Constraints of Agricultural Development in the Context of Environmental Conservation in Protected Areas of Vietnam

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1. Introduction

- Xuan Thuy national park (XTNP), the largest wetland ecosystem in Northern Vietnam was chosen for the case study. The park covers a total area of 15,100 hectares compromising core zone (7,100 ha) and buffer zone (8,000 ha).
- Objective of the core zone: conservation.
- Objective of the buffer zone: livelihood development and minize impacts for environment.
- There are 44,287 inhabitants in 14,076 households living in five buffer communes of XTNP (Giao Thuy district Statistical Office, 2018).
- Agriculture covers 2,188.71 ha (Giao Thuy district Statistical Office, 2017) and aquaculture domain is 1,669 ha (Hai, H.T, 2015) in total of 15,100 ha of the park. The ecosystem of this protected area bears many environmental impacts from agricultural production due to uncontrolled policies and unsustainable farming practices as claimed by many researchers (Beland et al., 2006; Haneji, Vu, & Duong, 2014 ; Haneji et al., 2015; Nguyen *et al.*, 2019).
- It is imperative to develop agriculture toward conservative prospect to ensure dual benefits for farmers and environment as follow:

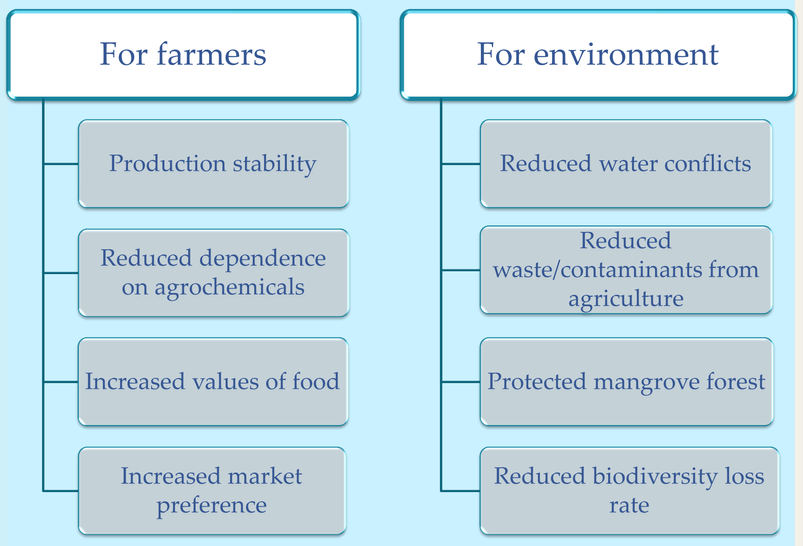

Fig. 1: Benefits of agricultural development and environmental protection in XTNP

2. Materials and Methods

2.1 Data collection:

The initial in-depth interviews were conducted with 12 staffs from local authorities (managers of communal people's committee (CPC), headers of communal agricultural board (CAB) and communal agricultural cooperative (CAC), managers of XTNP board management and officials of department of agricultural & rural development (DARD). Then 234 farmers living in buffer areas of XTNP were chosen for this study.

2.2 Data analysis:

- Production stability index (PSI) is estimated by an index of farmers' responses to production trends in recent five years.

$$PSI = [\sum De*1 + Sa*2 + In*3]/n*3$$

(0< PSI ≤ 1); De = number of farmers' response decrease yield; Sa = number of farmers' response remained yield; In = number of farmers' response increase yield; n = total number of respondents.

- Biodiversity loss (BDL) can be evaluated by multiplying the responses with scoring value and divided by total number of respondents and divides total number of respondents. The scores of wild-catch habitats are classified as > 50% = 0.25; 20 - 49% = 0.5; < 20% = 0.75; and no natural fry use = 1.
- Farmers' opinion on the effective level of AAS was evaluated by weighted average index (WAI):

$$WAI = [\sum(VL*0.2) + (L*0.4) + (M*0.6) + (H*0.8) + (VH*1.0)]/n$$

(0< WAI ≤ 1); VL = number of farmers' response very low effectiveness; L = number of farmers' response low effectiveness; M = number of farmers' response very medium effectiveness; H = number of farmers' response very high effectiveness; VH = number of farmers' response very high effectiveness; n = total number of respondents.

The above index were adapted to indicator-based sustainability assessment from works of Chowdhury, Khairun, and Shivakoti (2015).

