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Land-Use Efficiency of Some Agricultural Livelihood Models on Low-Lying Land: A Study in Ha Tinh, Vietnam

Nguyen Tran Tuan

Faculty of Real Estate and Resources Economics, National Economics University, 207 Giai Phong Street, Hai Ba Trung District, 113068, Hanoi, Vietnam

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Abstract Economic efficiency is a concept showing a concentration of development in depth, reflecting the exploitation of financial resources and the cost of resources in the production process. The study was conducted in Ha Tinh province, Vietnam, to evaluate the economic efficiency of agricultural production in low-lying areas. The research results of the topic are based on data collected from 80 agricultural households of 3 livelihood models (specialising fish, rice–fish, and rice–fish–duck). The results show that the specialising fish model gives the most extensive production value and requires the highest initial investment costs, followed by the rice–fish–duck model and the rice–fish model. However, considering the production efficiency indicators, the rice–fish–duck model has the highest economic efficiency, then the specialised fish model and the rice–fish model. The study also pointed out some limitations of livelihood models and farmer households, such as land size, technical system, and seed source. Therefore, if these shortcomings are solved, the economic efficiency of farmers will be improved.

Keywords Household Livelihoods, Economic Efficiency, Rural Area, Land-Use Change, Agriculture

1. Introduction

The term ‘livelihood’ is used in a wide variety of contexts and is thought to be a very complex notion with no clear boundaries. They provide people with the tools they need to design their life and meet their basic requirements. Livelihoods involve more than just money. It consists of compensation in money or in kind, in-kind services, social structures (such as families, organizations, and villages), intimate relationships, and property rights required to uphold and preserve a particular quality of living [1]. The capacity to use and gain from the public and social services offered by the government is also a component of livelihoods. These include transportation, water supplies, roadways, education, and health services [2]. The term “livelihood” also refers to a person’s or a household’s means of subsisting, which combines an individual or a household’s resources, activities, and access to these [3]. As a result, one of the key elements in building ‘resilience’ in a family or community is livelihood. Meanwhile, agricultural livelihood is human’s livelihood activity, reflected through the main field of agriculture [4]. In particular, the livelihood model is a model to show the combination of resources in specific production conditions to achieve product goals and economic benefits for people in that livelihood model [5].

When studying the economic nature, economists have

different perspectives, but all have a common consensus. In other words, producers that wish to make money must incur certain expenses. The deviation after a costly production process has an economic effect. If this difference is high, the economic efficiency is excellent and vice versa. Thus, economic efficiency is an economic category, showing a concentration of development in depth and reflecting the exploitation of financial resources and the cost of resources in the production process. In other words, economic efficiency is defined as the strong relationship between the quantity of results attained and the quantity of costs incurred in manufacturing and business operations [6]. The value of the output product is measured by the result, whereas the value of the input resources is measured by the price. Correlation should take into account both absolute and relative comparisons as well as how closely the two quantities are related. However, the conception of economic efficiency in different financial forms is not the same. Depending on socio-economic conditions and required purposes of a particular country, region, or industry, it may be evaluated according to different angles. Economic efficiency is not the ultimate goal but the goal throughout all economic activities.

However, in order to understand what economic efficiency is, it is necessary to avoid mistakes such as the identification between economic results and efficiency, and the identification of economic efficiency with economic efficiency measures. With this view, now there are many opinions agreeing with each other. First, economic results and economic efficiency are two completely different concepts in terms of form. Economic efficiency is a comparative category that shows the relationship between costs and results. Economic results are only one side of that correlation and a factor in determining efficiency. The distinction between economic efficiency and economic efficiency measures is also crucial. Economic efficiency is a concept in economics that encompasses both qualitative and quantitative elements and represents the overall caliber of the manufacturing and business process. Quantitatively, the results attained and the expenses incurred show how economically effective each socioeconomic activity is performed. In fact, the economic efficiency increases as the gap widens and vice versa [7]. Qualitatively, that is, the high level of economic efficiency reflects the work put forth at each stage, each level in the production system, the level and capability of production and business management, and the attachment of addressing economic requirements and goals with socio-political requirements and goals [8].

Therefore, in this study, the author will seek answers to the main research questions: ‘which do livelihood models bring high economic efficiency and are suitable for farmers in the study area?’. In the next part of this article, the author will outline the importance of the agricultural sector in the world and Vietnam. This is followed by the theoretical basis and research data used for this project. After that, the research results are presented and compared by the author. Before making conclusions, the author also points out the shortcomings in the livelihood models applied locally.

