

# Adaptation Options for Rice-Based Cropping Systems in Climate Risk-Prone Provinces in the Ca Mau Peninsula: An Assessment Report

Working Paper No. 278

CGIAR Research Program on Climate Change,  
Agriculture and Food Security (CCAFS)

Bui Ba Bong  
Nguyen Van Bo  
Le Thanh Tung  
Nguyen Dinh Vuong  
Chau Tai Tao  
Duong Minh Tuan  
Nguyen Duc Trung



RESEARCH PROGRAM ON  
Climate Change,  
Agriculture and  
Food Security



WorkingPaper

# **Adaptation Options for Rice-Based Cropping Systems in Climate Risk-Prone Provinces in the Ca Mau Peninsula: An Assessment Report**

Working Paper No. 278

CGIAR Research Program on Climate Change,  
Agriculture and Food Security (CCAFS)

Bui Ba Bong  
Nguyen Van Bo  
Le Thanh Tung  
Nguyen Dinh Vuong  
Chau Tai Tao  
Duong Minh Tuan  
Nguyen Duc Trung

**Correct citation:** Bui BB, Nguyen VB, Le TT, Nguyen DV, Chau TT, Duong MT, Nguyen DT. 2019. Adaptation Options for Rice-Based Cropping Systems in Climate Risk-Prone Provinces in the Ca Mau Peninsula: An Assessment Report. CCAFS Working Paper No. 278. Wageningen, the Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Available online at: [www.ccafs.cgiar.org](http://www.ccafs.cgiar.org)

Titles in this Working Paper series aim to disseminate interim climate change, agriculture and food security research and practices and stimulate feedback from the scientific community.

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is a strategic partnership of CGIAR and Future Earth, led by the International Center for Tropical Agriculture (CIAT). The Program is carried out with funding by the Donors: Australia (ACIAR), Ireland (Irish Aid), Netherlands (Ministry of Foreign Affairs), New Zealand Ministry of Foreign Affairs & Trade, Switzerland (SDC); Thailand, The UK Government (UK Aid); USA (USAID); the European Union (EU), and with technical support from the International Fund for Agricultural Development (IFAD).

**Contact:**

CCAFS Program Management Unit, Wageningen University & Research, Lumen building, Droevendaalsesteeg 3a, 6708 PB Wageningen, the Netherlands. Email: [ccaafs@cgiar.org](mailto:ccaafs@cgiar.org)

Creative Commons License



This Working Paper is licensed under a Creative Commons Attribution – NonCommercial 4.0 International License.

Articles appearing in this publication may be freely quoted and reproduced provided the source is acknowledged. No use of this publication may be made for resale or other commercial purposes.

© 2019 CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). CCAFS Working Paper no. 278.

**DISCLAIMER:**

This Working Paper has been prepared as an output under the CCAFS program and has not been peer-reviewed. Any opinions stated herein are those of the author(s) and do not necessarily reflect the policies or opinions of CCAFS, donor agencies, or partners.

All images remain the sole property of their source and may not be used for any purpose without the written permission of the source.

## **Abstract**

This assessment report presents the results of consultation meetings and field visits organized by the Department of Crop Production and the CGIAR Research Program on Climate Change, Agriculture and Food Security in Southeast Asia (CCAFS SEA) in association with the four offices of the Department of Agriculture and Rural Development in the provinces of Kien Giang, Ca Mau, Bac Lieu, and Soc Trang in Mekong River Delta.

The meetings highlighted the progress made by the provinces in converting rice lands into efficient agricultural areas and strengthening their climate change adaptation and mitigation in agriculture. Specific topics were discussed about climate risk reduction, crop production, conversion, and management, as well as the implementation of relevant circulars and decisions, especially Decision No. 1915/QD-BNH-KH issued by the Ministry of Agriculture and Rural Development. This decision approved the Master Plan for Rice Production Development in Mekong River Delta to 2025, Vision to 2030 under the context of Climate Change.

The Master Plan is deemed important not only for the Mekong River Delta, but also for other coastal areas in Vietnam. As the provinces use the Master Plan to craft and implement their climate actions, this report aims to contribute valuable inputs. Among the report's contributions is showing the relevance of climate-related risks maps and adaptation plans (CS MAP), which were proved to be complementary tools with the rice planting calendars.

This report also looks at various issues that affect the agricultural transformation of the region. Aside from climate risks, unstable prices of agricultural products in the local and global markets, the current status of linkages between farmers and their potential markets, their lack of knowledge and skills in growing new crops, and spontaneous breaching of provincial government plans in changing cropping systems all affect the agricultural transformation in the Mekong River Delta. Compounding these issues is the lack of investments to modernize agricultural infrastructures.

### **Keywords**

*Climate change, adaptation plans, cropping systems*

## About the authors

**Dr. Bui Ba Bong** is the former Vice Minister of the Ministry of Agriculture and Rural Development of Vietnam and the team leader for this research. Email: [buiomon999@gmail.com](mailto:buiomon999@gmail.com)

**Dr. Nguyen Van Bo** is the former President of the Vietnam Academy of Agricultural Sciences, MARD. Email: [nguyenvanbo2@gmail.com](mailto:nguyenvanbo2@gmail.com)

**Mr. Le Thanh Tung** is the representative of the Department of Crop Production Southern Office. Email: [tungctt@gmail.com](mailto:tungctt@gmail.com)

**Dr. Nguyen Dinh Vuong** is the Director General of the Center of Water Supply and Irrigated Agriculture Research, Southern Institute of Water Resources Research. Email: [vuongnd\\_siwrr@yahoo.com.vn](mailto:vuongnd_siwrr@yahoo.com.vn)

**Dr. Chau Tai Tao** is a lecturer from the Fisheries Department of Can Tho University. Email: [cttao@ctu.edu.vn](mailto:cttao@ctu.edu.vn)

**Mr. Duong Minh Tuan** is a research assistant for CCAFS Southeast Asia. Email: [d.minhtuan@cgiar.org](mailto:d.minhtuan@cgiar.org)

**Mr. Nguyen Duc Trung** is a research staff for CCAFS Southeast Asia regional office. Email: [n.trung@irri.org](mailto:n.trung@irri.org)

## **Acknowledgments**

This work was supported by the CGIAR Research Program on Climate Change, Agriculture and Food Security in Southeast Asia (CCAFS SEA) and the Department of Crop Production under the Ministry of Agriculture and Rural Development of Vietnam. The authors would like to thank the Department of Agriculture and Rural Development offices of the four provinces involved in this mission and the farmers for their hospitality and invaluable insights.

# Contents

Abstract .....	iv
Keywords.....	iv
About the authors .....	v
Acknowledgments .....	vi
Contents.....	vii
List of Figures .....	ix
Acronyms and abbreviations .....	x
I. Overview .....	1
II. Purpose and Methodology .....	1
Survey purpose.....	1
Methodology .....	2
III. Survey Result .....	2
Kien Giang.....	2
The situation of rice land conversion in Kien Giang.....	3
Using CS MAP in Kien Giang .....	5
General comments about Kien Giang.....	6
Conversion models suitable for adaptation to climate change for Kien Giang Province .....	6
Proposal of the province related to the survey objectives .....	7
Ca Mau.....	8
The situation of rice land conversion in Ca Mau.....	8
Using CS MAP in Ca Mau .....	10
General comments about Ca Mau .....	10
Conversion models suitable for adaptation to climate change for Ca Mau Province.....	12
Recommendations of Ca Mau Province .....	12
Bac Lieu.....	13

The situation of rice land conversion in Bac Lieu.....	13
Using CS MAP in Bac Lieu .....	15
General comments about Bac Lieu.....	15
Conversion models suitable for adaptation to climate change for Bac Lieu Province .....	16
Recommendations of Bac Lieu Province .....	16
Soc Trang .....	17
The situation of rice land conversion in Soc Trang.....	17
Using CS MAP in Soc Trang .....	19
General comments about Soc Trang.....	19
Conversion models suitable for adaptation to climate change in Soc Trang.....	19
Recommendations of Soc Trang Province .....	20
IV. COMMENTS AND RECOMMENDATIONS .....	20
General comments for the Mekong River Delta .....	20
The bottleneck of agricultural production in the Mekong River Delta .....	20
Changing the role of rice and the need to convert a part of rice land to crops and fisheries in the Mekong River Delta .....	22
Comments on the provinces of Ca Mau Peninsula .....	24
References .....	29
Appendix .....	30
Appendix 1. The area of seasonal rice in the Mekong River Delta provinces .....	30
Appendix 2. Aquaculture area of the Mekong River Delta in 2017.....	31
Appendix 3. Members of the Assessment Team.....	31
Appendix 4. Working schedule and survey locations .....	32



## List of Figures

Figure 1. Administrative map of Kien Giang Province.....	2
Figure 2. Administrative map of Ca Mau Province (Source: camau.gov.vn) .....	8
Figure 3. Administrative map of Bac Lieu Province (Source: baclieu.gov.vn) .....	13
Figure 4. Administrative map of Soc Trang province (Source: soctrang.gov.vn).....	17

## Acronyms and abbreviations

CCAFS SEA	CGIAR Research Program on Climate Change, Agriculture and Food Security in Southeast Asia
CS MAP	Climate-Smart Maps and Adaptation Plans
DCP	Department of Crop Production
DWRM	Department of Water Resources Management
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GIS	Geographic Information System
IRRI	International Rice Research Institute
LXQ	Long Xuyen Quadrangle
NGO	Non-government Organization
PPD	Plant Protection Department
UMT	U Minh Thuong
VietGAP	Vietnamese Good Agricultural Practices

## **I. Overview**

Two years since the 2016 El Niño–Southern Oscillation hit Vietnam, the CGIAR Research Program on Climate Change, Agriculture and Food Security in Southeast Asia (CCAFS SEA) and the Department of Crop Production (DCP) have collaborated in developing climate-related risk maps and adaptation plans (CS MAP) for the 13 provinces in Mekong River Delta (MRD) (Son, Yen, & Sebastian, 2018).

