International Journal of Advanced Engineering and Management Research

Vol. 9, No. 06; 2024

ISSN: 2456-3676

Nature-based Livelihood Solutions for Adapting to Climate Change: The Case of an Giang Province, Vietnam

Trinh Phuoc Nguyen[1], Pham Xuan Phu[*2]

*Corresponding author: Phone:0827.004.103

[1]Institute of Climate Change, An Giang University- Vietnam National University HoChiMinh City, An Giang, Vietnam.

[2*]Faculty of Agriculture and Natural Resources, An Giang University- Vietnam National University HoChiMinh City, An Giang, Vietnam.

doi.org/10.51505/ijaemr.2024.9606 URL: http://dx.doi.org/10.51505/ijaemr.2024.9606

Received: Nov 07, 2024 Accepted: Nov 13, 2024 Online Published: Nov 23, 2024

Abstract

Climate change severely impacts lowland areas and agricultural communities dependent on natural resources in Vietnam, mainly An Giang province in the Mekong Delta region. Nature-based solutions (NBS) are being implemented as an effective and sustainable approach to address the challenges of climate change. This study focuses on evaluating NBS livelihood models currently being applied in An Giang, including the "two rice crops and lotus" model, the "rice-fish" model, and the "Natural fish with sesbania" model. The results show that the "two rice crops and lotus" model increases farmers' profits by up to 25% compared to traditional rice farming due to reduced fertilizer costs and increased economic value from lotus. The "rice-fish" model also brings significant benefits, with a 40% increase in income through the combination of fish farming and rice cultivation during the flood season, helping to improve water quality and mitigate the impacts of climate change. The "Natural fish with sesbania" model also demonstrates great potential in enhancing resilience and diversifying farmers' income sources during the flood season. Based on these findings, the study highlights several challenges, including financial, technical, and community awareness issues. However, nature-based livelihood models hold great potential for expansion and sustainable development, contributing to climate change adaptation strategies in An Giang province and the Mekong Delta region. The study proposes specific measures to support local communities and enhance the implementation of these solutions on a larger scale.

Keywords: Climate change, nature-based livelihoods, An Giang, sustainable agriculture, climate adaptation

1. Introduction

Climate change is increasingly recognized as a critical challenge to socio-economic development, as it exacerbates the frequency and intensity of natural disasters and extreme weather events. These climate-induced events pose serious threats to livelihoods, infrastructure, and property, while also destabilizing ecosystems that many communities rely on for survival

Vol. 9, No. 06; 2024

ISSN: 2456-3676

(Nguyen Minh Quang,2013). The vulnerability of poorer regions and populations who often have limited resources to prepare for or recover from these events has become a major concern for global development (UNFCCC, 2019). In addition to the direct economic damage, climate-related disasters disrupt essential services like agriculture, water supply, and health care, thereby deepening poverty and inequality (World Bank, 2020). The degradation of natural systems, including forests, wetlands, and coral reefs, further complicates the task of building resilience, as these ecosystems provide critical resources for communities (IPCC, 2021). Urgent action is needed to address both the immediate impacts and long-term threats posed by climate change to ensure sustainable development for future generations (OECD, 2020).

Climate change has had, and continues to have, profound effects on rural communities in the Mekong Delta, particularly in An Giang province. Rising sea levels, extreme weather patterns, and changing rainfall have intensified flooding, salinization, and droughts, which threaten agricultural production, food security, and the livelihoods of local populations (Dung Duc Tran et al., 2022). These environmental shifts are especially damaging to small-scale farmers who rely on stable weather patterns for crop cultivation (Mekong River Commission, 2020). As the Mekong Delta is one of the most vulnerable regions to climate change in Southeast Asia, the socio-economic impacts in provinces like An Giang are expected to worsen unless effective adaptation strategies are implemented (World Bank, 2021). Local communities are struggling to cope with the increasing unpredictability of the environment, which has led to displacement, increased poverty, and loss of traditional livelihoods (UNDP, 2019).

Climate change has been and continues to cause serious impacts on rural communities in the Mekong Delta region, with An Giang province being the most heavily affected due to frequent issues such as saltwater intrusion, subsidence, and rising sea levels. To mitigate these impacts, many nature-based livelihood models (Nature-based Solutions - NbS) have been implemented to protect the environment and provide economic benefits to local people. This study evaluates the effectiveness of the “two rice crops and lotus” model, the “rice-fish” model, and the “natural fish with sesbania” model.