2. Literature Review

2.1. The Importance of Agriculture in the World

The role that agriculture plays in a specific economy’s manufacturing sector is irreplaceable over its entire existence [9]. Many countries see agriculture as the backbone of the economic system [10]. In other words, most countries have economies that are either small or large, dependent on agriculture. In addition to providing raw materials and creating food, agriculture also creates job opportunities for most of the population. Over 60% of the world’s population, as reported by FAO in 2009 [11], relied on agriculture for survival. It is also predicted that in order to feed the world’s 9.1 billion people by 2050, food production must increase by 70% between 2005 and 2050 [11]. Therefore, if the current population is about 7 billion people, 12% of the total land area, equivalent to 1.5 billion ha, will be used for agricultural production. In sustainable development and poverty reduction, agriculture also plays an essential role. Agricultural growth is seen as a powerful means of achieving overall growth [12]. Compared to increasing the incomes of the poor in other sectors, agriculture is two to four times more efficient [13]. Despite the dependence and inconvertibility of agriculture in the world economy, this region accounts for just 2.9% of global GDP growth. With growth rates of 14% in Africa, 5.9% in Latin America, 5% in Asia, 10% in China, 1.6% in Europe, 1.2% in America, and 3.3% in Oceania, the contrast between the continents is more noticeable [14].

In Europe, although this continent is characterised by high industrialisation and urbanisation, agriculture remains an important industry. Unlike other sectors, agriculture is the only sector that receives support at the European level [15]. About half of the population of the European Union lives in rural areas [16]. Without agriculture, it would not be easy to maintain the viability of these communities and to bring them together. In addition, if agriculture disappears, there will be land abandonment in many areas [17]. In 2010, the EU-27 had nearly 12 million farms with 170 million hectares of Utilized Agricultural Area. In other words, the area of these Utilized Agricultural Areas accounts for 40% of the whole EU territory and provides livelihoods for 25 million people [18]. However, after six years, with 28 member countries, the number of farms has decreased to about 11 million farms and 22 million people regularly working in the agricultural sector [15]. This decline leads to an estimated 11% agricultural land in the EU (equivalent to 20 million ha) at risk of fallow in the period of 2015 and 2030 [19].

In Africa, agriculture employs 50% of the workforce, 47% of which are female. It is also the primary income source for 64% of the rural population in this continent [20].

This situation shows the great benefits of agricultural growth to a large portion of the workforce in Africa. Contrary to popular belief, the farm production value on this continent has also increased by 160% and is almost the same in South America [21]. However, agricultural growth came amid a boom in demographics, which meant that the continent had more mouths to eat. It leads to a disadvantage that grain production cannot keep pace with population growth because it only reaches the 1.8 coefficient [22]. This situation has led to a corollary that, from a self-sufficient food region, Africa has had to import food for about $25 billion a year [20;22]. Furthermore, weak performance in agriculture undermines the process of poverty reduction. Despite the rapid economic expansion over the perious 20 years, the proportion of African living on less than 1.25 USD per day has decreased from 56% to 48 % (1990 – 2010), representing a minor improvement in poverty [23].

In the economic and social growth of Asia, agriculture has long played a significant role. In the process of economic growth, the comparative advantage of Asian countries shifted to non-agricultural sectors. The main reason is due to the small farm sizes in these countries [24]. Thus, since the early 1990s, in East Asian countries, the agriculture share in GDP decreased from 23.1% to 9.3%, which means that the percentage of employment in agriculture decreased by 25.4% after 25 years (1991 – 2016) [25]. Meanwhile, the share of agriculture in the GDP of Southeast and South Asian countries decreased 3% from 22% to 19% between 2003 and 2016 [26]. However, agriculture still provides 45% of the workforce in this area [27].

2.2. The Importance of Agriculture in Vietnam

With a long history of diversified agricultural development, Vietnam's agriculture, from simply producing to supplying food for domestic consumption to the world, has played an essential role in the economy. Tropical climate, abundant water resources, fertile soil, and rich biodiversity are critical conditions to help Vietnam's agricultural sector develop commercially to meet domestic and international needs [28]. As a country located in the intrinsic belt, Vietnam has favorable conditions to develop agricultural products with lowland, mountainous, highland, and coastal ecological sub-regions. Thanks to this advantage, Vietnam's agricultural sector consistently experiences an annual growth of 3.5% on average. Since 1989, after a protracted era of food scarcity, Vietnam has steadily risen to prominence as a major exporter of agricultural goods. Economically, Vietnam is the second-largest exporter of agricultural goods in Southeast Asia and comes from a nation that faces starvation [29]. The total agricultural sector's average annual GDP growth rate in Vietnam from 2008 to 2017 was 2.66%. In 2018, it was 3.76%, and in 2019, despite numerous challenges, Vietnam's agriculture continued to develop at a rate of 2.2%. Agricultural exports soared from $4.2 billion to $41.3 billion after 15 years (2004–2019) [30]. Socially, the farm sector helps ensure national food security for over 95 million people. Vietnam has one of the highest per capita food availability rates among middle-income nations [29].