After several consultations and discussions, DCP and the provincial Department of Agriculture and Rural Development (DARD) offices in the MRD identified common climate-related risks across the provinces. The identified levels of risks (e.g. flood, drought, and salinity intrusion) and site-specific natural and socioeconomic factors were also evaluated by local officials. Currently, DCP has asked the MRD provinces to use the risk maps as guides to develop climate change adaptation plans for rice production.

The current adaptation plans contain two measures: changing of cropping system and adjusting the planting and/or sowing dates. The adaptation plans show the rice areas that need to shift from three-rice cropping into two-rice cropping models and rice-aquaculture (e.g., shrimp or fish) systems. The alternative cropping systems have yet to be identified in areas where reduced cropping is recommended. The possibilities, constraints, market opportunities, and other requirements to implement these options have not been assessed as well.

The DCP and CCAFS SEA organized a consultation meeting with the DARD offices of selected MRD provinces from 13-18 August 2018 to identify possible alternatives in developing their agricultural and adaptation plans.

## **II. Purpose and Methodology**

### **Survey purpose**

CCAFS SEA assisted DCP in determining the efficiency of converting rice lands for other agricultural products—mainly aquaculture products—in some coastal provinces in the MRD. Alongside land conversion, the DCP and CCAFS SEA identified existing problems and propose conversion plans that would thrive against sea level rise, salinity intrusion, and extreme weather events (e.g. drought and flood). The working group initially explored the implementation of Decision No. 1915/QĐ-BNN-KH dated 28 May 2018 issued by the Ministry of Agriculture and Rural Development (MARD) in approving the Master Plan for Rice Production Development in Mekong River Delta to 2015, Vision

to 2030 under the Context of Climate Change. The survey took place from 11-15 December 2018 in the provinces of Kien Giang, Ca Mau, Bac Lieu, and Soc Trang.

## Methodology

Group discussions and consultation meetings were held in each province. The participants were experts from international and national research institutes, leaders and experts from DCP, and representatives from the Plant Protection Department (PPD), Department of Water Resources Management (DWRM), provincial agricultural extension centers, and functional departments of the provincial DARD. The participants discussed the following key agenda:

1. progress of converting inefficient rice lands according to Circular No. 19/2016/TT-BNNPTNT of MARD;
2. types of natural disasters and impacts of climate change in each province and zoning of affected areas; and
3. conversion measures and science and technology suitable for sub-regions under specific climate change scenarios.

Aside from these discussions, the working group organized field visits in the provinces. During the visits, the group observed, interviewed, and exchanged information with local agriculture officials and farmers about agricultural transformation. The group looked for potential conversion models as well.

## III. Survey Result

### Kien Giang

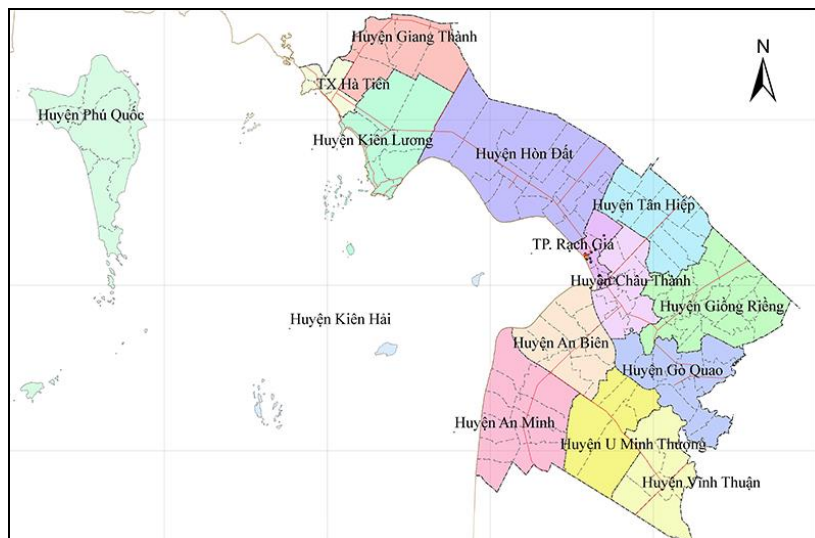


Figure 1. Administrative map of Kien Giang Province (Source: <https://www.kiengiang.gov.vn/>)

## The situation of rice land conversion in Kien Giang

Kien Giang holds the largest rice cultivation area in the country with 724.81 thousand hectares and a production of 4,056 million tons<sup>1</sup>. However, rice production has low efficiency, prompting the Provincial People's Committee to issue Decision 41/QD-UBND dated 9 January 2017 to “adjust the agriculture-rural development planning in association with restructuring agriculture in Kien Giang Province to 2020 and orientations to 2030.” In the case of Kien Giang, shifting to fruit trees is almost negligible and converting to cash crops is not possible on a large scale because output is not available. Instead, Kien Giang converts its rice lands into rice-vegetable, rice-shrimp, and rice-fish farming systems. The province set the following objectives for such conversion:

### a) From now to 2020

- Production value structure: Agriculture 49.1%, forestry 0.5%, and aquaculture 50.4%
- By 2020, rice production will reach about 5 million tons; catching and aquaculture production will reach about 755,505 tons (about 265,505 tons from aquaculture and 80,000 tons from shrimp farming).
- The average production value per 1 ha of agricultural land is about VND 130 million, wherein cultivation reaches VND 100 million/ha on average.

### b) By 2030

- Production value structure: Agriculture 41.1%, forestry 0.5%, and aquaculture 58.4%
- By 2030, rice production will be reduced to about 4.96 million tons. Catching and aquaculture production will increase to about 800,000-840,000 tons (about 320,000-340,000 tons from aquaculture and about 150,000-155,000 tons for brackish shrimp farming).
- The average production value per one hectare of agricultural land is about VND 170-200 million.

Table 1. Rice conversion targets for Kien Giang Province

Year	Agriculture	Forestry	Aquaculture
2015	57.0%	0.5%	42.5%
Planning to 2020	49.1%	0.5%	50.4%
Planning to 2030	41.1%	0.5%	58.4%

<sup>1</sup> Report on Agriculture Production of Kien Giang province in 2017. Kien Giang DARD.

Most of the rice varieties planted in Kien Giang possess high quality, some of which are even tolerant to salinity intrusion. These varieties, however, constitutes no more than 4% of all varieties planted in the province. Currently, the variety DS1 (Japonica) is planted on about 70,000 ha in the Long Xuyen Quadrangle (LXQ) District due to its export potential and tolerance to salinity. The rate of using certified rice varieties is high due to a functional seed center in the province. Transplanters are now being used for rice production, but its application is hampered by expensive machine prices and seeding costs.

According to the plan, the province will reduce its rice land area from 395,820 ha in 2015 to 382,829 ha by 2020, with a cultivated area of 800,950 ha. This size will be maintained until 2030. Kien Giang will specifically plant three rice crops in the west of Hau River and a part of LXQ in the area of Tan Hiep, Rach Gia, and south of Tri Ton Canal in Hon Dat District. For the rest of rice lands in LXQ, the province will plant two rice crops, two rice crops with one cash crop (e.g. corn, soybean, sesame), and some shrimp-rice models. After 2020, it will gradually develop the shrimp-rice model in the southern region of National Road 80 from Rach Gia to Ba Hon-Kien Luong.

The shrimp-rice model will be prioritized in U Minh Thuong (UMT) where it will be developed on about 17,000 ha. After the main model, UMT will plant two rice crops and two rice crops with one cash crop (vegetables) for the rest of its area. In two years (2015-2017), the province had converted rice lands into 10,290 ha of rice-shrimp production and 940 ha of annual crops. Meanwhile, more than 15,500 ha of winter rice were converted into aquaculture farms, applying the shrimp-rice model.

Kien Giang Province also converted rice lands into fruit tree plantations. A total of 7,000-7,100 ha, mainly in the two districts of Chau Thanh and Go Quao, are now dedicated for pineapple production (7,000-7,100 ha). About 7,000 ha are converted for coconut production. The area for vegetables is about 18,142 ha and expected to reach 25,000 ha in 2030 mainly due to rotational vegetable production on the land for two rice crops-one cash crop in the UMT region. Converting rice lands for shallow root crops such as corn, soybean, and sesame based on the two rice crops-one cash crop model in LXQ districts is found to be ineffective and difficult to expand.

That is not the case for the shrimp-rice model in Kien Giang. It is the fastest growing conversion model in the province, with a conversion rate that only increases rapidly year by year. Specifically, the new rice-shrimp area in 2014 covering 71,500 ha increased to 89,000 hectares in 2017. The UMT (An Bien, An Minh, U Minh Thuong, and Vinh Thuan districts) region accounts for over 90% of the total rice-shrimp farming area in the whole province and offers a conducive environment for this model to thrive.

The rice-shrimp model has been improved and is now being applied together with the giant freshwater prawn model, which integrates giant freshwater prawns in rice fields. The rice-shrimp model is also

integrated with the intercropping of giant freshwater prawn and white leg shrimp. Meanwhile, in LXQ, some areas of triple rice crops have shifted to double rice crops-fish (farming in rice fields in floating season).

