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Agricultural Development for Sustainable and Foreseeable Agroecology in the Red River Delta, Vietnam

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Abstract:

This research has sought to analyze the agricultural development in the Red River Delta, Vietnam with perspectives on agroecology. The structure and emphasis of this research have been shaped mainly by the material gathered through the interviews 234 farmers represented 03 farming systems (mono and poly-culture).

Through the adoption of systemic approach of agroecology (objectives-practices-outcomes), this research reviews agricultural sustainability in the region. There is an existence of diverse farming systems but there is a dearth of ecological-based knowledge and practices of farm households. Whole-farm performances gained with different levels of sustainability. From socio-economic perspective, farm households achieve some profitability. From environmental perspective, there are many issues of environmental risks (spontaneous drainage of farm effluents, inordinate application of pest and disease control, unwise utilization of synthetic fertilizers and biodiversity loss.

Through Rapid Appraisal of Agricultural Information System analysis, this research identifies a vast range of constraints and their interlinked causes that hinder sustainable development. The top three clusters of constraints are mismanagement practices at the farm-scale, economic issues and environmental pollution. The first interlinked cause starts with the poor policy development associated with the limited implication of the regulatory framework for ecological-based production. The second underlying cause that influences the developments are poorly performed transferred works of advisory service providers. None of the providers achieved sustainable effectiveness. The third blocking mechanism is related to the objectives and characteristics of farmers. Most farmers enjoy their own needs of profit from farming and sell surplus products rather than feeling responsible for long-term maintenance. Whilst the conservative authorities expect both conservation and development, but it is not always possible for them to do so.

Several implications are arising to reflect on what needs to be put in place. These include ways of the policy-making process and stakeholder engagement as well as fostering of local knowledge and capacities and conservative practices in the response to agricultural development and pollution mitigation. The changes require help to regulate agriculture toward the preservation of local ecosystems.

Keywords: Agricultural development, Agroecology, Red River Delta, Vietnam
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1. Introduction

The Red River Delta (RRD) is seen as an important area of the economic and social development of Vietnam. It covers 1,405.39 thousand ha of agricultural land. This area has mostly plain sites, fertile soil, mild climate, relatively develop infrastructure and high educational levels. Therefore, agricultural development is still central to economic activity and employment in this delta. However, the developments in modern agriculture have led to a host of environmental concerns because it impinges on natural resources and heavily relies on synthetic fertilizers, pesticides and other chemicals. Agricultural developments include various influences on biodiversity and ecosystem functioning and services such as destruction of wildlife habitat, organic and nutrient enrichment, pollution risks, etc. It raises an important question about how can manage agricultural production to achieve economic viability and ensure ecological sustainability. This research has sought to analyze the agricultural development in the RRD, Vietnam with perspectives on agroecology.

2. Material and Methods

2.1 Data collection:

- The in-depth interviews: with key informants firstly were used in 2017 to identify characteristics of main farming systems, main issues of agricultural development in the RRD and objectives of communal authorities.

- Household surveys: three farming systems in 14 villages of Giao Thien commune (belong to RRD) were selected purposively including integrated mangrove – aquaculture (IAM, n=84), intensive shrimp (ISH, n=54), and rice-based (RB, n=96). Fieldwork is carried out from 2017 to 2018 with a total of 234 respondents to collect information of one year activities.

- Rapid Appraisal of Agricultural Information System (RAAIS):

  - First, the multi-stakeholder workshop was held in Giao Thien commune in December 2019, included 11 farmer representatives (05 RB, 03 ISH, 03 IAM). The starting point of the multi-stakeholder workshop was to determine constraints or challenges of agricultural development. The participants were guided through a series of participatory exercises to identify the main problems they faced in their work regarding socio-economic-environmental-institutional aspects. Participants were asked to list and write down the problematic issues, then they discussed with others to explore overlapping issues. The top main constraints then were concluded based on the consensus of the stakeholders. The researchers capture all the discussion of participants to ensure the quality of information.

  - Second, in-depth interview and synthetic review of secondary data: to deepen the understanding of causes of constraints that hinder the production, further in-depth interviews (with a semi-structured questionnaire) were conducted with key-informants of each above group in the next few days. We continued gathering communication information, concerns and frustration from diverse respondents through recurring questions. Common themes arose throughout the in-depth interviews. Based on the topic lists, we collected related problems and all detailed notes from interesting storylines of respondents. Total, 12 headers of Communal People's Committee, Communal Agricultural Cooperatives, and Communal Agricultural Board were interviewed.

  - Third, site visits: we conducted further site visits to collect data on assessment of farmers on the effectiveness of agricultural advisory services, the interaction of farmers and service providers, etc. The semi-structured interviews were used while we were visiting farms.