2. Research Methodology

The livelihood models were piloted in Vinh Trung commune, Tinh Bien town, An Giang province. Comparative data was collected through direct interviews with 90 households participating in similar livelihood models. The study employed primary data collection methods combined with an analysis of the economic efficiency of the NbS livelihood models. The indicators analyzed include investment costs, revenue, and profits, along with an assessment of environmental and social factors.

3. Results and Discussion

3.1. The two rice crops and lotus during flood seasonmodel

The two rice crops and lotus model was implemented to enhance the climate change adaptability of farmers in the Mekong Delta region. This model combines winter-spring and summer-autumn

Vol. 9, No. 06; 2024

ISSN: 2456-3676

rice cultivation with lotus planting during the flood season on the same land, helping to diversify farmers' income and improve farming conditions. Lotus is grown on rice fields after the summer-autumn crop, creating a sustainable crop rotation cycle that improves soil quality and reduces pests for subsequent rice crops.

3.1.1. Economic efficiency:

According to Trinh Phuoc Nguyen, 2024 showed that the winter-spring 2024 rice crop on lotus land had the lowest production cost among the three models, at only 22.986 million VND per hectare. This cost was 15.8% lower than the winter-spring 2023 rice crop model and 16.1% lower than the winter-spring 2024 rice crop model. Notably, fertilizer costs decreased by more than 52% compared to the winter-spring 2023 crop and by 46% compared to the winter-spring 2024 rice crop.

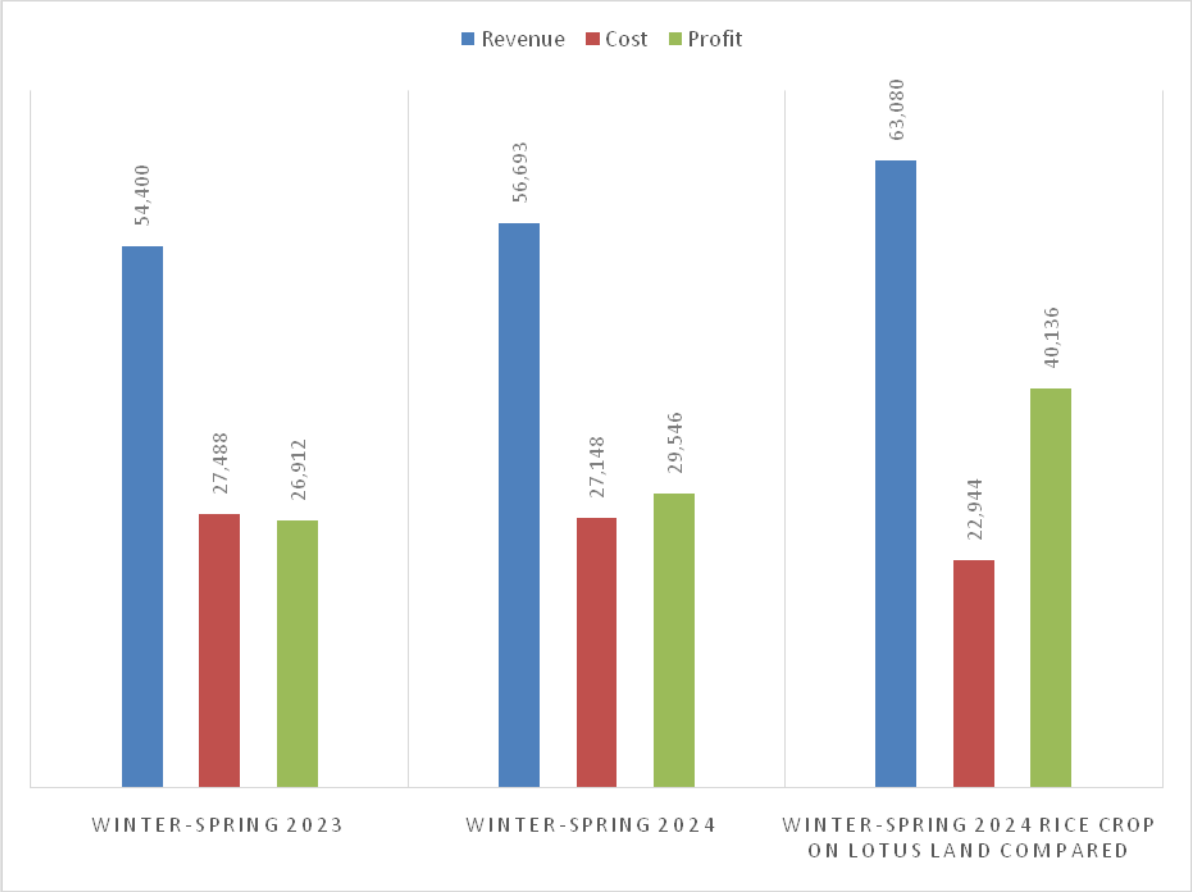

Figure 1. Comparison table of the economic efficiency of the winter-spring 2024 rice crop on lotus land compared to the winter-spring 2023 and 2024 rice crop models