The rice-shrimp model, based on the survey, had generated income for the farmers in Bau Tram Cooperative in An Bien District and Nga Bac Village in An Minh District. Not only is this model providing income for farmers, it is also easy to prepare. The shrimp season runs from February to March when saline water returns. When the water has enough salinity (from 5 ‰) already, it can be transferred into the ditch. After filling up with water, treatment with calcined lime can now be conducted (pH to reach 7.0 - 8.5) and will be followed by stocking, wherein the density must be one shrimp/m<sup>2</sup>. After three months of farming, productivity can cover 75-110 kg/ ha with 15-30 shrimps/kg.

When the first batch of shrimp is already on the second month, the farmers can begin raising the second batch. Every 2-3 months, farmers can add shrimp by 50-70% depending on the survival rate of the previous batch. This ensures that farmers have income all year, which is estimated at about VND 40 million/ha/year.

“Mot bui do” is a popular rice variety in this model. Rice naturally grows without the need for fertilizers or pesticides. The time for sowing is from May-June while transplanting is in July-August in the lunar calendar. The model of converting acid sulfate soil, which can only plant melaleuca to plant pepper is impressive in the districts of Go Quao (specifically in the Vinh Hoa Hung Bac Commune), Giong Rieng, and UMT. Over 153 ha are planted with pepper while 125 ha are dedicated for fruits, yielding an average 2.8 tons/ha. The total output is 280 tons/year.

### **Using CS MAP in Kien Giang**

DARD, DCP, and the PPD of Kien Giang Province affirmed the importance of the climate risk map, especially the provincial risk map for salinity intrusion. This helps the province draw an overview of high-risk areas, providing the crop conversion plan with solid scientific basis. The map of the rice sowing season for the province was presented during the Summer-Autumn Review Conference 2018, which can also be referenced to serve the conversion models, as well as the planting season in the years when natural disasters occur.

Despite their usefulness, provincial government officials still face capacity building issues that keep them from fully utilizing the maps. Kien Giang, as a response, aims to improve the capacity of its staff not only to better use the maps, but also to draw them on their own.

## **General comments about Kien Giang**

Several models are available to convert inefficient rice lands into cash crops, aquaculture, or rice-aquaculture (especially shrimp). Among these models, rice-shrimp is the most suitable. Kien Giang has largest shrimp-rice area in the MRD. These rice-aquaculture production models are new, diversified, and high-income in nature. They must be documented well to achieve expansion.

Despite the emergence of the rice-shrimp model, autumn-winter rice crop still occupies a large area due to the spontaneous planting of farmers. Such large area is even stated in the provincial planning for 2020 and 2030. The province needs to identify unstable autumn-winter rice areas to encourage farmers to not produce them or convert them into fish farming during the floating season. The province can also consider having an appropriate scale to adapt to climate change and improve efficiency and quality. Kien Giang also has an area for winter rice (local varieties) that can still be restored and be purified by an appropriate program.

## **Conversion models suitable for adaptation to climate change for Kien Giang Province**

- Farming areas must be established for brackish water shrimp farming in LXQ, Giang Thanh, Kien Luong District, Ha Tien Commune, and some parts of Hon Dat and UMT in An Bien, An Minh, and Vinh Thuan districts. Alongside this, the shrimp-rice model in UMT must be developed. The area for farming brackish water shrimp in 2020 is projected to cover about 104,325 ha, including 5,000 ha for intensive-semi-intensive farming, 19,325 ha semi-extensive farming, and 80,000 ha for shrimp-rice. By 2030, the scale can expand to about 132,300 ha, including 15,380 ha for intensive-semi-intensive farming, 16,550 ha for semi-extensive farming, and 100,370 ha for shrimp-rice.
- The province should pay attention to raising other aquatic products such as combined fish farming in the forest (i.e., in the UMT), rice fields, and specialized farming over about 35,000 ha of land. Mollusc farming in the mudflats area covers about 16,800 ha. Sea crab farming in shrimp field and specialized farming covers 60,000 ha. Fish cage farming has reached about 3,000 cages in coastal areas and coastal islands. Aquaculture can occupy about 100 ha by 2020.
- The model of converting rice land to pepper cultivation must be assessed. There are two considerations: pepper can be grown on alum soil and poles; cajuput trees, which are adaptable to alum soil—they do not need wooden or concrete pillar unlike in many other places—can be used. The quality of pepper in Vinh Hoa Hung Bac has been confirmed in the market, but the effect will be more evident if it is certified for collective trademark registration.



In presenting solutions to implement conversion, Kien Giang should prioritize forming large-scale commodity production areas with the participation of enterprises in production linkage, purchase, and consumer products. The focus should be on developing farm economies and the collective economy under the new type of cooperative model; linking farming households into clubs and cooperative groups; and forming cooperatives to link with input suppliers and those that will purchase the output products.

Currently, aside from the local rice variety "Mot bui do," the round rice variety DS1 is suitable for the rice-shrimp model. However, because DS1 is only recognized in the northern provinces, the team asked DCP to carry out procedures to promote the variety in the southern provinces as well. Through this promotion, local farmers from the south can replicate this variety quickly.

### **Proposal of the province related to the survey objectives**

- The Department of Crop Production recognized the rice variety DS1 immediately.
- Support costs are needed to certify Vietnamese Good Agricultural Practices (VietGAP), Global Good Agricultural Practices, organic farming, and mechanization of rice cultivation in the shrimp fields. In those fields, the harvesting stage requires full support because large combine harvesters are difficult to operate in this kind of area.
- International Rice Research Institute (IRRI)/DCP can train DARD offices and the districts to use the CS MAP in directing rice production.

## Ca Mau

### The situation of rice land conversion in Ca Mau

Ca Mau is a province without freshwater despite three of its sides facing the sea. It is affected by the semi-diurnal tide in the West Sea and diurnal tide in the East Sea. This province has the largest shrimp farming area in the country with over 280,000 ha. Its main products include shrimp, crab, high-quality rice, and wood. Moreover, Ca Mau has 5,000 ha of banana plantation capable of developing organic bananas.

The 84 000-ha rice land includes 36,000 ha of double rice crops (with embankments keep freshwater). This rice area is stable and suitable for shrimp farming because it is not encroached by saltwater. The remaining area for rice cultivation, about 40,000 ha, mainly rotates with shrimp (rice-shrimp). Ca Mau has no structure of triple rice crops.

Ca Mau Province has quickly acquired the ST24 rice variety and dedicated an area of 10,000 hectares in 2018 for production. This was relatively a rapid change in the province's rice seed structure (ST variety account for 28%; RVT 14%; OM5451 20%; and OM18 12%).

The province used to have special rice varieties such as Tai nguyen, Tep hanh, and Mot bui, but local farmers are no longer planting them; there should be a plan to conserve these rare indigenous rice varieties. Aside from this issue, difficulties in agricultural production and climate change-related issues include: erosion of coastal and river dikes; subsidence due to overexploitation of groundwater; flooding caused by storms and high tides (every year about 30-40 thousand ha are affected); salinity intrusion, drought; and the shortage of fresh surface water for farming.

The People's Committee of Ca Mau Province issued a decision approving the restructuring of its agriculture, forestry, and fishery sectors from 2017 to 2020, vision to 2030. This project aimed to improve quality and added value by developing value chain models that link key products and form a green, ecological, and sustainable production.

After the policy of agriculture conversion was issued, Ca Mau has increased the area for cash crops to 6,000 ha and for fruit trees to 7,231 ha (bananas, mainly Xiem bananas, to 5,568ha). Coconuts have been well developed, reaching 7,500 ha. The conversion of rice to fruit trees and cash crops is negligible. Developing cash crops, however, is difficult because there is no stable output.



Figure 2. Administrative map of Ca Mau Province (Source: [camau.gov.vn](http://camau.gov.vn))

The biggest change in the restructuring process of Ca Mau is in aquaculture. The total area for shrimp farming is up to 280,000 ha, including 10,000 ha for industrial farming and 2,000 ha for super-intensive farming. The shrimp-forest system in Nam Can can be considered a model in Ca Mau with a scale of 24,000 ha. The shrimp-rice area reaches 37,280 ha in 2018.

Surveying at the household of Mr. Huynh Van Duong (Nhi Nguyet Village, Tran Phan Commune, Dam Doi district), the mission team saw that applying the "closed recirculation systems" shrimp farming process of Viet My Trading and Services Co., Ltd. could generate a profit of nearly VND 800 million annually on a 1,200-m<sup>2</sup> pond. This process is both economically and environmentally efficient as water is reused and not discharged as waste.

Another high-yield shrimp farming model is also being replicated in Ca Mau. Survey at the household of Mr. Nguyen Thanh Ha (Chong My Village, Ham Rong Commune, Nam Can District) showed that they have five ponds with a lined tarpaulin with a two-stage model. Each pond is 2,000 m<sup>2</sup> and covered with HDPE tarpaulin. They are treated and sucked out daily and are designed with holes to collect waste. The shrimp nursery is situated in a controlled environment, with the water being changed daily by 10-20%. This model requires high investment, but the production is highly sustainable and effective. According to Mr. Nguyen Thanh Ha, the cost is VND 250 million per pond (> 1 VND million/1m<sup>2</sup>) and the harvest reaches three batches of shrimp per year. With his harvest, the output is 10 tons/2000m<sup>2</sup>/batch.

Farmers in Cau Mau are also interested in organic rice production. The downside, however, is its inefficiency. For instance, the production of the 317.5-ha organic rice model of Vien Phu Company (Green Farm) adopted by Mr. Vo Minh Khai at U Minh, Ca Mau is limited due to a lack of stable market, high registration costs, and lack of attention from the authorities.

By 2020, Ca Mau plans to introduce new models of farming and dedicate thousands of hectares for the following: climate-smart rice production on 15,000 ha of land; rice-fish on 5,000 ha; and rice-giant freshwater prawn on 15,000 ha. The shrimp-forest model can increase by 5,000 ha to 29,000 ha. In the future, Ca Mau will continue to implement the project "Agricultural restructuring towards raising added values" for the following industries: i) high-quality rice; ii) organic shrimp; iii) acacia hybrid; iv) sea crabs; v) banana and vi) U Minh gourami fish.