Furthermore, although the proportion of labour involved in agricultural production has decreased significantly compared to before, agriculture has always been the largest employer in Vietnam. This number was 65% in 2000, but it has dropped to 27.8% in 2022 [31]. Similarly, the number of households whose income is dependent on agriculture has also decreased compared to the past. Still, it remains at a high level (68% in 2006 and 50% in 2016) [32]. The World Bank also forecasts that, by 2040, employment in agricultural households will still account for over 50% of total jobs in Vietnam [32]. This figure shows that agriculture contributes significantly to job creation and income for people, especially in rural areas where over 70% of the Vietnamese population lives.

Therefore, it can be said that the agricultural sector has contributed to socio-political stability as a foundation for industrialisation and modernisation in Vietnam after 1986. The farm sector develops comprehensively and continues to assert its role as a pillar of the economy by ensuring national food security in all situations, creating stable livelihoods, jobs, and income for rural people. During the Covid-19 pandemic, the agricultural sector continued to function as protection for the entire economy by distributing food to the poor and the unemployed [33]. It is also the foundation for the State to stabilise consumer prices, provide alternative jobs and generate export revenue [34].

3. Methodology

3.1. Theoretical Basis

When it comes to efficiency, it is necessary to distinguish three basic concepts: technical efficiency, allocative efficiency, and economic efficiency. Technical efficiency is the number of products that can be achieved per unit of input cost or resource used in production under specific technical or technological conditions applied to agricultural production [35]. Technical efficiency reflects qualifications, expertise, and quality in using inputs for production [36;37]. Technical efficiency is related to the physical aspect of production, and it indicates how many units of the product a resource is spent in production [38]. Allocative efficiency is an efficiency indicator in which the product price and input price factors are calculated to reflect the additional product value per other input or resource cost [36]. Allocative efficiency demonstrates the ability to incorporate inputs reasonably to minimise costs with a specific output to achieve maximum profitability [39]. Meanwhile, economic efficiency is only achieved when the technical efficiency and resource use efficiency

(allocative efficiency) are maximised [40]. That means that both value and in-kind are taken into account when considering used resources in agriculture. Economic efficiency is central to all types of effects and is decisive for other types of efficiency [41]. Economic efficiency is the kind of efficiency that can be energised, calculated relatively accurately, and expressed by a criteria system.

Economic efficiency is the primary factor used to assess the caliber of a given economic activity in the framework of Vietnam's market economy. The market acceptance of a product is determined not only by its features and level of quality, but also by the price at which it is offered for sale. As a result, when efficiency is assessed, both the costs and the findings are dependent on the market price at the time of determination. The elements influencing efficiency in agricultural production also have unique traits relating to biological efficiency and land use efficiency (new varieties, production technology). To reach the objective of getting the most outcomes per unit area for the least amount of money, the two aforementioned factors work together and compliment one another. That is how effectively agricultural land is used.

In order to show the economic efficiency of agricultural livelihood models in this study, the article applies some economic efficiency formulas of Lan and Tai (2007) [42], which are being widely used in Vietnam. These formulas are built based on Marx's theory of surplus-value. The reason is that Vietnam has a socialist-oriented market economy. Therefore, Marx's surplus-value theory is the foundation for building the economic and political theory about land in Vietnam [43]. As mentioned above, economic efficiency is understood as the comparative relationship between the amount of results achieved and the amount of costs spent in production and business activities. The cost is the value of the input resources, whereas the value of the outcome is the value of the output product. In addition to examining the strong correlation between those two values, correlation must also be taken into account in terms of absolute and relative comparisons. The economic category of land usage can be summarized as follows: "With a specific area of land, it will create the largest amount of material wealth with the lowest amount of material and labor expenditures." From there, it satisfies society's growing material needs. On the other hand, this indicator system can evaluate land-use efficiency in farmer households and small-scale farms. That is where the level of accounting is low, and the labour costs cannot be fully accounted for, especially the self-employed labour of farmer households. In conditions of surplus labour, farmers often "take the credit for profit". Analytical indicators are assessed quantitatively in money according to time and current prices. The higher the value of the indicators is, the greater the economic efficiency will be.