(Source: Trinh Phuoc Nguyen, Model evaluation report, 2024)

Vol. 9, No. 06; 2024

ISSN: 2456-3676

The revenue from the winter-spring 2024 rice crop on lotus land: The highest profit among the three models, reaching 63,080,000 VND/ha. This profit was 16.1% higher than the winter-spring 2023 rice crop model and 11.3% higher than the conventional winter-spring 2024 rice crop model.

The profit of the winter-spring 2024 rice crop on lotus land: The highest among the three models, reaching 40,136,000 VND/ha. This profit was 49.1% higher than the winter-spring 2023 rice crop model and 36.0% higher than the winter-spring 2024 rice crop model. Looking at the table above, it is evident that the costs for the winter-spring rice crop on lotus land are significantly lower, particularly in fertilizer and seed costs. Meanwhile, the total income from the rice-lotus model is higher due to the sale of lotus and reduced production costs.

3.1.2. Environmental impact of the rice-lotus model

Besides the economic benefits, the rice-lotus model also has a positive environmental impact. This is one of the major advantages that makes the model a sustainable farming solution in the context of climate change.

Soil improvement and protection:

Lotus plants have the ability to retain water and provide organic matter to the soil, helping to maintain moisture and improve soil fertility. This not only benefits the subsequent rice crop but also helps protect the soil from degradation caused by continuous and intensive rice farming. Additionally, lotus helps prevent soil erosion in wetland areas.

Reduction in fertilizer and chemical use:

Minimizing the use of chemical fertilizers and pesticides helps protect groundwater and maintain the ecological balance in the area. Using fewer fertilizers and chemicals also means reducing greenhouse gas emissions, contributing to global efforts to mitigate the effects of climate change.

Ecosystem diversification:

The rice-lotus model creates a more diverse ecosystem in the farming area. Lotus provides favorable living conditions for many aquatic animals and beneficial insects, helping to maintain ecological balance. These organisms, in turn, contribute to natural pest control, reducing reliance on pesticides

3.1.3. Social benefits of the rice-lotus model

The rice-lotus model not only has positive economic and environmental impacts but also contributes to improving the quality of life and raising awareness among rural communities about sustainable agriculture.

Enhancing food security and livelihoods:

The combination of lotus with rice helps diversify farmers' income, reducing dependence on a single crop and helping them cope with risks from natural disasters and climate change. Farmers

Vol. 9, No. 06; 2024

ISSN: 2456-3676

can generate additional income from lotus during times when other crops may face challenges due to unfavorable weather conditions, such as drought or flooding.

Improving community health:
Reducing the use of pesticides and fertilizers in farming lowers the risk of water and air pollution, thereby improving public health. Specifically, limiting exposure to agricultural chemicals helps reduce the risk of chemical-related diseases, such as cancer, respiratory problems, and skin diseases.

Raising awareness about sustainable agriculture:
The rice-lotus model raises farmers' awareness about adopting sustainable and environmentally friendly farming practices. Through participation in training sessions and implementing the model, farmers gradually recognize the importance of environmental protection and apply ecological farming techniques.

3.1.4. Challenges and limitations of the rice-lotus model
Although the rice-lotus model offers many benefits, there are still some challenges that need to be addressed for the model to be expanded and widely adopted.

Initial investment difficulties:
To transition from monoculture rice farming to the rice-lotus model, farmers need capital to invest in irrigation systems, buy lotus seeds, and cover other initial costs. This can be a barrier for low-income farmers who do not have access to preferential loans.

Unstable market demand:
Although lotus is a product of high economic value, the market for lotus-based products is not yet stable. This can make it difficult for farmers to find buyers for their products, especially during times when lotus production increases but consumer demand does not keep pace.

3.2. The "Rice-Fish" Model
The "Rice-Fish" model is a nature-based livelihood solution where fish farming is carried out during the flood season, followed by the planting of winter-spring rice. This model is particularly suited to flood-prone areas in the Mekong Delta, such as An Giang, Dong Thap and Long An. It not only brings high economic benefits but also helps improve the environment and create a sustainable ecosystem. By combining fish farming with rice cultivation, farmers can make optimal use of floodwaters, reduce production costs, and generate additional income from fish.