In terms of high-quality rice production, from the present up to 2020, Ca Mau Province will build a 90,000-ha specialized area to enhance efficiency by 20-30%. This will include the following: building a specialized area for high-yield rice production on about 36,500 ha of land; 46,000 hectares for one-rice crop rotation on shrimp farming land; 6,500 ha for specialty rice production area; 1,000 ha for organic rice production area; and 10,000 ha for rice production that meet VietGap standards.

## **Using CS MAP in Ca Mau**

DCP believes that Ca Mau is the most affected province by climate change, specifically sea level rise, in the MRD. The diurnal and semi-diurnal regimes in the province may lead to salinity intrusion that is different from the remaining localities. The risk map should focus on these climate issues to identify high-risk areas. Although Ca Mau does not have much rice area, the CS MAP approach can be applied to other agricultural commodities. Currently, the province has built and used a software system and smartphone application to monitor local farming activities. Ca Mau's DARD affirms that integrating forecast and warning of natural disasters into this software will help the province implement natural disaster prevention and agricultural adaptation to climate change. In addition, DARD also proposed technical assistance and capacity building for staff in charge of cultivation, irrigation, and natural disaster prevention, as well as tools and methods to develop digital maps.

## **General comments about Ca Mau**

After four years of implementing the provincial agriculture restructuring project (Decision 1605/QD-UBND dated 24 October 2014), the agricultural production aiming to bring added value and sustainable development has achieved good results. The shrimp industry has the biggest breakthrough. The conversion from traditional extensive shrimp farming to intensive and super-intensive farming were proved to be successful for almost all crops.

The province's total aquaculture production in 2017 reached over 530,000 tons, up 17% compared to 2013—the year before the project implementation. During this period, the production registered an average increase of 2.48% annually. Aquaculture production produced 320,929 tons, up 10.23% compared to 2013 or an average increase of 3.33% per year. The development of this sector can be attributed not only to the increase in area and output produced but also to the integration of different models adopted. In the same area, for instance, combined farming, rotational farming, and intercropping of goby, seabass, crab, and blood cockle are integrated within intensive, semi-intensive, semi-extensive, extensive farming, shrimp-rice, and shrimp-forest models.

These farming methods brought positive changes already. Compared to 2013 numbers, the province's industrial shrimp farming area in 2017 reached 9,875 ha, increasing by 1.65 times; semi-extensive shrimp farming expanded to 102,689 hectares, increasing by 2.65 times; and certified organic shrimp area now covers 19,000 hectares, an increase of 1.58 times. Super-intensive shrimp farming now occupies 1,442 ha, with an average yield of 40-50 tons/ha of water surface area per crop.

Among the popular models in Ca Mau is the shrimp-rice model. The province even planned to adopt it on a 90,000-ha land (Decision 1116/QD-UBND dated 19 Nov 2001 on Adjusting the planning of agriculture-forestry-fishery production in Ca Mau province in the period of 2001-2010). However, the irrigation system for this model has not met the demand yet and the environmental monitoring system

is not capable to deliver timely warnings. Moreover, Ca Mau is the only province that does not have any freshwater source; everything is endogenous freshwater. It is difficult for agricultural production, as well as shrimp farming, to thrive in drought years. Suitable rice varieties for this model are yet to be identified too.

Aside from shrimp, the other four key commodities in Cau Mau are bringing many positive changes. As response, the Provincial People Committee has adjusted the production restructuring plan for banana, sea crab, wood, and high-quality rice via Decision 841/QD-UBND dated 23 May 2018.

In the case of crabs, its area and production have increased yearly after building the brand of Nam Can crab. Currently, 250,131 ha are dedicated to intercropping crabs with extensive shrimp, semi-extensive shrimp, shrimp-rice, and shrimp-forests models. This produces over 20,053 tons worth of outputs, an increase of 18% compared to 2013, during which the area was about 240,000 ha and produces an output of 17,000 tons.

Meanwhile, bananas only account for 2.72% of the total crop production value and 0.24% of agriculture's total production value. Despite its relatively small contributions in the agriculture sector, there is a potentially strong market for banana. It is indigenous, naturally grown, and does meet the requirements for both fresh and processed food.

By 2020, Ca Mau Province is planning to achieve the following: improve the productivity, quality, and efficiency of its rice production from 20-30% compared to 2015; enhance the competitiveness and increase the income of the people alongside protecting the environment in a sustainable manner; and establish a specialized area for raw materials in rice cultivation with large output to supply to the domestic and export markets.

Accordingly, the province will build a specialized area to produce high-quality rice covering 90,000 ha and an output of 641,000 tons. In this specialized area, high-yield rice production area will be built on around 36,500 ha; 46,000 ha will be dedicated to one rice-crop rotation on shrimp farming land; 6,500 ha on specialty rice production area; 1,000 ha for organic rice farming production area; and 10,000 ha for rice production areas under VietGap standards.

All these activities are geared towards the development of the agriculture value chain. Up to now, 22 enterprises have signed 61 contracts to co-develop the shrimp industry value chain with 15 cooperatives and an 800-household cooperative group over an area of 1,323.3 ha. This will provide input materials and build an area to produce internationally certified shrimp farming materials associated with processing and consumption.

The province continues to speed up the restructuring of its five key commodities focusing on four contents: Cooperation; Linkages; Brand; and Market. As a result, over the past four years, 19,000 ha of shrimp-forests owned by 4,200 households have been certified (including forest area). The

province also granted VietGAP certificates to 99 households occupying 100 hectares. Alongside this process, seafood processing and exporting enterprises located on 675 ha and owned by 552 households have been supported to build intensive shrimp farming areas with international certification from the Aquaculture Stewardship Council and Best Aquaculture Practices. Shrimp farmers are also supported for them to apply practices that meet VietGAP standards.

Since Ca Mau is heavily affected by climate change, especially sea level rise, the government is advised to continue supporting the province in building infrastructure that improves its adaptation capacity against coastal and river dike erosion, subsidence, salinity intrusion, and flooding due to high tide.

### **Conversion models suitable for adaptation to climate change for Ca Mau Province**

Based on the survey, the province's climate change adaptation models should focus on certified organic or ecological shrimp-rice production and shrimp-forests in saline areas. These models are suitable for organic, high-value added products. The percentage of organic products needs to increase rapidly. Aside from the models on super-intensive shrimp farming, water circulation must receive investments. Moreover, with priority products such as bananas, it is necessary to consider the market demand before investing in expansion. Adaptation plans for these two rice crop areas are needed since they are likely to be at risk of extreme weather events (e.g. drought). The ST24 has been approved by the Seed Recognition Council and can now be considered as a special variety by the DCP.

### **Recommendations of Ca Mau Province**

- The province has planned for the components of agriculture components, but a master plan for the sector must stop under the Planning law;
- Central budget investment to complete sea dikes and critical irrigation works (the province already has a list);
- Ca Mau Provincial People's Committee speeds up the approval of the provincial shrimp farming project proposed by DARD;
- MARD recognizes the ST24 rice variety (which has been widely developed in production) as exceptional and can be added to the ongoing export rice project of the province (this project is chaired by DCP);
- The province must consider its plans on rice breeding since it experienced difficulties from copyright issues on rice varieties (owned by big companies). These may lead to scarcity of local seeds.



The major rice varieties in Bac Lieu include Nang hoa 9, Dai thom 8, OM5451, RVT, Loc troi, OM4900, DS 1, all of which are of high quality. Bac Lieu also maintains the local varieties Mot bui do and Tai nguyen, which are tolerant to salinity intrusion, over an area of about 30,000 ha. DARD reported that the area of certified rice seed accounts for 63% with an underwriting rice area of 45,000 ha. The planted area for food crops only occupies 14,076 ha.

In 2017, the total production of aquaculture and fishing in the province reached 32,650 tons (up 24.37% compared to 2012). Moreover, shrimp production was recorded at 129,745 tons (up 40.06% compared to 2012); fish and other aquatic production at 192,905 tons (up 15.65% compared to 2012); total rice production at 1,077,848 tons (up 9.23% compared to 2012); and salt production at 36,096 tons (down 51.02% compared to 2012).

Due to these results, the mission focused on shrimp farming models with different technology levels. The Viet-Uc Corporation (with 102 ha of hatchery and 315 ha shrimp production facility at Giong Nhan Village, Hiep Thanh Commune, Bac Lieu City) invested on high-quality, super-intensive shrimp production complex in a greenhouse. Specifically, the Corporation tests the air dome (2 000 m<sup>2</sup>) with a simple design, which can adjust its height to avoid damages from strong winds and storms. This technology can be applied for crop production (e.g. flowers, mushrooms, vegetables).

Currently, with outstanding technology, Viet-Uc provides 50% of the varieties of shrimp seed market share nationwide with nine large-scale seed companies from Quang Ninh, Nghe An, Binh Dinh, Binh Thuan, Ben Tre, Bac Lieu, Soc Trang and Ca Mau, carrying over 50 billion post annually. In terms of commercial shrimp farming, Viet-Uc can conduct intensive farming because the life cycle of white-leg shrimp lasts only 90 days and the volume reaches 34 shrimps/kg.