Gross Output Golha (GO) is the total value of the product produced in a given period (usually one year) per hectare of land.

$$GO = \sum_{i=0}^{i=n} Q_i P_i =$$

$$= \text{Product output x product selling price} \quad (1)$$

Where: P_i is the unit price/product, and Q_i is the i product volume.

Intermediary Cost (IC) includes all regular physical costs in cash that the entity pays to rent and purchase inputs (less depreciation of fixed assets) and services used in the production process.

$$IC = \text{material costs} + \text{service costs} \quad (2)$$

Value-added (VA) is the added value of the production process after eliminating the costs of material and services. In the market, economy producers are very concerned with VA, especially in short-term decisions. It results from investing in the material costs and living labour of each household and the manageability of the head.

$$(VA) = GO - IC \quad (3)$$

Mixed-income (MI) is the net income, including the family's labour involved in production.

$$MI = VA - A \text{ (Depreciation)} - \text{Tax} \quad (4)$$

Production value per unit of intermediate cost (*GO/IC*) shows how many units of production value are obtained for every unit of intermediate cost.

The value-added per unit of intermediate cost (*VA/IC*) shows how many value-added units are obtained for every unit of intermediate cost.

Mixed-income calculated for one unit of intermediate cost (*MI/IC*) shows how many units of mixed-income for every unit of intermediate cost spent.

Meanwhile, to determine how much production value and added value a labour day produces, they are determined by the formula *GO/L* and *VA/L* (L means labor).

Table 1. Households participating in the survey

Model	Number of households				Total
	Son Tien commune	Tri Khe commune	Song Hai commune	Song Tien commune	
Specialising Fish	6	5	3	11	25
Rice – Fish	12	13	6	6	37
Rice – Fish – Duck	6	5	3	4	18
Total	**24**	**23**	**12**	**21**	**80**

3.2. Research Data

This writing used primary data collected from a survey of 80 households engaged in agricultural production in Ha Tinh province. Families participating in the survey were selected through a combination of two methods, including stratification and random sampling. The stratification method was first applied to filter out agricultural production households with three non-traditional livelihood models, namely 'specialising fish', 'rice–fish', and 'rice–fish–duck'. The stratification method was also applied through the household's geographical location for convenience in the survey process. After classifying the groups of respondents, the author used random sampling by interviewing farmers directly. Respondents are the head of the household or main production participants because only these people can provide complete and accurate information on their production and business activities. Details of the number of surveyed households are listed in Table 1.

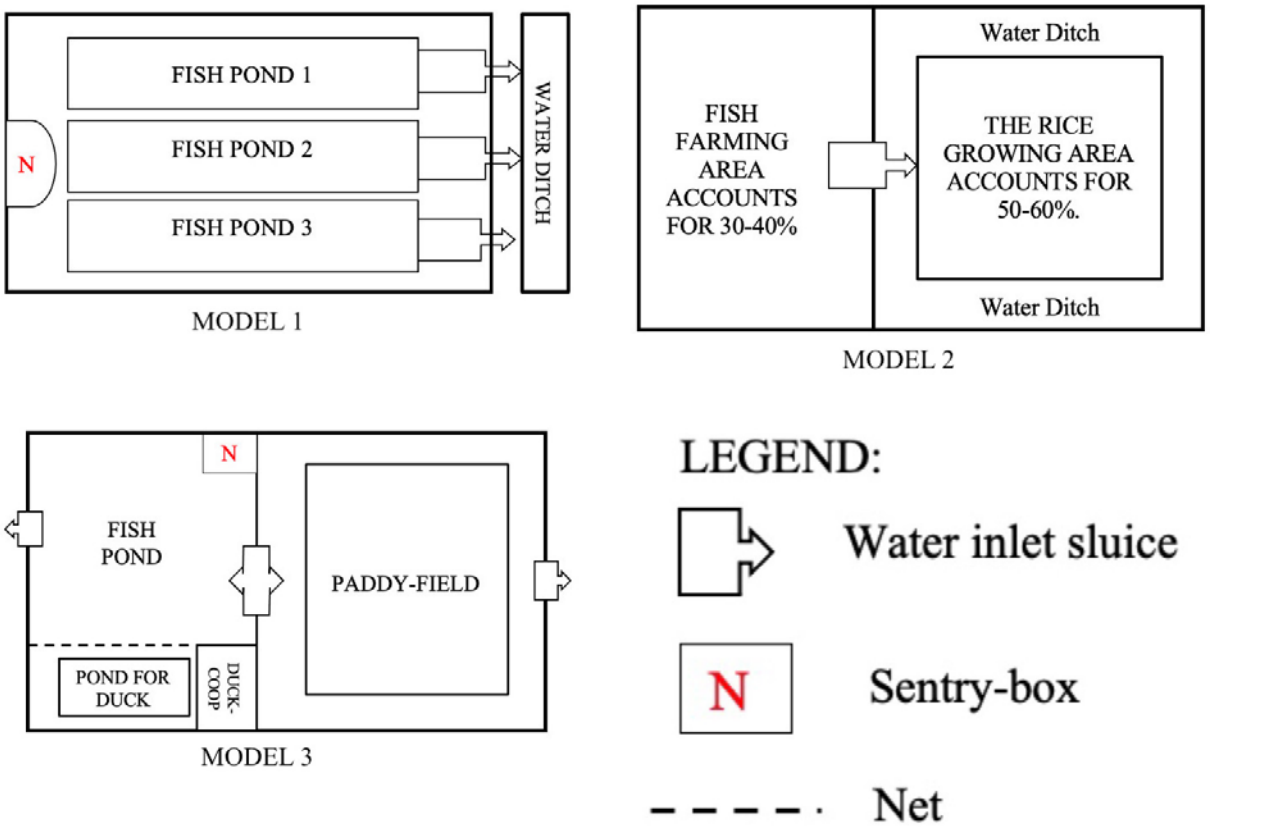
Among the producing households surveyed models, on average, each household has five members. In comparison to the total population, the proportion of persons of working age is large (80%), and each home contains two to three men. The average age of householders is 45.5 years, and there are 25 female householders, accounting for 31.3%. Most households have settled in their current residence for more than 30 years (57.5%). As a result, they have experience in local agricultural production. 58.8% of the household heads have a high school education, which is enough to ensure selective information reception and an excellent ability to absorb knowledge if they are instructed to disseminate farming and animal husbandry techniques.