3.2.1. Economic effectiveness of the rice-fish model
The "Rice-Fish" model has been proven to provide higher economic returns compared to monoculture rice farming. Farmers can not only harvest rice but also utilize the flood season to raise natural fish in rice fields, increasing their income without significant investments in fish feed or farming infrastructure.

Vol. 9, No. 06; 2024

ISSN: 2456-3676

- **Soil preparation costs:** The rice-fish winter-spring 2024 model has higher soil preparation costs than the standard winter-spring 2024 model but lower than the winter-spring 2023 model. This is because the low flood levels this year required farmers to invest more in making the soil softer and looser.
- **Seed costs:** The rice-fish winter-spring 2024 model has higher seed costs than both the standard winter-spring 2024 model and the previous year's model. The higher cost (15,500 VND/kg) is due to rising market rice prices, which have driven up seed prices as well. Additionally, households used approximately 4% more seeds compared to others since they applied fewer snail control chemicals and expected higher seed amounts to compensate for any losses.
- **Pesticide costs:** The rice-fish winter-spring 2024 model has lower pesticide costs than both the standard winter-spring 2024 model (12% lower) and the previous year's model. This is likely due to the more diverse ecosystem in the rice-fish model, which helps limit the spread of pests, even though there was a notable increase in white-backed planthoppers this year.
- **Fertilizer costs:** The rice-fish winter-spring 2024 model has the lowest fertilizer costs among the three models, using only 50% of the fertilizer compared to similar models. This is likely because the rice-fish model benefits from the nutrients provided by the fish for the rice crops.
- **Harvest costs:** The harvest costs for all three models were the same.
- **Labor costs:** The rice-fish winter-spring 2024 model had the lowest labor costs among the three models. This may be because the rice-fish model requires less labor for care compared to the monoculture rice models