Viet Uc's shrimp farming program has proven its success due to its initial implementation in Vinh Tinh Commune, Hoa Binh District, in Bac Lieu Province. The program was implemented over an area of 50 ha, the main output of which was white-leg shrimp. The farming area is nearly 21 ha with 70 ponds and enjoys fully automatic feeding. After more than three months of farming with a density of 200-500 shrimp/m<sup>2</sup>, the shrimps grew well, yielding 2-4 tons/pond or equal to 40-80 tons/ha/crop (120-140 tons/ha/year). In addition to high economic efficiency, this model ensures food safety and hygiene and avoids wastes and antibiotics; it can be exported to the most demanding markets. Moreover, the model allows the possibility of tracing the origins of shrimp.

Aside from Viet Uc Corporation, in Bac Lieu, the following shrimp businesses are enjoying success due to application of improved technology: Hai Nguyen Company Limited in Vinh Trach Dong Commune, occupying 10 ha for indoor and 50 ha outdoor farming; Truc Anh Company Limited in Vinh Trach Commune covering 20 ha for intensive farming; and Huy Long An Company Limited occupying an area of 25 ha. Some households also invest in high-tech shrimp farming: Mr. Ta Hoang



Nhiem's household in Long Dien Dong, Dong Hai District, which owns a 500-m<sup>2</sup> pond, and Mr. Tran Chi Hieu's household in Vinh Thinh, Hoa Binh District, owning a 1 200-m<sup>2</sup> pond.

Bac Lieu is interested in investing in organic shrimp farming as well. This time, the province wants to combine it with shrimp-forest on a 79,000-ha land, expecting an average shrimp yield of 0.41 tons/ha and fish productivity of 0.38 tons/ha. The shrimp-rice model occupies 33,747 ha with an average shrimp productivity of 0.23 tons/ha and fish yield of 0.27 tons/ha.

In terms of rice production, the province focuses on high-quality rice along the value chain. From 2013-2017, the province organized a production linkage on 51,706 ha of land. The most effective form of linking involves the supplier of seeds to sell the deferred payment for part or all the supplies, support technical training, and most importantly, commit to underwrite the product at a price higher than the market price at the time of sale.

However, regulators also warned about the high standards of shrimp import markets, which usually come from rich countries. They require that shrimps are not only high in quality but also environmentally friendly. This includes informing them about how water was used in the shrimp production.

### **Using CS MAP in Bac Lieu**

Since the province is heavily affected by climate change impacts, specifically salinity intrusion, Bac Lieu's DARD realizes the need to identify the rice-growing areas that are most affected and develop appropriate adaptation measures. Risk maps and adaptation plans were developed with the help of the inputs from DCP and DWRM. Their inputs included information about risk areas and levels, as well as options for crop restructuring and seasonal calendars. However, the computer systems of the departments and units lack the software to read, edit, and update maps. This software issue hampers the application of CS MAP in Bac Lieu. Eventually, officials of DARD grasped how to develop and apply the CS MAP, enabling them to respond accordingly to climate change impacts.

### **General comments about Bac Lieu**

Bac Lieu has a strong advantage in aquaculture, including high-tech, intensive, and super-intensive farming with local seed systems. These systems allow the province to produce proactively. Shrimp farming models have proved highly effective compared to other industries. However, risks are also high in the shrimp industry. Many investors lack the experience and often do not follow the planning process.

Despite the policy implementation shifting farmers from inefficient rice production to rice-shrimp intercropping for more than 10 years already, Bac Lieu farmers are still struggling due to lack of

resources. For instance, they do not have enough water for their granaries even during the middle of the rainy season. Farmers are also still struggling with rice seeds.

Based on the seasonal calendar, every September, Bac Lieu must complete 100% of the rice sowing on shrimp farming land. However, farmers cannot find rice seeds even if the supply of freshwater is enough. In contrast, farmers who can access the seeds suffer water shortage and high salinity. This issue has been existing for many years already but still face no solution. Consequently, farmers must find seeds and water to maintain the production by themselves, affecting their efficiency.

The proposal on the province's rice development direction is appropriate, positive, and oriented towards the development of specialty and organic rice. However, Bac Lieu must consider the area for implementing triple-rice crop farming. A total of 30,000 ha can reduce autumn-winter rice in low-risk production areas. The pure selection of local varieties of winter rice is necessary; the province must cooperate with the the relevant institutions to implement it.

### **Conversion models suitable for adaptation to climate change for Bac Lieu Province**

Through the survey, the province should focus on the following climate change adaptation models: organic/ eco rice-shrimp production, and certified shrimp-forests production in salinity areas. These models can fully develop towards organic, high added value. The proportion of organic produce needs to increase rapidly. In addition, it is also necessary to invest in super-intensive shrimp models, closed recirculating shrimp models. For priority products like bananas, it is necessary to consider market demand before investing in expansion. The double-rice crops area is likely to be at risk in extreme weather conditions (drought), so the province needs an adaptive plan. The ST24 rice variety has been approved by the Seed Recognition Council, requesting the Department of Crop Production to recognize it specifically.

### **Recommendations of Bac Lieu Province**

- The province has the policy to maintain a stable area of 58,800 ha for rice (70,000 ha of high-quality rice and 85,000 ha of fragrant rice) and 38,000 ha for rice-shrimp systems. The area for local specialty rice is 25,000 ha, including the rice varieties Tai nguyen and Mot bui do on 15,000 ha, and 10,000 ha for organic rice production. MARD is recommended to support the planning of appropriate irrigation systems.
- The province needs new rice varieties with better salinity tolerance.

# Soc Trang

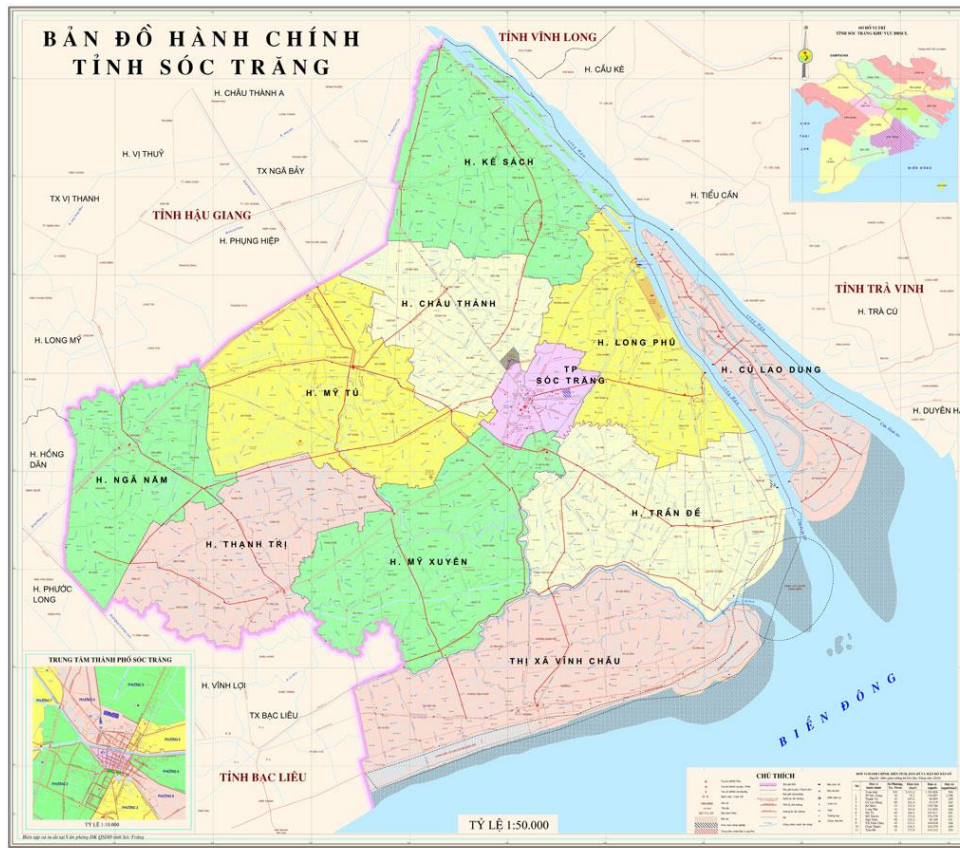


Figure 4. Administrative map of Soc Trang province (Source: soctrang.gov.vn)

## The situation of rice land conversion in Soc Trang

Soc Trang can be found at the end of Hau River. Agricultural production is considered as the main industry in the province, but it suffers from various climate change impacts such as salinity intrusion, soil erosion, and insufficient supply of freshwater from upstream. Any changes can disrupt the traditional production structure and people's daily lives. As a response, farmers must find measures to proactively adapt to the impacts of climate change and find specific production structures for salinity, brackish water, and freshwater areas.

In Soc Trang, aquaculture and shrimp-rice models were not considered in this province since they are already evaluated in Kien Giang, Ca Mau and Bac Lieu. In the process of project development, the agricultural sector has identified key production areas and selected key seedlings and breeding stock as follows: rice, sugarcane, red onion, fruit trees, shrimp, catfish, artemia, dairy cows, poultry, and coastal protection forests. However, during the implementation, due to market problems and poor efficiency, sugarcane was gradually replaced by other crops. High efficiency

conversion models include organic red onion (Vinh Chau), fragrant rice-clean shrimp (My Xuyen), king oranges-green skin grapefruit (Ke Sach) or a model of growing prickly custard apple (Nga town), and Idor Longan on sugarcane land.

Typically, in Tran De District, after two years of implementing the project "Restructuring agriculture sector," this locality has converted 1,400 ha of inefficient rice land to grow grass and corn for animal feed and aquaculture. Currently, the area of fragrant rice accounts for 94% of the district's rice area while shrimp farming has been highly effective for three years already.