3.3. Diagram of Livelihood Models

In this study, the author studies three prominent local livelihood models. These are the specialised fish model, the Rice–Fish model, and the Rice–Fish–Duck model. Specialised Fish model is a traditional model and famous in the district before converting low-lying fields to building a model of poly-cropping production. Therefore, farmers have accumulated much experience in aquaculture. With the specialised fish model, the entire model area is dug into ponds to raise fish, and the initial construction cost of each household for the model is about 20 million VND (867.1 USD). Each model usually has two to three ponds, and these ponds stock the same types of fish. The pond has a depth of 1.2 – 1.5 m and a width of about 1,000 – 2,000 square meters. This arrangement of many ponds is to avoid spreading in case of disease. It makes monitoring and caring for each fish pond, as well as harvesting, easier.

The Rice–Fish model is quite popular in low-lying land areas. Since the Vietnamese Ministry of Agriculture and Rural Development had a policy of changing rice cultivation to annual crops and aquaculture, several low-lying areas have been converted to combined production models. This model is divided into two parts. One part is used as an entire pond, and the other part is used for rice cultivation. There are water ditches in the surrounding rice-growing area with a depth of 0.8 – 1 m and a width of 1.2 m. The trenches in model 2 are designed about 10% – 20% of the area. Thanks to that, the fish can move back and forth between the pond and the rice field. Especially in the spraying phase for rice or preparing the soil for the next crop, if the farmers have not harvested fish yet, this is a place for fish to shelter and avoid the sun. Pond depth is from 1.2 to 1.5 m. The average initial cost of earthwork per household is nearly 12 million VND (520.3 USD).

The Rice–Fish–Duck model is a model that is evaluated to have many advantages compared to other livelihood models because it ensures ecological balance. The three objects of the model support each other and grow together. Specifically, rice takes nutrients in the soil, and in water, photosynthesis in sunlight produces grain for human consumption. It is also part of the food for fish and ducks. Besides, the rice field is the habitat of fish and ducks. Fish get food from rice products. They clean the environment, catch insects, and limit rice pests and diseases. It aids in weed control and sludges the rice to make the atmosphere rich in oxygen to help the roots develop. Ducks grazing in ponds and fields have the effect of catching insects and reducing pests and diseases. Ducks' excrement is food and nutrients for fish and rice, thus helping to save costs in rice cultivation and fish farming (these data were collected from interviews with local officials and obtained information from producers).



Note: Model 1 is the specialised fish model. Model 2 is the Rice–Fish model. Model 3 is the Rice– Fish–Duck model.