Vol. 9, No. 06; 2024

ISSN: 2456-3676

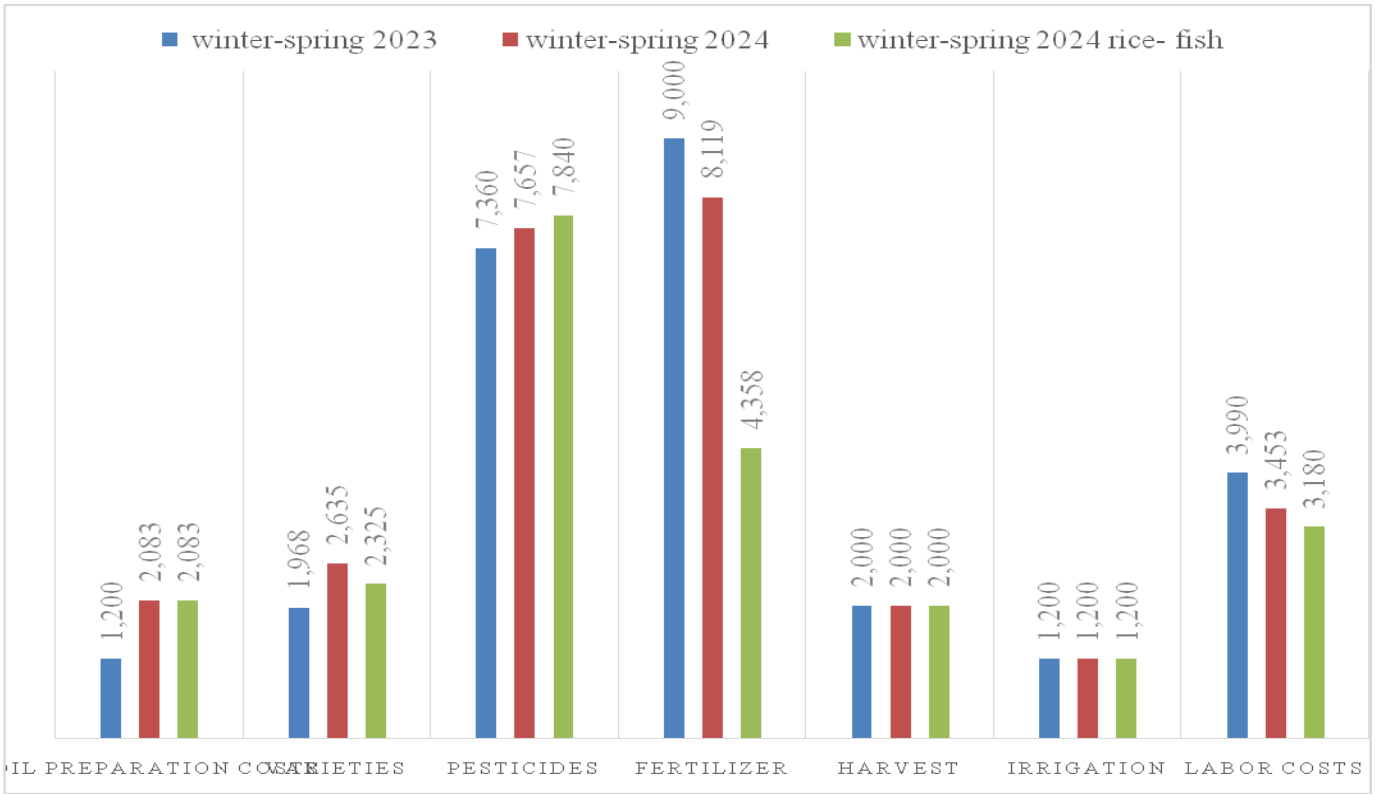

Figure 2. Comparison of the cost structure of the rice-fish model versus winter-spring rice models over the years
(Source: Chau Thi Da, Model evaluation report, 2024)

Utilizing floodwaters and reducing feed costs for fish:
In this model, the fish are primarily wild fish raised in rice fields during the flood season. The floodwaters bring plankton and other natural food sources for the fish, reducing the need for artificial feed. This not only saves costs but also minimizes the negative environmental impacts associated with the use of artificial feed.

Vol. 9, No. 06; 2024

ISSN: 2456-3676

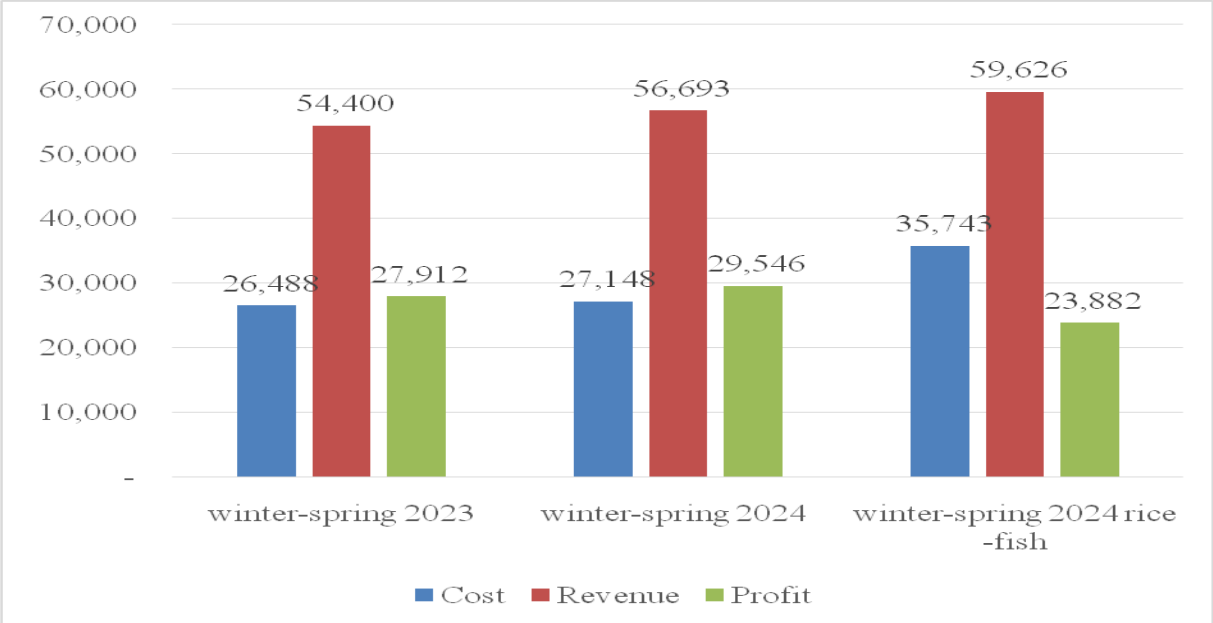

Figure 3. Comparison Table of the Effectiveness of the Rice-Fish Model in Winter-Spring 2024 vs. Winter-Spring Rice Models of Previous Years
(Source: Chau Thi Da, Model evaluation report, 2024)