As a traditional red onion-producing region, farmers in Vinh Chau have converted to grow fresh red onions (including young tubers and leaves instead of tubers), which significantly reduced the time for growing onions, increased crops, and increased the value towards organic onion. Surveying the organic onion production model of Mr. Chiem Liet's household in Au Tho B Village, Vinh Hai Commune in Vinh Chau District shows that the economic efficiency increased by 1.5-2 times and the land use coefficient also increase more than 2 times. Based on this model, the province has tested the conversion of rice land into red onion in Lich Hoi Thuong Commune, Tran De District. Onions have been purchased at attractive prices and very high replicability.

Sugarcane is a crop planned for large-scale development in Cu Lao Dung. However, due to the low price, the province is struggling to find an alternative model. The investigation into models of converting sugarcane land to Idor longan or sweet sorghum is inconclusive.

In the process of agriculture restructuring, Soc Trang Province also focuses on promoting the improvement of mixed gardens to grow fruit trees of high economic value. The province has built and completed key brands of agricultural products such as grapefruit, king oranges, and star apple (Ke Sach and My Tu districts); "xuong com vang" longan (Vinh Chau); prickly custard apple (Nga Nam); and Taiwanese mangoes (Cu Lao Dung) over a total area of more than 29,000 ha to meet the standards of good agricultural practices, food safety, and hygiene. These are agricultural products with local advantages, suitable for natural conditions, are highly productivity, possess good quality, and have high economic efficiency.

Soc Trang is also interested in directing production linkages. After two years of implementation, the number of enterprises and agents joining with farmers in rice production and consumption in the next year is always higher than the previous year. From 20 enterprises that signed linked contracts for about 6,900 ha in Winter-Spring crop season 2014-2015, the number has increased to 50 enterprises signed with nearly 12,000 ha of Winter-Spring crop for 2015 - 2016. Specifically, Soc Trang has the Ho Quang Enterprise specializing in ST rice varieties, which has led to the formation of a national and international supply chains.

### **Using CS MAP in Soc Trang**

Although the CS MAP has not been applied in Soc Trang Province, representatives of DARD, together with the staff from DCP, PPD, and DWRM, confirmed that this is a valuable tool for them to identify high-risk areas in terms of drought and salinity intrusion and develop appropriate adaptation plans for each region. Officials involved in developing salinity risk maps and seasonal calendars for the province were familiar with the mapping method, which could be applied to build more updated maps with changes in irrigation infrastructure, forecasts, and warnings about natural disasters.

In the future, the DARD of Soc Trang Province proposes to support capacity building on using a mapping software. In this regard, the province recommends the building of a smartphone or software application to monitor rice production, and update warnings about natural disasters, pests and diseases, and other climate change impacts.

### **General comments about Soc Trang**

In the province, aside from rice, shrimp is a key economic product. The province should develop traditional products that have brands such as red onions (organic red onions), of which Vinh Chau district has an annual output of nearly 140,000 tons. Depending on the market, onions may expand on rice land in other districts such as Tran De and Cu Lao Dung. Moreover, fruit trees bring a significant economic potential, including some specialty trees such as green grapefruit, durian, star apple, and longan, the annual output of which is estimated at 200,000 tons.

The VietGAP certified the purple star apple, which is being exported to the United States and needs to be maintained and developed, together with the model of growing Idor longan and green grapefruit. The new model of tiger shrimp farming is also promising in the field of aquaculture.

### **Conversion models suitable for adaptation to climate change in Soc Trang**

- Red onion production is an advantage for Soc Trang. However, the province should expand the production area of red onions in an organic way to improve efficiency and reduce the harmful effects of plant protection drugs (often used in red onion production). In addition, relevant agencies shall support the province to address the irrigation problems of its onion regions.
- The irrigation infrastructure in Cu Lao Dung must be completed to sustain the aquaculture sector and fruit tree plantations.
- The model of three plants-one animal is unique. The province must document its experience and expand its implementation if deemed possible.
- The province may consider converting the unstable 3<sup>rd</sup> rice crop production during extreme weather conditions.

## Recommendations of Soc Trang Province

- Irrigation is the main issue of the province that affects its adaptive capacity to climate change. The province asked the central government to support the implementation of projects on sluices along the Hau River and the lock to regulate saltwater and freshwater. Irrigation-related solutions must address the water-related problems of Vinh Chau's red onion-growing areas during the dry season (currently using underground water) and combat flooding during the rainy season.
- The use of rice land for reservoirs of freshwater needs to be legalized.
- The province needs support to change the sugarcane-growing areas in Cu Lao Dung into aquaculture (salinity-affected area) and fruit trees (freshwater area) and attract businesses to invest in production and consumption.
- Establishing submerged forests to raise fish, bee, and swallow must be supported. Specifically, building swallow houses can increase the income of coastal communities.
- Local seed-producing businesses find it difficult to make pure seed (making the purity of commercial varieties low) due to high royalties paid to monopoly enterprises (VND 1,000/kg).
- VietGAP certification of organic products is expensive, discouraging farmers to apply.
- The development of cash crops is limited due to difficulties in output.

## IV. COMMENTS AND RECOMMENDATIONS

### General comments for the Mekong River Delta

#### The bottleneck of agricultural production in the Mekong River Delta

1. Vietnam ranked 14<sup>th</sup> in terms of population as of 13 September 2018 (96,682,257 people), accounting for 1.27% of the global population. The country, however, ranked 65<sup>th</sup> in terms of the natural area. Agricultural land area per capita is 0.1104 ha, equivalent to 8.7% of the world average. Vietnam ranks 42<sup>nd</sup> in terms of Gross Domestic Product (GDP) and 129<sup>th</sup> for GDP per capita (USD 2,109), showing that the investment capacity is not high, and the trained rural labor is only 13.9%.
2. The MRD is a major economic region for Vietnam. The region contributes 54% of rice production, 70% of aquaculture, 36.5% of fruits, 90% of rice exports, and 65% of fishery exports of the country. At the same time, it is one of the world's most vulnerable to climate

change impacts, especially sea level rise<sup>2</sup>. This affects 17.3 million farmers who are mostly smallholders and poor. If they cannot adapt, the food security and daily lives of people not only in the region but also in the whole country can be affected.

The global climate risk index in 2016 ranked Vietnam as the 7<sup>th</sup> most affected country from extreme weather events from 1995 to 2014.

- i. *In terms of flooding*: In the sea level rise to 100 cm, 38.9% of the MRD will be flooded, including 80.62% of Hau Giang, 76.86% of Kien Giang, and 57.69% of Ca Mau (MONRE 2016)<sup>3</sup>.
- ii. *In terms of salinity intrusion*: MRD has an area of about four million ha, but its terrain is low, with a common elevation of +1.0 m. Salinity intrusion can potentially affect more than two million ha in the MRD. During the period 2010-2017 to present, salinity intrusion had undergone changes in terms of its entry and offset compared to previous years: i) in the previous years, it starts on February. Now, it usually comes at the end of December or start of January (earlier than 1-1.5 months); ii) it now lasts six months or longer than before; and iii) the salinity levels at the beginning of the season (January and February) are greater in the middle of the season (March and April), which is the opposite with what was happening in the previous years.

According to the MARD (2016)<sup>4</sup>, due to drought and salinity intrusion, 139,000 ha of rice area were damaged from the end of 2015 to March 2016. Within these damaged areas, 86,000 ha were damaged by over 70% in terms of productivity (accounting for 62%); 43,000 ha damaged by 30-70% (accounting for 31%), and 9,800 ha damaged by less than 30% (accounting for 7%). The most damaged provinces are Ca Mau with 49,343 ha, Kien Giang 34,093 ha, Bac Lieu 11,456 ha, and Ben Tre 13,844 ha. By 2050, under the average climate change scenario, the output of Winter-Spring rice in the MRD is likely to be reduced by 2.16 million tons while the summer-autumn rice is projected to be cut by 1,475 thousand tons.

3. The most critical bottleneck is the quantity and quality of freshwater. Regarding the water security index, Vietnam ranked 9/10 among ASEAN countries<sup>5</sup>.
  - a. *Water quantity*: 89% of MRD's water comes from outside the territory. According to a study<sup>6</sup>, for nearly 90% of the years, floods are considered “small” and “medium” and the possibility of "lost flood" is very high.

---

<sup>2</sup> Opening remarks by Deputy PM Vuong Dinh Hue at the Conference “Sustainable Development of MRD adapting to Climate change”, Can Tho 26-27 September 2017.

<sup>3</sup> MONRE, 2016. Climate change and sea level rise scenario for Vietnam – updated version for 2016.

<sup>4</sup> MARD, Department of Crop Production. 2015 - 2016 Winter-Spring season review report.

<sup>5</sup> Richard Silbergliitt. Symposium on Integrated Foresight for Sustainable Economic Development and Eco-Resilience in ASEAN Countries. Thailand, 1– 2 October 2013

<sup>6</sup> Tran Minh Tuan, SIWRR. Some issues about the flow and salinity intrusion in the Mekong River Delta. “Report: Developing a plan to cope with drought, salinity intrusion and flooding, adapting to climate change in the Mekong River Delta provinces.” Can Tho 21 July 2017

- b. *Alluvial: (flowing through Tan Chau and Chau Doc):* From 1997-2016, the trend reduces by an average of 0.7210<sup>6</sup> tons/year (equivalent to 2.3%/year). In other words, the reduction levels reached 46% after 20 years. The average amount of alluvium for many years (September & October) is 24.310<sup>6</sup> tons/year, of which 89% flows to Tan Chau and 11% flows to Chau Doc<sup>7</sup>. It is impossible to improve the fields because the increased incidence of pests leads to more use of pesticides while reduced alluvium increases fertilizer use.
4. Underdeveloped infrastructure—specifically road transport and seaports—such as lack of railways (the most efficient means of transportation) is evident. There is almost no facility to process and preserve agricultural products, forcing farmers to sell them fresh. (It must be noted that the global market for processed fruits is about USD 300 billion).
  5. The quantity and quality of human resources, including science and technology, are both insufficient and low. Low investment rate for research on key products (except for rice, but rice is also mainly about varieties) is evident.
  6. Up to now, the growth model of MRD's agriculture sector has mainly relied on land and water resources, as well as manual labor. The farming scale of the households is the largest in the country, but they still use the farming methods of households. Poverty can be seen in the Northern Uplands, the main cause of which is lack of resources. In the MRD, poverty is mainly due to lack of science and investment.
  7. Agriculture is dependent on outside factors. The input (fertilizer, supplies, material) and the output markets mainly depend on China. The market, mainly traders (including foreign traders), is more developed than in other rural areas. However, traders are not under the strict management of the State.
  8. The value chain has not been formed in a sustainable manner. The number of enterprises investing in agriculture is very low (less than 2%). The links between businesses and farmers are weak. Although the Government has many policies, there is no effective operational mechanism.

