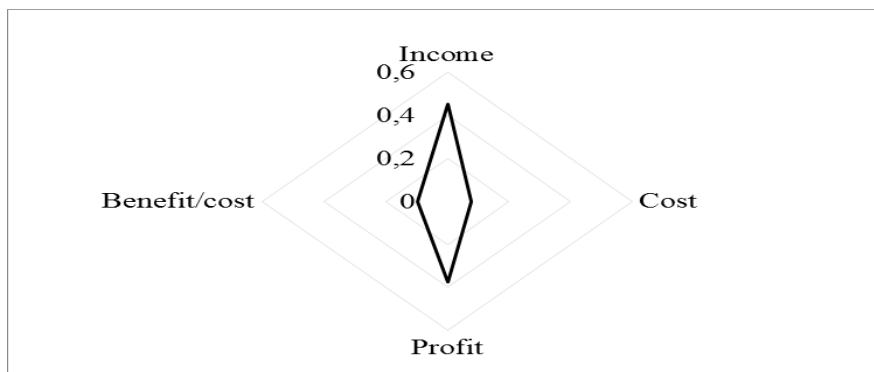


Figure 5: The chart for sub-criteria about economic

3.6. The sub-criteria (C2) about social

Affairs affecting agricultural production most in the district was the scale of production, followed by infrastructure, labour sources, people's knowledge, and capital sources (Figure 6). Advisors and supporting policies in agricultural production were the least influential factors (Table 2). According to experts, the policy of supporting local agricultural production was not much and the level of support was low (mainly supporting annual water pumping), the training for farmers on science and technology. There were no policies to support capital, consumption, and chain of link policies. The production scale and infrastructure were social factors highly influenced by small and fragmented production conditions, while the area of raw material products has not been developed, resulting in low product quality and uneven, inadequate irrigation system, inland canals affect the transportation of agricultural products.

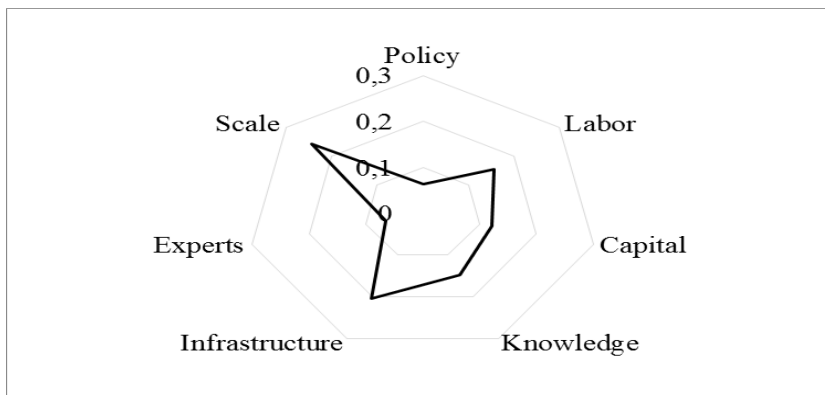


Figure 6: The chart for sub-criteria about social

3.7. The sub-criteria (C2) about the environmental

Factors have identified the saline element as the one that was considered to be the most influenced by the salinity element that has a great impact on crops (the plant varieties in the district are grown in freshwater), followed by acidic soils, the increase in disease, water pollution and soil pollution (Table 2, Figure 7) were the factors that have little effect on the agricultural production of the study area.

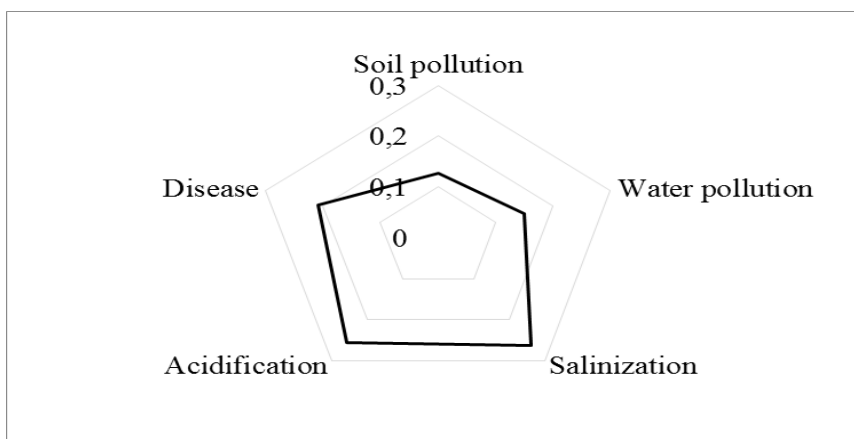


Figure 7: The chart for sub-criteria about the environment

Therefore, with 26 Sub-criteria (C2) affecting agricultural production in the district, the economic criteria [total revenue (0.075) and profit (0.062)] was still the leading decision criteria, followed by infrastructure criteria (0.071), scale (0.084), and criteria of plant varieties (0.013) are of little interest in the cultivation process in the district.

3.8. The Solutions for sustainable agricultural production in the study area

Based on the criteria and sub-criteria were determined above, some solutions for sustainable agricultural production:

- 1) Several scientific and technical measures need to be carried out to limit the use of inorganic fertilizers and plant protection chemicals, and to raise the awareness for people to use organic matter and to apply high-tech agriculture.
- 2) The local managers also need to focus on repairing, upgrading and constructing a closed dyke system, and irrigation systems to limit the impact of flooding in the rainy season;
- 3) The policymakers need to develop the strategies to manage the agricultural materials appropriately to ensure quality, as well as to reduce the production costs. At the same time, it is necessary to build a system of linking offsets of agricultural products to ensure outputs for agricultural products.
- 4) It is necessary to recommend the concentrated production areas towards uniform product quality, as well as to support policies on land to expand the farming scale to meet the supply of raw materials.
- 5) The training on scientific and technical measures for farmers to limit the use of inorganic fertilizers that adversely affect soil resources such as soil acidity and salinity formation in the production process.

4. CONCLUSION

Based on the study results showed that agricultural production is very complex with many factors influence and interact with each other. The study concluded that of the five (05) criteria (C1), the social criteria are most interested in agricultural production. In which, twenty-six (26) additional sub-criteria (C2) were identified affecting the agricultural production of the study district. The criteria of income, infrastructure and profit were the main influencing criteria, and the policies to support agriculture and plant varieties were the criteria that have less impact on production. This factors supported the current policymakers to promote the production status of farmers and will prove as a benefit for district agriculture in the coming future. The AHP was a useful tool to assist the determination of the current limitation of criteria in agricultural production and proposed

solutions have been developed to improve the livelihood ability in the future for a larger extent. The research results were the basis for further studies on land use and climate change, it should be consulted by managers with necessary and effective orientations to cope with issues change contribute to sustainable agricultural development strategy.

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