The comparison chart between the Winter-Spring rice production models of 2023, 2024, and the Rice-Fish model of Winter-Spring 2024 shows significant differences in costs, revenue, and profits. The production cost for the Winter-Spring rice crop in 2023 was 26,488 thousand VND/ha, slightly lower than that of Winter-Spring 2024 at 27,148 thousand VND/ha. The Rice-Fish model for Winter-Spring 2024 had the highest cost at 35,743 thousand VND/ha due to additional expenses from fish farming. In terms of revenue, the Winter-Spring 2023 crop reached 54,400 thousand VND/ha, lower than the 56,699 thousand VND/ha of the Winter-Spring 2024 crop. Notably, the Rice-Fish model in Winter-Spring 2024 had the highest revenue of 59,626 thousand VND/ha, indicating that the combination of fish farming generated additional income. However, despite higher revenue, the profit of the Rice-Fish model was only 23,882 thousand VND/ha, lower than the profits of the rice-only models (27,912 thousand VND/ha for Winter-Spring 2023 and 29,546 thousand VND/ha for Winter-Spring 2024), mainly due to higher production costs. This indicates that while the Rice-Fish model has economic potential, cost control needs to be improved to optimize profits.

Stable income from fish:
In this model, the fish can be harvested at the end of the flood season. This provides farmers with a stable source of income, supplementing their earnings from rice. The main species farmed include perch, carp, and snakehead, which are economically valuable and commonly consumed in the region.

Vol. 9, No. 06; 2024

ISSN: 2456-3676

3.2.2. Environmental Impact of the Rice-Fish Model

The Rice-Fish model not only brings economic benefits but also has positive environmental impacts. Raising fish in rice fields improves soil and water quality while reducing the need for chemical fertilizers and pesticides, contributing to environmental protection and maintaining ecological balance.

Improved soil and water quality:

Fish raised in rice fields help clean the water by feeding on plankton and harmful algae, improving water quality. Cleaner water supports better rice growth and reduces diseases caused by bacteria and mold. Additionally, fish waste and organic matter provide natural nutrients to the soil, enriching it for future rice crops.

Reduced use of fertilizers and pesticides:

Fish in this model act as a natural pest control tool. They feed on harmful insects and pests, reducing the need for pesticides. This not only saves costs but also helps protect the environment by reducing water and soil pollution from agricultural chemicals.

Natural pest control:

One of the significant benefits of the Rice-Fish model is its ability to control pests naturally. Fish consume larvae and harmful insects, decreasing the need for pesticides. This not only lowers production costs but also helps protect the environment, preserving biodiversity in the rice fields.

Reduced greenhouse gas emissions:

By reducing the use of chemical fertilizers and pesticides, the Rice-Fish model helps lower greenhouse gas emissions, a major cause of climate change. By utilizing natural resources, this model contributes to global efforts to mitigate the environmental impacts of agriculture.

3.2.3. Social Benefits of the Rice-Fish Model

The Rice-Fish model not only brings economic and environmental benefits but also has positive social impacts, particularly on rural communities. This model helps improve farmers' livelihoods, raise awareness of sustainable agriculture, and create economic stability for households.

Improved livelihoods and food security:

The Rice-Fish model allows farmers to diversify their income sources and reduce reliance on a single crop. With additional income from fish, farmers can improve their living conditions and invest in other production activities. Additionally, raising fish in rice fields provides families with a rich source of protein, improving food security and nutrition for the community.

Raising awareness of sustainable agriculture:

Through participating in the Rice-Fish model, farmers are exposed to sustainable and environmentally-friendly farming methods. They become more aware of the importance of

Vol. 9, No. 06; 2024

ISSN: 2456-3676

environmental protection, efficient resource use, and implementing measures to mitigate climate change. This leads to a positive shift in agricultural production thinking in rural areas.

3.2.4. Challenges and Limitations of the Rice-Fish Model

While the Rice-Fish model offers many benefits, several challenges must be overcome for it to be scaled up and widely adopted.

Initial investment difficulties:

The Rice-Fish model requires farmers to make an initial investment to build fish farming systems, including setting up ponds or traps to attract natural fish. For farmers with low income or no access to loans, this can be a significant barrier.

Unstable fish market:

Although wild fish are popular food, the market for fish products raised in rice fields remains limited. Farmers may struggle to find buyers for their fish, especially in years when fish harvests are high but market demand is insufficient.