### **Changing the role of rice and the need to convert a part of rice land to crops and fisheries in the Mekong River Delta**

1. At the present and in the future, the role of rice in Vietnam will change because (i) rice-based food security is no longer as absolute as before. It now needs to incorporate nutritional

---

<sup>7</sup> Meteorological stations in the South. Movement of suspended matter and risks of landslides in the Mekong River Delta. Workshop report: Risk assessment of early floods and major floods in the Mekong Delta in 2017. Dong Thap 2 June 2017



security, which means an enhanced focus on food that are high in protein, vitamins, and micronutrients in the meal structure. At the same time, rice consumption per capita is expected to decrease due to a (ii) decline in global rice prices. Since 2012, rice exports have been difficult to conduct due to low efficiency and low prices. This decline is expected to continue, leading to (iii) lower income from rice production than many other agricultural sub-sectors.

2. On the role of ensuring food security, MRD will not have to shoulder the entire burden as before for the whole country. The region now has the conditions to convert a part of rice production into other goals to achieve higher economic efficiency. However, the State must always have special policies for the MRD to be able to serve as a safety valve on food safety in the whole country. Vietnam's government must ensure that agricultural lands chosen for conversion can still grow rice if the need arises.
3. The question now is how much land should be maintained in the MRD from the current rice area of 1.85 million ha. According to calculations by MARD, to ensure food security by 2030, the minimum rice area nationwide must be 3.2 million ha with a planted area of six million ha and an average yield of about six tons/ha. This calculation comes from the World Bank. Under the plan to keep rice land to a minimum for food security, rice exports will decrease gradually. By 2030, almost no rice exports will occur.
4. Another issue to address is the use of the retained land areas to achieve high efficiency, as well as economic, social, and environmental sustainability for farmers:
  - a. *Identify key rice-growing areas in the MRD that are favorable to ensure two high-yield rice crops.* According to MARD and the World Bank, this specialized farming area is located in 30 districts across eight provinces in the MRD: An Giang, Dong Thap, Kien Giang, Hau Giang, Can Tho, Soc Trang, Tien Giang, and Long An. These are considered as the granary of the Delta and the whole country. Currently, the rice production of these districts accounts for 50% of the total rice output of MRD and contributes 75% of the total rice export volume of the whole country.

For this region, the State needs appropriate investment to complete synchronous infrastructure for production, post-harvest, processing and trade, 100% mechanization, 100% collective production, association and joint venture production, and application of advanced and high technologies in the value chain. In addition to the two main rice crops, depending on the specific situation, this region can produce one more short-term crop (two rice crops rotation with vegetables, beans) or triple rice (three rice crops/year). The two-rice crop rotation with short-term crops should

be encouraged while triple-rice should only be farmed when rice prices are good and to allow the crop rotation to get alluvium. The area of rice land in the key specialized cultivation areas should be stable around 800,000 ha. This region mainly cultivates high-yield fragrant rice and high-quality rice.

- b. *Identify areas for specialty fragrant rice and organic rice based on climate change adaptation scenarios and natural ecological conditions.* Ca Mau Peninsula has an area dedicated for shrimp-rice rotation area in coastal provinces, as well as for single rice crop. For this region, the government needs to invest in perfecting the irrigation system for the shrimp-rice rotation model (if there is a good irrigation system, it is possible to increase to 100,000 ha of shrimp-rice rotation and consolidate the existing shrimp-rice area of about 150,000 ha). In addition to the irrigation system, the State can support the selection of specialty rice varieties and craft policies to encourage organic rice production. Rice products in this region can go into the specialty rice market segment with the highest price on the world market. The area after stabilizing is about 500,000 ha.
- c. The remaining region has flexible rice production involving one rice crop rotation with upland crops. It can also be converted into specialized short-term upland crops (e.g. vegetables, beans, flowers, grass for livestock). When necessary, it can be converted to rice cultivation again. The area after stabilizing is about 200,000 ha.

## **Comments on the provinces of Ca Mau Peninsula**

1. The provinces surveyed (Kien Giang, Ca Mau, Bac Lieu, and Soc Trang) are all coastal provinces with very diverse characteristics in terms of their farming system, from specializing in rice, rice-cash crop, fruit trees, vegetables, fishery, crop-fishery, and forestry-fishery. In these provinces, there is no spontaneous conversion from rice land to grow fruit trees like in other provinces. The conversion mainly involves rice-aquaculture, which is highly adaptable to climate change and brings about high economic efficiency. Recently, rice-aquaculture has developed many good models and increased biodiversity and economic efficiency (such as shrimp-giant freshwater prawn+rice; tiger shrimp+white-leg shrimp-rice; and 2 rice crops-fish). These developments must be documented and replicated in appropriate areas.
2. All localities have plans to restructure their agriculture sectors towards commodity production, creating business linkages with farmers under the value chain at different levels of commitment, from large-scale field model to production under contract, certified production and traceability. Many production models of high-tech applications are applied.

3. The coastal provinces of Ca Mau Peninsula are seriously affected by climate change, but the area of summer-spring or autumn-winter rice is still large (except for Ca Mau). The provinces must then plan to convert a part of this rice area to minimize risks. The risk boundary map for triple rice areas per year can be detailed based on the risk map developed by IRRI and DCP. Agricultural extension and promotional activities must be enhanced to limit the farmers' spontaneous cultivation of winter rice crops in high-risk areas. Quality rice is an interest to all provinces, as well as organic rice, VietGAP rice, and rice from pure farming and rice-shrimp model. Some provinces commit to convert 100% of rice land to produce high-quality rice.

Rice production needs to be fully mechanized, including those in the shrimp-rice models. Currently, the gap in the mechanization of rice production is in sowing. Sowing must be mechanized to keep farmers from using hand tools. The use of rice transplanters should be promoted too with the necessary technical improvements (such as plating) and conducive policies.

It is necessary also to continue developing new, high-quality, specialty, salinity-tolerant, and restorative varieties, involving pure selection of cultivated rice varieties. DCP chooses the new rice varieties, which have been planted on a large area by the locals, for production and for the provision of legal seeds.

4. Developing cash crops on rice land to increase adaptability to climate change and increase crop diversity is a good trend, but this poses problems for the provinces now. Moreover, the price of all kinds of vegetable products is unstable. The solution is to organize production (large enough area - associated farmers) combined with technical advances (e.g. new varieties, irrigation for vegetable,) and establish purchasing and processing enterprises. This can be achieved by paying more attention to research and development on cash crops in the coming years.
5. Aquaculture, especially shrimp, is the strength of the provinces surveyed, accounting for nearly all the country's seafood export volume. The shrimp farming models are also diverse, from shrimp-forest to ecological shrimp and from organic shrimp (rice-shrimp) to extensive, semi-intensive, intensive, and super-intensive shrimp. This diversity in farming models bring both economic and environmental benefits. Specifically, shrimp breeding is of special interest because it accounts for 50-55% of the cost of shrimp on average.

Currently, 8 out of the 13 provinces and cities in MRD have raised tiger shrimp on an area of about 598,000 ha, in which shrimp-rice and semi-extensive farming models always occupy a large area compared to the remaining models. According to experts, salinity intrusion and sea level rise will lead to the possible expansion of shrimp farming areas or force the farmers to

convert to shrimp farming to adapt. Therefore, the brackish shrimp farming areas in the coming years is likely to expand from 800,000 to 1 million ha, concentrated mainly in the MRD. Brackish water shrimp, especially tiger shrimp (native species), is always of high commercial value, have a stable market, and shows great competitiveness.

6. The shrimp-rice farming model has a relatively fast growth rate in the MRD. In 2000, the area for shrimp-rice farming in the whole area was only 71,000 ha. Fifteen years later, the area expanded to 175,000 ha, accounting for 30.5% of the total area of tiger shrimp farming in the whole region and yielding 75,000 tons. Provinces with large shrimp-rice farming areas include Kien Giang, Ca Mau, Bac Lieu, and Soc Trang. The average shrimp-rice farming productivity is about 300-500 kg/ha of shrimp and 4-7 tons of rice. The average production cost is 30-35 million VND/ha, with an average interest rate of 35-50 million VND/ha/year.

In the shrimp-rice model, in addition to tiger shrimp farming, farmers also raise shrimp-crab and tiger shrimp-giant freshwater prawns, in which the farming area for giant freshwater prawn is huge, reaching 36,800 ha. The areas are concentrated in the provinces of Bac Lieu (17,275 ha), Ca Mau (11,382 ha), Kien Giang (5,200 ha), Ben Tre (1,500 ha), and Tra Vinh (1,112 ha). This polyculture should be encouraged because it reduces market risks, increases income, creates better feed cycles, and reduces environmental pollution.