Figure 1. Livelihood models in the case study

The rice–fish–duck model has firm banks. The field is surrounded by a ditch that is 1.2m wide and 1 to 1.2m deep. Meanwhile, the pond area is 1.2 – 1.5m deep and partially separated by the net to release ducks. The scope of the fish pond and duck stocking is about 40%. This is a place to release ducks and an environment for fish to live, keep fish, avoid the sun for fish, and it is convenient when harvesting fish. The duck barn is built on the pond bank with about 100 m^2 to keep ducks at night and in bad weather. The average initial construction excavation cost of the model per household is nearly 18 million VND (780.4 USD), which is higher than that of the rice–fish model. About 60% of the remaining area is used to transplant rice and dig surrounding ditches.

4. Results of Research

4.1. Production Results of Livelihood Models

Through calculation, it shows that the specialised fish model has a pretty high yield. The revenue of this model reached over 14,000 USD, minus the cost of about 7,000 USD. Each producing household got a profit of about 7,000 USD (Table 2). This is a considerable revenue compared to other production models in the area. Among the types of fish, the payment from grass carp has a harvest value of nearly 6,500 USD, accounting for 45.6% of the whole model's revenue. Mud-carp also brings no less profit when accounting for 44.7% of total revenue (Table 3). Although grass carp is a high-value fish, it is also susceptible to ulcers and food poisoning. Therefore, it requires a clean water environment, and the farmer must have good disease prevention and treatment to be effective. Carp has a high selling price, but the average revenue is nearly 530 USD. This number is relatively low and only accounts for 3.8% of total revenue. This fish is stocked sparingly because it is not suitable for low-lying soils. Meanwhile, chub are less stocked because the resistance of this fish is less than some other fish, so the chance of disease will be higher.

Table 2. Production cost (calculated for 5,000 m^2 and production for one year)

No	Categories	Specialised Fish Model (USD)	Rice – Fish Model (USD)		Rice – Fish – Duck Model (USD)		
			Rice	Fish	Rice	Fish	Duck
1	Variety	3,845.6	34.7	737.3	34.7	925.7	130.1
2	Digging the pond	867.6	-	520.5	-	420.3	-
3	Refined food	1,822.0	-	303.6	-	130.1	43.4
4	Green food	216.9	-	43.4	-	43.4	21.7
5	Preventive medicine	43.4	-	21.7	-	21.7	53.6
6	Depreciation	108.5	43.4	34.7	43.4	43.4	66.8
7	Fertiliser costs	-	86.8	-	65.0	-	-
8	Pesticides	-	26.0	-	21.7	-	-
9	Land preparation costs	-	52.0	-	52.0	-	-
10	Protein food	-	-	-	-	-	86.8
	Total	**6,904.0**	**242.9**	**1,661.2**	**216.8**	**1,584.6**	**402.4**
			1,904.1		**2,203.8**		

Source: Households survey, 2020

Therefore, the specialised fish model has a considerable monetary investment in material costs. This model is suitable for households with a good economy. The farming method of the model is synthetic farming of traditional fish in the form of semi-intensive agriculture. The stocking structure of the mud carp and grass carp models accounts for a large proportion. The cost of seed and refined food accounts for a large balance of the model's total cost. This model is very suitable for low-lying land in the study area because most local people have long experience in fish farming. From there, they can share their experiences with just starting households. Moreover, in the planning of new rural construction and converting crops and animals on inefficient arable land, the locality has plans to support loans and open training classes to improve people's qualifications. Therefore, this model will be a positive direction for the local economic development in general and farmers.

Meanwhile, the total revenue of the rice – fish model is nearly 1,900 USD, in which the source of income from fish is mainly with over 80%. The yield of fish is 1,970 kg and is about 0.3 times that of the specialised fish model. While the rice yield is 2,182 kg, the average product is 218.2 kg/Sao[1]. Thus, the low-lying fields previously transplanted rice due to flooding, so the output only reached 136 -170 kg/Sao. However, thanks to the plot bank of the model, it can actively regulate water, so the locality is cultivating the same rice varieties, but the rice yield is already higher. In the total revenue of the model, the income is mainly from mud carp. Sales of this fish reached over 2,000 USD, accounting for 55.6%. Compared to it, sales from carp were only 19.4% and ultimately chub with only 7.7% of the total model.