3.3. The "Natural Fish with Sesbania" Model

The "Natural Fish with Sesbania" model is one of the common nature-based livelihood models in An Giang, especially in the flood-prone areas of the Mekong Delta. This model takes advantage of natural flooding conditions and uses traps to attract wild fish into fields planted with sesbania. It is a sustainable solution that allows farmers to harvest both sesbania high-value native plants and wild fish without requiring significant investment in farming infrastructure.

3.3.1. Economic Efficiency of the "Natural Fish with Sesbania" Model

This model generates two main sources of income: from harvesting wild fish and from sesbania flowers. It is a low-investment, high-profit model that helps farmers make use of both floodwater and submerged land for cultivation.

Utilizing available resources:

Sesbania is a native plant that thrives in flood conditions. It not only generates income from the sale of sesbania flowers, a popular food in local cuisine, but also helps improve the soil. Sesbania has the ability to fix nitrogen from the air, enriching the soil without the need for chemical fertilizers.

Table 1: Economic Calculation of the "Natural Fish with Sesbania" Model

No.	Item	Convert to hectares*(vnđ/ha)*	Convert to 03 hectare model*(vnđ/ha)*
1	**Total expenses**	**6,343,506**	**19,030,518**
2	**Total Revenue**	**21,359,733**	**64,079,200**
3	**Profit**	**15,016,227**	**45,048,682**

(Source: Le Thanh Phong, Summary Report of the Model,2024)

Vol. 9, No. 06; 2024

ISSN: 2456-3676

Income from Natural Fish: One of the attractive aspects of this model is the ability to utilize a fish trap system to lure natural fish into the fields. This is a very cost-effective method, as farmers do not need to invest heavily in feed or aquaculture infrastructure, yet can still harvest a large amount of natural fish after the flood season. The income from natural fish in this model can reach up to 15,016,227 VND/ha, providing an additional stable source of income for farming households.

Income from Sesbania Flowers: Sesbania flowers are a popular food in the region, especially in traditional dishes. With income from Sesbania flowers reaching tens of millions of VND each year, this model provides farmers with an important additional income source without requiring complex care or maintenance costs.

3.3.2. Environmental Impact of the "Natural Fish and Sesbania" Model

The "Natural Fish and Sesbania" model not only brings economic benefits but also has a positive environmental impact. The Sesbania plant and the natural fish farming system help maintain biodiversity, improve soil quality, and protect water sources from agricultural chemical pollution.

Improving Soil Quality and Reducing Chemical Fertilizer Use: Sesbania plants can fix nitrogen from the air through root nodules, enriching the soil without the need for chemical fertilizers. This not only reduces investment costs but also minimizes environmental pollution caused by chemical fertilizers, while maintaining soil fertility.

Maintaining Biodiversity and Natural Ecosystems: Luring natural fish into Sesbania fields helps maintain the ecosystem of the fields and protects native aquatic species. Natural fish can grow and thrive in the natural flood conditions, helping to conserve local fish species and reduce dependency on imported fish species. Furthermore, natural fish farming in Sesbania fields does not require artificial feed, reducing negative environmental impacts and preserving ecological balance.

3.3.3. Social Benefits of the "Natural Fish and Sesbania" Model

According to Pham Xuan Phu, 2024 showed that this model not only increases farmers' incomes but also offers significant social benefits, especially for rural communities in An Giang. Applying this model helps improve livelihoods, create more jobs, and raise awareness among locals about sustainable farming practices.

Improving Livelihoods: The "Natural Fish and Sesbania" model provides farmers with two income sources: fish and Sesbania flowers. This helps reduce economic risks when one of the income sources is affected by climate change or natural disasters. Additionally, harvesting natural fish provides a rich source of protein for the community, improving local living conditions.

Vol. 9, No. 06; 2024

ISSN: 2456-3676

Creating Jobs and Enhancing Sustainable Farming Knowledge: Although the model does not require complex techniques, it still needs some labor for harvesting fish and Sesbania flowers. This creates additional jobs for local people during idle periods after the rice harvest. Moreover, participation in the model helps locals better understand sustainable farming methods and the importance of environmental protection.

3.3.4. Challenges and Limitations of the "Natural Fish and Sesbania" Model

While this model brings many benefits, there are still some challenges and limitations that need to be addressed for wider adoption and scalability.

Scalability: The "Natural Fish and Sesbania" model heavily depends on natural flooding conditions, making it difficult to expand to areas without similar conditions. Additionally, the model requires a fish trap system to lure natural fish, which may not be easily implemented in areas with unfavorable terrain or water conditions.