3. Results

3.1 Farm management and inputs

Month	Rice – based (RB)	Intensive shrimp (ISH)	Integrated aquaculture - mangrove (IAM)
1	Plough Sowing land with rice varieties	Fallow	
2	Transplanting		Fallow
3	Pesticide & fertilizer application	Pond preparation, Releasing shrimp larvae, Feeding and water mgt.	
4	Pesticide & fertilizer application	Feeding and water mgt.	Releasing shrimp/crab larvae, Feeding and water mgt.
5	Harvesting	Feeding and water mgt.	Feeding and water mgt.
6	Plough Sowing land with rice varieties	Feeding and water mgt., Harvesting	Feeding and water mgt.
7	Transplanting	Fallow	Feeding and water mgt.
8	Pesticide & fertilizer application	Pond preparation, Releasing shrimp larvae.	Harvesting shrimp, crabs
9	Pesticide & fertilizer application	Feeding and water mgt.	Harvesting crabs, fish
10	Harvesting	Feeding and water mgt.	Harvesting crabs, fish
11		Feeding and water mgt. Harvesting	Harvesting seaweed
12	Fallow	Fallow	Fallow

Fig. 2: Farming activities of three main farming systems

- *RB:* Rice is cultivated by two mono-crops/year. Farmers no longer use rotational cropping or integrated pest management (IPM). Diverse kinds of synthetic fertilizers and pesticide are broadly used by 100% respondents. There are overuse of urea and imbalance rate of chemical fertilizers in this production.
- *ISH:* Culturists apply monoculture with two raising cycles/year. White leg prawns (*Litopenaeus vannamei*) are conducting with high stocking rate of fries (70-80 PL/m^2). Shrimps were fed by additive nutrients and antibiotics (Nguyen *et al.*, 2019). Sewage and effluent from ISH ponds is discharged to common rivers without careful treatment technique and water indicator testing as recommended by Department of Agriculture and Rural Development of Giao Thuy district.
- *IAM:* Black tiger shrimp (*penaeus monodon*) was reared with crabs in mangrove farms. Beside shrimps and crabs, co-products such as wild-catch shrimps (*metapenaeus ensis*) & fishes, seaweed are harvested. This system relies mainly on ephemera going from the coast. No fertilizers and lime are utilized. Eight-month production cycle lasts from April to November annually.

3.2 Farm outputs and impacts

- Farm yield of IAM, ISH were lower than other areas of Vietnam (Seafood Trade Intelligence Portal. 2018; Thakur, K, 2018), whist yield of RB were higher than Vietnam national average (FAO, 2019).
- The lowest BDL of IAM demonstrated the highest level of natural fries were stocked in production as compared with ISH and RB which corporates biodiversity degradation.
- ISH does not apply technique to catch natural post-larvae (BDL = 1), but sludge and sewage from ISH ponds create pollution for both ISH (100%) & IAM (33.3%).
- Farmers claimed for price squeeze and there are no certified products of RB & ISH

Table 1: Farm outputs and impacts

	IAM	ISH	RB
1. Economic			
Production of target product (kg/ha)	69.89	3,745	6,225
Production changes (no. of respondent)			
Increase	0	0	78
Remained same	78	2	11
Decrease	6	52	7
Production stability index (PSI)	0.64	0.35	0.91
2. Environmental			
Wild-catch use (no. of respondent)			
>50%	72	0	0
25-49%	12	0	0
< 25%	0	0	71
No use	0	54	25
Biodiversity loss index (BDL)	0.28	1.00	0.82

3.2 Constraints of agricultural development toward environmental protection

• *Farmers rank conservation at least important while cultivating*:

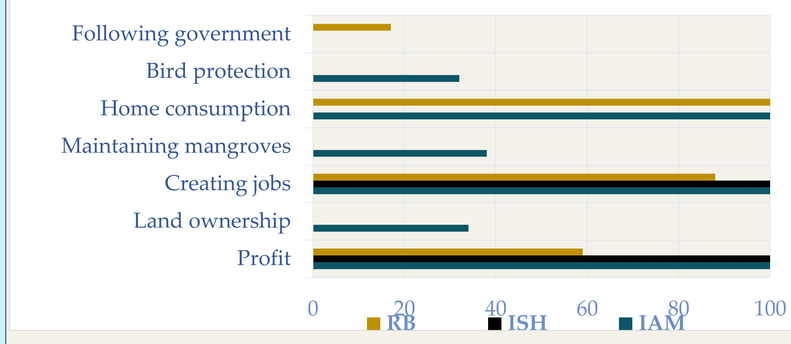

Fig. 3: Objectives of farmers

•*Low collaboration between farmers and local organizations*:

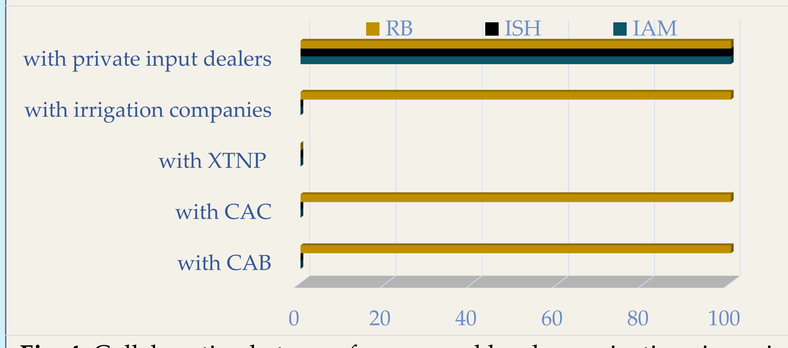

Fig. 4: Collaboration between farmers and local organizations in agri. development

- CAB and CAC have more collaboration with RB than IAM & ISH.
- Private inputs dealers focus more on selling companies' products than promoting conservation.
- XTNP have no collaboration with farmers in agriculture

• *Low effectiveness level of agri. advisory service providers*:

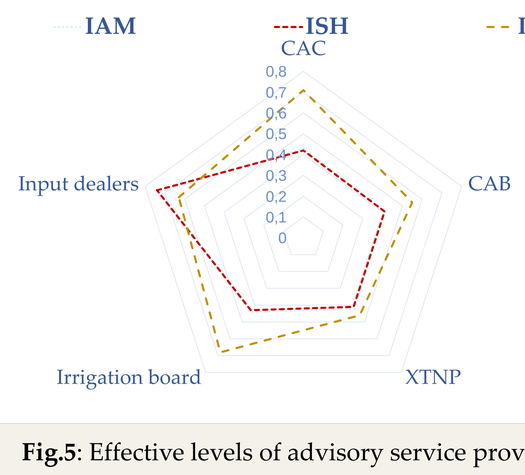

Fig.5: Effective levels of advisory service providers

- CAC and CAB concentrate more on promoting food security and productivity for buffer inhabitants than conservation perspectives.
- XTNP focus on general environmental propagation. They receives little political supports in monitoring unsustainable practices.
- There are no effective mechanism in solving environmental problems: disease outbreak in ISH, un-controlling exotic snail in RB and water conflict from pesticide in RB for IAM & ISH and sludge disposal from ISH for ISH & IAM

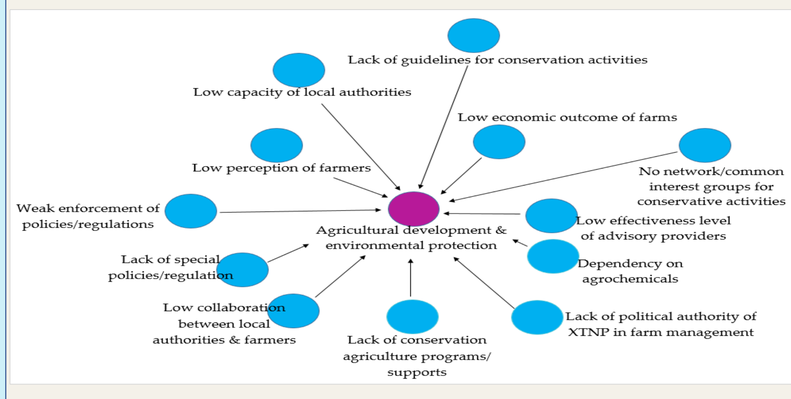

Fig. 6: Constraints of agri. development toward env. protection

Note: Constraints which are closer to the center are more important

- *Policies/regulation of agriculture: Farming activities are under regulated by DARD of district but are not enforced.*
- *Shortage of conservative agriculture programs: there are no environmentally friendly programs in the protected area in recent three years (2017-2019).*
- *No networks/common groups for conservative activities.*
- *Lack of guidelines for conservation agriculture in this area.*
- *No certification supports for organic products in this area.*

4. Implication

- ✓ Heightening awareness of farmers on the conservation through the public education.
- ✓ Improving stability of production through application of sustainable practices: (1) reducing the wild-captured in IAM; (2) lower antibiotics, improving recycling and lower water exchange system in ISH; (3) restraint of urea abuse and synthetic fertilizer imbalance and pesticide in RB.
- ✓ Developing certification for farm products applying environmentally friendly practices.
- ✓ Promoting specific policies/programs and the enforcement in agriculture/aquaculture for buffer zones of protected areas.
- ✓ Strengthening capacity of local authorities in transferring advanced technologies of conservation agriculture and problem solving.
- ✓ Strengthening collaboration of local authorities with farmers.
- ✓ Stimulating experts of XTNP involve in agri. development of buffer zones.

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