1 Sao is the unit to calculate the area of land in Vietnam. In the study area, a Sao is equal to 500 m^2.

Table 3. The revenue of livelihood models

No	Categories			Output (kg)	Price (USD/kg)	Revenue	
						Money (USD)	Ratio (%)
1	Specialised Fish Model		Grass Carp	2,458	2.6	6,390.8	45.6
			Mud Carp	3,620	1.73	6,262.6	44.7
			Chub	925	0.9	832.5	5.9
			Carp	305	1.73	527.65	3.8
			Total	7,308	-	14,013.55	100
2	Rice – Fish Model	Rice		2,182	0.3	654.6	17.3
		Fish	Mud Carp	1,218	1.73	2,107.14	55.6
			Chub	325	0.9	292.5	7.7
			Carp	427	1.73	738.71	19.4
		Total		4,152	-	3,792.95	100
3	Rice – Fish – Duck Model	Rice		2,092	0.3	627.6	11.3
		Fish	Mud Carp	744.8	1.73	1,288.5	23.2
			Chub	224.8	0.9	202.32	3.6
			Carp	279.9	1.73	448.2	8.1
		Duck		1,358	2.2	2,987.6	53.8
		Total		4,699.5	-	5,554.22	100

Source: Households survey, 2020

Therefore, it can be said that the Rice – Fish model has lower revenue than the specialised fish model. However, compared with the existing livelihood models on the low-lying lands, it still gives a much higher and stable income. This livelihood model is suitable for households with medium or low-income families who can borrow capital to build the model. This is a livelihood model with many advantages. For example, the cost is not too high and does not require too excellent farming experience. This model also makes use of the idle local labour force. It also helps to protect the environment while reducing the use of pesticides and chemical fertilisers.

Finally, there is a rice–fish–duck model. The total revenue of this livelihood model is nearly 5,600 USD, minus the total cost of about 2,200 USD, and each household producing under this livelihood model will benefit nearly 3,400 USD. The rice–fish–duck model has a higher turnover than the rice–fish model and lower than the specialised fish model. The initial investment cost of this livelihood model is also proportional to the return it brings. This means that it is higher than the rice–fish livelihood model and lower than the specialised fish livelihood model. This model is suitable for households with average income and above.

4.2. Economic Efficiency of Livelihood Models

For the specialised fish model, the investment efficiency indicators of this model are pretty high. For 1 unit of intermediate cost, 2.06 units of production value are obtained, but only 1.05 units of mixed-income and 1.06 units of value-added are obtained. Table 4 also shows that, on average, a labour day creates nearly 450 units of production value and about 231 units of value-added in the specialised fish model. In this livelihood model, the employee can make almost 230 units of mixed-income value. This number is a high level of income in rural areas compared to working as a hired labourer locally or far away. It is not only meaningful in terms of economic terms for households, but it is also significant in stabilising people's lives. It reduces the migration pressure and increases the population in urban areas, thereby helping to minimise housing anxiety in cities.

Table 4. Efficiency indicators of 3 livelihood models

No	Categories	Unit	Specialised fish model	Rice–Fish model	Rice–Fish–Duck model
1	Gross Output (GO)	USD	**14,013.55**	**3,792.95**	**5,554.22**
2	Intermediary Costs (IC)	USD	6,795.5	1,826.0	2,050.2
3	Labour (L)	USD/day	31.2	17.3	22.5
4	Depreciation (A)	USD	108.5	78.1	153.6
5	Value-Added (VA)	USD	7,218.05	1,966.95	3,504.02
6	Mixed-Income (MI)	USD	7,109.55	1,888.85	3,350.42
	Efficiency indicators				
7	GO/IC	times	2.06	2.08	2.7
8	MI/IC	times	1.05	1.03	1.63
9	VA/IC	times	1.06	1.08	1.71
10	GO/L	times	449.2	219.2	246.8
11	MI/L	times	227.9	109.2	148.9
12	VA/L	times	231.3	113.7	155.7

Source: Calculated from data collected from the survey

Compared with it, with the indicators of the capital efficiency of the rice–fish model, the ratio of production value per intermediate cost is higher than that of the specialised fish model. One unit of intermediate cost is spent, resulting in 2.08 units of production value. However, the two indicators of mixed-income and value-added per intermediate cost are lower when one unit of cost only results in 1.03 units of mixed-income and 1.08 units of value-added. Meanwhile, a labour day creates nearly 220 units of production value and about 115 units of value-added. Therefore, with this rice–fish model, every day, employees only generate almost 110 units of mixed-income. Compared with people's living standards in the area, this income level is acceptable, but it is not enough for households to have a breakthrough and rise to get rich. As for the rice–fish–duck model, the efficiency indicators on intermediate costs are higher than the other two models. Nevertheless, one working day of this model creates about 250 units of production value and over 155 units of value-added. With this model, each day, employees generate nearly 150 units of income. Although not as high as the specialised fish model, the costs and care spent on the rice–fish–duck model are lower than the specialised fish model. Therefore, the income generated from this model is still considered to be highly effective and brings good pay for people in the study area.