Climate Change and Flood Variability: Increasing flood variability due to climate change may affect the effectiveness of this model. If floods arrive earlier or later than expected, or if water levels are insufficient to lure fish, the model may not perform as well. This raises the need for contingency measures or flexible methods to adapt to climate fluctuations.

4. Conclusion

Natural livelihood models in the Mekong Delta, including the "two rice crops and lotus cultivation during the flood season" model, the "rice-fish" model, and the "natural fish with Sesbania" model, have demonstrated great potential in improving farmers' livelihoods, protecting the environment, and enhancing climate change adaptability.The " two rice crops and lotus cultivation during the flood season" model not only offers superior economic benefits by reducing production costs and increasing income from lotus, but it also improves the environment by enriching the soil, reducing erosion, and minimizing dependence on chemical fertilizers. At the same time, this model helps raise farmers' awareness of sustainable agriculture, diversifying income sources, and enhancing food security. However, challenges such as the initial investment capital and the instability of the lotus market remain issues to be addressed.

The "rice-fish" model shows high economic efficiency by combining fish farming with rice cultivation, fully utilizing floodwaters and natural aquatic resources, which reduces production costs and increases income from fish. Additionally, this model improves soil and water quality, reduces the use of chemical fertilizers and pesticides, helps protect the environment, and contributes to global efforts to reduce greenhouse gas emissions. However, scaling up the model faces challenges due to high initial investment costs and the unstable fish market.The "natural fish with Sesbania" model is a sustainable livelihood solution, making use of natural flood systems to grow Sesbania plants and lure natural fish. This model provides stable income from both fish and Sesbania flowers, while also improving soil quality and maintaining biodiversity. However, it is highly dependent on natural flooding conditions, and climate change may affect its effectiveness. Overall, all three models provide numerous economic, environmental, and

Vol. 9, No. 06; 2024

ISSN: 2456-3676

social benefits to farmers in the Mekong Delta. With financial and technical support, these models have the potential to be scaled up, helping farmers enhance their adaptability to climate change and achieve sustainable development.

6. Acknowledgements: This research was funded by WWF, Mekong NBS project, 2024.

7. References:

Chau Thi Da, 2024. Summary report of the rice-fish farming model with fish trap systems storing natural fish during the flood season, combined with supplementary fish farming. Mekong NBS Project.

DungDucTran, Edward Parka, Huynh Thi Ngoc Tuoi, Nguyen Duc Thien, Vo HongTue, PhamThiAnhNgoc, Can Thu Vang, PhamKimLong, HuuLoc Hoi, Chau Nguyen Xuan Quang, 2022. Climate change impacts on rice based livelihood vulnerability the lower Vietnamese Mekong Delta: Empiricale evidence form Can Tho City and Tra Vinh Province. Journal EnvironmentalTechnology&Innovation, Published by Elsevier B.V, 2022.

Intergovernmental Panel on Climate Change (IPCC), 2021. *Sixth Assessment Report: Climate Change 2021: The Physical Science Basis*. Cambridge University Press.

Le Thanh Phong, 2024. Summary report of the Sesbania farming model with natural fish trap systems during the flood season. Mekong NbS Project.

Mekong River Commission, 2020. *State of the Basin Report: Climate Change Impacts in the Mekong Delta*. Retrieved from mrcmekong.org

Nguyen Minh Quang, 2013. Operational framework for ecosystem based adaptation to climate chnage foe Vietnam a policy supporting document.

Organisation for Economic Co-operation and Development (OECD), 2020. *Climate Change and the Economy: Policy Responses and Opportunities*. Retrieved from oecd.org

Pham Xuan Phu, 2024. Socio-economic and gender survey in the buffer zone of the Tra Su Melaleuca Forest landscape conservation area. Mekong NbS Project.

Trinh Phuoc Nguyen, 2024. Summary report of the rice cultivation model on lotus-flooded soil. Mekong NbS Project.

United Nations Development Programme (UNDP), 2019. *Climate Change Adaptation in Vietnam: A Focus on the Mekong Delta*. Retrieved from undp.org

United Nations Framework Convention on Climate Change (UNFCCC), 2019. *The Climate Change and Development Challenge*. Retrieved from unfccc.int

World Bank, 2020. *Climate Change and Development: A Critical Challenge*. Retrieved from worldbank.org

World Bank, 2021. *Climate Change and Agriculture in the Mekong Delta: A Vulnerability Assessment*. Retrieved from worldbank.org.