2.2 Data analysis:

- Net farm income: Net farm income is a key indicator of agroecology toward economic theme: Net farm income = Revenue from animals/plants/other farm activities (quantity of crops/animals/other activities sold multiplied by the gate price) – Total operating expenses after rebate (input costs + depreciation of equipment and machinery + taxes + hired labor costs + interests + cost land rent + veterinary service costs) (FAO, 018 & Mottet et al., 2020).

- The "Traffic light" approach was used as an analytical technique to evaluate the environmental sustainability of RB cultivation. Farms that perform badly results are signified with unsustainable (marked with red), while others that achieved preferable outcomes are highlighted with sustainable/desirable (marked with green). Those performances obtained at neutral are being rated acceptable (but need to be improved) (marked with yellow). The ranking varies differently environmental indicators: soil fertility (soil health), water use, fertilizer management, pesticide management, and application of biodiversity-friendly practice (FAO, 2018).

- The index of biodiversity loss (BDL): BDL is one indicator of agroecology outcomes. BDL can be evaluated by multiplying the responses with scoring value and dividing the total number of respondents. The scoring value of wild-caught habitats use in the cultivation are classified as >50% = 0.25; 20-49% = 0.5; < 20% = 0.75; and no natural fry use = 1 (Chowdhury et al., 2015).

3. Results and Discussion

3.1 Farm management practices

- *Rice-based (RB) farming system:* Rice is grown by two mono-crops per year. After the second crop, local cultivators dry and fallow land for about 8 weeks then starts preparing land with plow by machines for the next crop. This production is a low-intensive technological application. Only machines are used to plow land and harvest grains. Various inorganic fertilizers and pesticides are widely utilized in rice plots. Our further results reveal that there is no special training or different farm management skills for rice farmers.

Land preparation | Sowing land with rice | Transplanting rice | Pesticide spraying | Harvesting rice grains | Burning straw

Figure 1: Main activities of RB cultivation

The technical knowledge and actual practice toward conservation of farmers are **similar low.** The most frequently barriers to the limited use of agroecological-based methods in this area have been reported:

- Soil fertility management methods: Farmers have limits on their own energy and time. Soil fertility management methods require for more labour and time consuming as compared with conventional ones. If they use hired labour, it could reduce their profitability. Poor economic situation of local farmers as well as and high incentive for profits are barriers to the adoption of environmental friendly practices.
- Site specific integrated nutrient management: Farmers face unavailability as well as inaccessibility of conservation equipment to test soil fertility. There are no public and private shops or other places to sell and provide the tools for farmers.
- Integrated pest management:

+ First, integrated pest management practices need longer time between treatment and effect than chemical pesticides. However, farmers lack understanding of long-term benefits of these methods. In this area, there are no demonstration farms to convince farmers to follow the good practices.

+ Second, ongoing habits limit the involvement of farmers in good practices. Farmers feel convenient with things that their parents and neighbours do. New things become unfamiliar for farmers. Farmers also perceive complexity when changing current activities.

+ Third, lack of institutional supports for sustainable practices: Shortage of environmental friendly programs as well as agricultural advisors restrains to learning process and application of farmers. Farmers wonder the practices will work in their soil/farms without reduction of yield?

- *Integrated aquaculture – mangrove system (IAM):*

The common characteristics of the system are low intensification with low production cost, low stocking density, available wild-caught marines but high market prices of farmed products. This production is based on culturing aquaculture species within mangrove trees. Target products including hatchery black tiger shrimps and crabs were reared inside mangrove ponds together with the recruitment of wild captured species including wild-caught shrimps and milkfish, etc. Seaweed also exists naturally in the farms and farmers collect this plant at the end of the grow-out season. IAM mainly uses local resources as well as local production methods.

Farm preparation | Post-larvae releasing | Water management | Harvesting | Emptying

Figure 1: Main activities in IAM culture

- *Intensive shrimp system:*

Shrimp culturists apply intensive monoculture with two raising cycles per year. ISH production relies on aeration to provide oxygen for shrimps and phytoplankton and shrimps need various inputs including pellet feeds, supplements (minerals and vitamins), probiotics, antibiotics, veterinary drugs, etc. This cultivation requires stricter management skills and capital investment than IAM. After the harvest of the second crop, farmers leave pond emptying in three months from December to February.