Table 4 and the above analysis show that the specialised fish model gives the most superior production value and requires the highest initial investment costs, followed by the rice–fish–duck model and the rice–fish model. However, considering the production efficiency indicators, the rice–fish–duck model has the highest efficiency per cost, then the specialised fish model and the rice–fish model.

5. Discussion

The land is a unique and irreplaceable means of production in agriculture [44]. Land size affects the production value as well as significantly affects the economic efficiency of the livelihood model [45]. Through the investigation process, the author found that the average cost per 5,000 m^2 of households decreased gradually with the size of the land. In contrast, the value of production is directly proportional to the size of the land. When the land size becomes more prominent, it is easier for people to focus on production, investing costs, and applying for scientific and technical advances. Thanks to that, the product value is raised, and the investment costs are reduced by reducing harvesting and care. However, through the process of survey and investigation, the author finds that at present, the land size of households in the livelihood models is still fragmented and small. In other words, the livelihood model is the same but the production area of the households is different. When the site is small and fragmented, the cost will significantly increase, reducing efficiency and profitability. '*Locally, the agricultural sector is facing difficulties in sharing land funds for infrastructure development, industrial development, services, and urban areas.*' (Local authority, female, 42).

Moreover, the infrastructure and technical system for production and transportation have not been completed, especially the irrigation system. This problem is one of the difficulties faced by farmers in the study area. Most of the farmers have to be self-sufficient in pumping water. Households with reasonable expenses can buy or share money to buy large-capacity water pumps, while other families will have to rent pumps at a high cost. Meanwhile,

the price of motor oil for pumping water is increasing. This cost is enormous in the total cost of the model and makes the production cost of the farm households significantly increase. Besides, farming households in the surveyed livelihood models mainly produce and farm based on their own experiences. Therefore, more efficient farming practices have not been applied. Although the locality has also opened training courses, it has not received much attention from production households. '*Although local authorities have had many propaganda campaigns and mobilise farmers to participate in classes to improve and update new farming techniques, the ability of households to absorb is still limited. Therefore, households often rely on their own production experiences.*' (Local authority, female, 42). From this limitation, livelihood models cannot make the most natural and artificial conditions to maximise production efficiency and profit.

One of the other limitations of the production households in the three above models is on seeds and consumption markets. Varieties determine the maximum productivity potential of plants and animals and their resilience to environmental circumstances. Therefore, it requires households to choose varieties suitable for the requirements of each region and each production model. However, most of the livelihood models of farmers mainly use local and traditional varieties. Origin mostly comes from sources that do not guarantee prestige and quality. The number of households using seeds with clear head and quality is very few. Meanwhile, the consumption market of farm households is also facing many difficulties. According to the survey results, 30% of products from livelihood models are consumed in the commune and surrounding areas. 70% of products are purchased from traders in the province. However, because the origin of the seed is not clear, traders have a reason to force prices up often and affect farmers' income.

6. Conclusions

Through assessment of economic efficiency of livelihood models on low-lying land in Ha Tinh province, the study has found some conclusions. The district's low-lying livelihood models bring about high results and affirm the beliefs in the authorities and people at all levels. However, polyculture production models (rice–fish, rice–fish–duck, specialised fish) in the commune are still modest. In fact, with the existing local models, the specialised fish model has the highest production value. This shows that a high level of investment results in increased production value. The research results show that the rice–fish model is the lowest in terms of capital efficiency and the highest in the rice–fish–duck model. From the perspective of mixed-income and added value per day the employee generates, the specialised fish model is the highest, followed by the rice–fish–duck model and the rice–fish model. This situation illustrates that any model that requires high investment capital, labour, and care will give equal productivity and efficiency.

Therefore, households with low-lying fields who want to develop aquaculture models should pay attention. For families with sufficient financial strength (abundant capital) and extensive experience, farmers should expand the model towards integrated model development to increase income per unit area. This focuses on rice–fish–duck and specialising fish models but is combined with duck raising to create a food source for fish. For medium and low-income households with limited capital, they should first develop according to the rice–fish model to get out of poverty.

Although the study provided an answer to the research issue, it still has several shortcomings that will need to be fixed in the future. First of all, there are only a few samples that were taken. The financing and time constraints for the study's execution and the survey's execution itself are the root of the issue. The second drawback is that this formula model is virtually exclusively used in Vietnam; it is not yet well-known globally. This makes comparing the findings of fieldwork conducted in Vietnam and the rest of the world challenging. Finally, because the survey was carried out before the Covid-19 epidemic ravaged Vietnam and the rest of the world, it was unable to evaluate how the pandemic had affected the livelihoods of the households in the research area. The author will fix these issues in his further research.

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Conflict of Interest

The author declares that they have no conflict of interest.

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