Pond preparation PL releasing Feed preparation Harvesting Emptying

Figure 3: Main activities of ISH culture

Barriers to adoption of agroecological-based practices:

- Farm design and building: Some of farmers face limited land and capital for designing canals for wastewater treatment and low perception of environmental protection lead to the discharging of pond sludge to the common rivers.
- Water quality monitoring: Tests and treatment for farm effluents incur higher production costs. So, farmers do not prefer this kind of "extra" work which leads them to lower profits. In addition, water quality assessment is not compulsory in this area. The standards for farm effluents are existing but lack of implementing and monitoring.
- Water exchange: Most farmers believe that more frequency of water exchange provides the cleaner condition for shrimps. So, they exchange water daily which resulting in more dependency on water quality from outside.
- Veterinary drugs and chemical products:
  +The old habits and time-consuming prevent farmers to record the use of chemical products daily.
  + Belief in antibiotics' effects: Most farmers believe that antibiotics can ensure a stable yield of shrimps in unfavorable environments. So, they often apply antibiotics as a preventive method.
  + More farmers lack pond ecology knowledge, so a small number of them can wait until compounds of waste have enough biodegradation time.
- Disease management:
  + Farmers only communicate with their neighbors to build the electricity system at the starting stage of farm preparation. After that, they work individually in their ponds. Lack of common interest groups leads to low cooperation and communication among communities when disease occurrence and spread in the region.
  + Farmers buy PL shrimps from companies in the central or south of Vietnam. They do not own equipment to test the shrimp quality before releasing point. When shrimps get diseases, farmers increase the frequency of water exchange to pump cleaner water from rivers.
- Pond effluent treatment:
  + The dearth of land and shortage of financial sources are barriers to build reservoir ponds for water circulation and sedimentation ponds for effluent treatment in this area.
  + Limited land and lack of knowledge on farm ecology prevent farmers grow mangroves on discharge areas as filters.
  + The majority of farmers resist applying standard treatment methods for farm effluent because it causes higher expenses for their own production. Plus, low awareness of environmental preservation and lack of law enforcement hinders famers from responsible treatment of waste before releasing to the water bodies.

3.2 Outcomes

- **Net Farm Income**

The values of net farm income of ISH gains at 321.17 mil. VND/ha/year which is 15.7 times higher than those in RB and 16.3 times higher than those in IAM. ISH farming is attracted to farm owners due to higher opportunities for short-term profits especially in rural areas where monitoring and control of environmental standards are limited. However, the income of ISH production in this area was assessed at a medium level of economic performance in the intensive white-legged shrimp production in other coastal provinces of Vietnam (Engle et al., 2017).

Table 1: Net farm income of farming systems (unit: mil.VND/ha/year)

Indicators	IAM	ISH	RB
1. Total revenue*	**32.99**	**1,017.00**	**124.79**
2. Total cost*	**13.29**	**695.39**	**104.31**
2.1 Variable cost*	**10.70**	**643.66**	**103.20**
Labor (hired and family)	4.48	73.98	61.66

Seeds	5.72	96.89	3.15
Feeds	0.41	243.11	-
Miscellaneous	0.34	0.00	-
Lime	0.20	11.20	-
Sand	0.00	17.53	-
Chlorine	0.00	10.85	-
Bacteria/virus drugs	0.00	6.46	-
Antibiotics	0.00	42.33	-
Pro-biotic	0.00	39.78	-
Supplement	0.00	37.24	-
Electricity	0.00	57.32	-
Oil	0.00	6.97	0.00
Fertilizers	-	-	15.68
Pesticides	-	-	6.21
Rented machinery	-	-	16.50
2.2 Fixed cost*	**2.59**	**51.73**	**1.11**
Land annual rental	0.35	1.5	1.11
Interest on loans	0.40	16.93	0.00
Repairs	1.21	0.00	0.00
Depreciation	0.63	33.30	0.00
3. Net Farm Income*	**19.70**	**321.17**	**20.48**

Different superscripts (*) from Kruskal–Wallis test denote a significant difference between mean within rows ($p < 0.05$).

(Source: Compiles from data survey, 2018)

- ***Environmental risk***

Figure 4 shows that none of the environmental indicators gain at a desirable or sustainable level. In particularly, biodiversity-friendly methods were emerging concerned in this site when most of its requirements were not adopted. Pesticides and water use were mainly evaluated as acceptable, but they are required to adjust for higher performance. Soil fertility has been degraded in recent years partly due to improper fertilization.

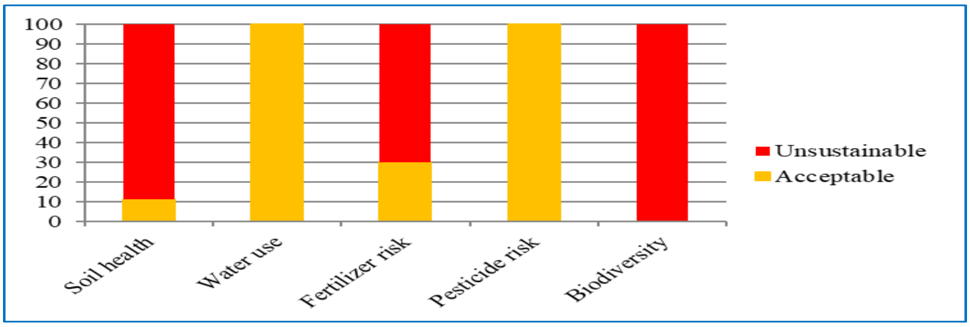

Figure 4: Environmental sustainability assessment of RB cultivation (Source: Survey, 2018)

- **Biodiversity loss rate (BDL)**

In IAM cultivation, there were 100% of farm owners trapped and harvested wild marines through frequent exchanges of brackish water from rivers, canals, or estuary. Moreover, wild crab seeds (size 3-5 cm/crab) were used in most of IAM ponds and they were also bought from crab harvesters living inside and outside the commune. This activity is partly responsible for the degradation of critical aquatic species around the park as well as the disruption of living environment of water-birds especially when people use flash-lamps at night time. The lower BDL (0.28) demonstrates the higher level of wild fries was captured which corporate the risk of natural aquatic resource degradation in regional rivers. The biodiversity degradation in turn decreases yields of IAM farms because this system still depends much on wild fisheries.

Table 2: Biodiversity loss rate of IAM

Wild-caught use	**IAM** (number of respondent)
>50%	72
From 25-50%	12
< 25%	0
No use	0
Biodiversity loss rate	0.28

(Source: Survey, 2018)

3.3 Constraints and causes

Through RAAIS, this research identifies a vast range of elements that constitute constraints and underlying causes that hinder sustainable agricultural development and the application of ecological-based management practices in this delta. The top three clusters of constraints to achieving the development are mismanagement practices at the farm-scale, economic issues and environmental pollution.

The first cause relates to the poor policy development associated with low enforcement of agroecologically-based methods. Meanwhile, literature and policy documents show that Vietnam has numerous laws, policies and regulations for sustainable agriculture and eco-friendly cultivation, they have not been effectively transferred into practices at this site. There is a lack of economic incentives for farmers. Authorities at district and commune levels manage agriculture toward intensification but deficient ecological knowledge. Furthermore, the enforcement of environmental standards in farming activities is limited despite the existence of environmental regulations and laws. The weak enforcement attributes by the dearth of facilities, resource-conserving equipment, laboratories, and staff from district to communes. In other words, environmental standards are given too much emphasis, while they have not transferred into practice and materialized in this site.

The second emergent cause call for a reorientation is the agricultural advisory service system due to its low performance. Packages of technical advisory have not yet satisfied various needs of farmers or improved the economic and environmental outcomes of diverse production systems.

Another critical interlinked constraint is related to the gap between the objectives of farmers and the authority. Primary, farmers have the top priority for profits and they want to satisfy their own needs rather than feeling responsible for long-term maintenance. While economic factors shaped the decision-making of provincial government and lower agencies. From the preservation perspective, there have not clear indicators or measures of environmental sustainability for agriculture.

Lastly, the findings of the research point out that farmers' knowledge of ecological agriculture is deficient, and these have an impact on the limited adoption of environmentally friendly production methods.

4. Conclusions and Outlook

Through the application of the systemic approach of agroecology (objectives-practices-outputs), this research reviews the current situation of agricultural development in the RRD of Vietnam. There is an existence of diverse farming systems (mono and poly-culture) but there is a dearth of ecological-based knowledge and practices of farm households. From ecological and environmental sustainability perspectives, the cultivation rose diverse undesirable problems. Several implications are arising from this research to reflect on what needs to be put in place to helps to regulate agriculture toward the preservation of local ecosystems.: (1) specific policies and operation mechanism for agricultural development, (2) agroecological-supportive programs through economic instruments, (3) law enforcement for environmental protective technology for different farming systems, (4) enhanced agricultural advisory services, education, awareness toward conservation for farmers, (5) more social involvement.

References

1. Chowdhury, M. A., Khairun, Y., & Shivakoti, G. P. 2015. Indicator-based sustainability assessment of shrimp farming: a case for extensive culture methods in South-western coastal Bangladesh. International Journal of Sustainable Development, 18(4), 261-281.

2. Engle, C.R., Mcnevin, A., Racine, P., Boyd, C.E., Paungkaew, D., Viriyatum, R., Tinh, H.Q. & Minh, H.N. 2017. Economics of sustainable intensification of aquaculture: evidence from shrimp farms in Vietnam and Thailand. Journal of the World Aquaculture society, 48, 227-239.

3. FAO. 2018. Proportion of agricultural area under productive and sustainable agriculture. SDG Indicator 2.4.1. Methodological note. Online available at: http://www.fao.org/3/ca7154en/ca7154en.pdf

4. Mottet, A., Bicksler, A., Lucantoni, D., De Rosa, F., Scherf, B., Scopel, E., ... & Tittonell, P. 2020. Assessing transitions to sustainable agricultural and food systems: a Tool for Agroecology Performance Evaluation (TAPE). Frontiers in Sustainable Food Systems, 4, 252.