7. In addition to rice and shrimp, some provinces also develop specialty and indigenous products such as red onion (in Vinh Chau-Soc Trang), Xiem bananas (in Ca Mau), and crabs (in Nam Can).
8. Intensive, high-tech, and even super-intensive shrimp farming requires a large investment and high-quality human resources, thereby affecting the rate of production practices. The number of small-scale shrimp farmers has led in providing raw materials for processing and export. Therefore, the State and locals should have enabling policies to link the production of smallholder farmers through cooperatives or connect them with businesses through seed, food supply, training, and underwriting products. Capital for intensive shrimp farming is also expensive, averaging 70-80 million VND/200-m<sup>2</sup> pond. If there is no supportive capital policy, sustainable production is difficult to achieve and the risk of losing the market is high.
9. It is necessary to be proactive in areas for raw materials when there are markets available and to meet the market requirements for quantity, types, quality standards, and food safety and hygiene.
10. However, the development of agricultural production in coastal areas is still facing many challenges and require effective solutions:

- a. Investment in irrigation is essential for coastal provinces in the Ca Mau Peninsula to cope with climate change and develop sustainable agriculture. All provinces in the region have urgent and large demands for irrigation investment such as sea dikes, Cai Lon-Cai Be sluice, locks, and irrigation works. State budget and Official Development Assistance must be allocated in the MRD to build irrigation infrastructures, including sea dikes for the coastal provinces of Ca Mau Peninsula.
- b. Freshwater source is scarce, and Ca Mau Province does not have any source of water from outside its premises. The Cai Lon and Cai Be river systems have no support for Ca Mau. Therefore, the storage of water for domestic use, cultivation, and especially aquaculture is vital. The use of a small area of rice land to build freshwater reservoirs is an effective solution, but it is difficult to implement because the land is used by farmers.

The immediate feasible solution is to dredge canals and ditches as a place to store freshwater in the rainy season, which will then be used for the dry season. Along with the water source, the water supply and drainage system, which were built for rice cultivation, also need to be adjusted to suit the restructuring goal. The water supply and drainage system not only ensure timely, quality, and enough water supply, but also prevent diseases and wastes to spread among ponds.

- c. Rice seed for the shrimp-rice area and shrimp seed for shrimp farming need special attention. The rice varieties suitable for organic farming in the shrimp-rice model such as Mot bui do, DS1, and ST require special attention to perfect the legal system of seed copyright, three-level variety production, and supply system. Through the survey, although the model of rice production on shrimp farming land has a large area, the team learned that the source of rice seed for planting by the seasonal calendar is seriously lacking. For many years, farmers in coastal provinces mainly cultivated the 'Mot bui do' rice variety, but this type of rice has a long growth period. If it catches the end of the rainy season, farmers may suffer heavy losses.
- d. Development of shrimp farming was unplanned; small production made it difficult for farmers to control the quality and origin of the seed, making them prone to pests and diseases. If the shrimp is treated with drugs and chemicals, residues may remain with the product, turning it into a rejected export.
- e. There are many models of organic and intensive production that must be summarized as a basis for large-scale deployment of effective models.

- f. A major cause of concern in implementing agricultural restructuring is the lack of capability among the people to link agricultural production and consumption. When "good harvest, devaluation" happens, congestion of goods in need of rescue still occurs. In some cases, the production was "oversupply, lacked in the sale" due to a lack of brand name and uneven quality. Therefore, conditions must be presented for mechanisms and policies to urge businesses to increase their investments and link production and consumption of products towards 100% of crop and aquaculture areas that are under contracts.
- g. The price of commercial shrimp is high due to the use of imported auxiliary technology, chemical drugs, and environmental remediation, especially feed. Shrimp seed is also imported mainly from ISI (America), SIS (Singapore), and CP (Thailand), affecting the competitiveness of Vietnam's shrimp products. In this regard, Viet-Uc Corporation said that it is necessary to build the value chain of the shrimp industry, with the first breakthrough starting from the shrimp seed, because it contributes to 55% of the success of shrimp farming.
- h. In terms of policy, the Government needs to pay attention to infrastructure investment in aquaculture areas, especially industrial and semi-industrial shrimp farming areas. Electricity is the main challenge for these areas. At the same time, it is necessary to re-plan the area for shrimp farming, considering regional links, seed inputs, food, and medicine, and product outputs.
- i. The coastal provinces of Ca Mau Peninsula have an advantage in the production of organic agricultural products due to the shrimp-rice, shrimp-forest, and rice-fish ecosystems, among others. Some provinces have set development goals in planning already. In promoting organic agriculture, meanwhile, an organic agricultural belt across coastal provinces in Ca Mau can be a key project.
- j. The livelihoods of people in coastal areas need to be cared for (international projects often target this goal) to enable their communities to contribute effectively in protecting the ecological environment and coping with climate change. Livelihood enhancement models for coastal people need to be summarized to mobilize State and international investment.

## References

MARD. 2016. 2015 - 2016 Winter-Spring season review report. Hanoi, Vietnam: Department of Crop Production.

MONRE. 2016. Climate change and sea level rise scenario for Vietnam – updated version for 2016. Hanoi, Vietnam: Ministry of Natural Resources and Environment.

Nguyen HS, Bui TY, Sebastian LS. 2018. Development of Climate-Related Risk Maps and Adaptation Plans (Climate Smart MAP) for Rice Production in Vietnam's Mekong River Delta. CCAFS Working Paper no. 220. Wageningen, the Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Available online at: [www.ccafs.cgiar.org](http://www.ccafs.cgiar.org)

Silberglitt R. 2013. Symposium on Integrated Foresight for Sustainable Economic Development and Eco-Resilience in ASEAN Countries. Thailand, 1– 2 October 2013.

Vuong DH. 2017. Sustainable Development of MRD adapting to Climate change. Conference opening remarks. Can Tho 26-27 September 2017.

## Appendix

### Appendix 1. The area of seasonal rice in the Mekong River Delta provinces

No	Province	2013				2017				2017 so 2013, %			
		Total	Specifically			Total	Specifically			Total	Specifically		
			Winter-Spring	Summer-Autumn	Autumn-Winter		Winter-Spring	Summer-Autumn	Autumn-Winter		Winter-Spring	Summer-Autumn	Autumn-Winter
1	Long An	527.7	232.7	224.7	61.5	523.5	234.2	224.1	63.0	99.2	100.6	99.7	102.4
2	Tien Giang	235.6	79.3	118.3	38.0	210.1	71.6	108.5	30.0	89.2	90.3	91.7	78.9
3	Ben Tre	72.2	19.0	20.1		40.7	15.7	15.2		56.4	82.6	75.6	-
4	Tra Vinh	235.6	64.5	80.7	90.4	220.2	59.9	77.0	83.3	85.3	92.9	95.4	92.1
5	Vinh Long	181.9	63.5	60.3	58.1	168.4	59.0	55.4	54.0	92.6	92.9	91.8	92.9
6	Dong Thap	541.8	208.2	198.6	135.0	534.8	208.9	198.5	127.4	98.7	100.3	99.9	94.4
7	An Giang	641.4	238.1	234.7	163.2	643.6	236.2	232.6	169.8	98.9	99.2	99.1	104.0
8	Kien Giang	770.4	300.6	294.2	109.7	737.8	298.8	303.0	88.6	95.8	99.4	103.0	80.8
9	Can Tho	236.6	88.0	81.6	67.0	240.1	85.4	81.1	73.6	101.5	97.5	99.4	109.8
10	Hau Giang	212.0	79.9	76.6	55.5	206.8	77.9	77.0	51.9	97.5	98.7	100.5	93.5
11	Soc Trang	373.5	141.3	200.7	-	350.0	144.2	183.2	-	93.7	102.1	91.3	
12	Bac Lieu	181.8	49.3	56.4	-	181.8	46.3	58.8	-	100.0	93.9	104.3	
13	Ca Mau	129.8		35.5	-	118.9	na	36.7	-	91.6	-	103.4	
	MRD	4340.3	1564.4	1682.4	688.0	4157.5	1539.4	1651.1	658.3	95.8	98.4	99.9	95.7
	Whole country	7,902.5	3106.6	2122.8	688.0	7673.5	3077.4	2105.9	658.3	97.1	99.1	99.2	95.7

Source: The Department of Crop Production



## Appendix 2. Aquaculture area of the Mekong River Delta in 2017

No	Area	Aquaculture area, ha		Shrimp-rice area, ha
		Total	Shrimp	
1	Whole country	1.10.200	723.760	
2	MRD	798.400	598.690	
3	Long An	9.400	12.073	
4	Tien Giang	16.000	24.498	
5	Ben Tre	45.200	54.870	
6	Tra Vinh	33.800	43.242	2.619
7	Vinh Long	2.300	15	
8	Dong Thap	6.200	1.548	
9	An Giang	2.700	50	
10	Kien Giang	153.900	63.190	77.264
11	Can Tho	8.300	23	
12	Hau Giang	7.300	34	
13	Soc Trang	74.100	127.882	9.919
14	Bac Lieu	136.100	114.865	28.285
15	Ca Mau	303.100	156.400	51.570

Sources: General Statistics Office, 2019; AMDI 2015

## Appendix 3. Members of the Assessment Team

Organization	No	Name
Independent expert	1	Mr. Bui Ba Bong, former Vice Minister of MARD, team leader
	2	Mr. Nguyen Van Bo, former President of Vietnam Academy of Agricultural Sciences
The Department of Crop Production	1	Mr. Le Thanh Tung, presentative of the Department of Crop Production
	2	Ms. Tran Thi My Hanh, a staff of DCP
Research Institutes	1	Mr. Nguyen Dinh Vuong, Director General of Center of Water Supply and Irrigated Agriculture Research, Southern Institute of Water Resources Research.
	2	Mr. Chau Tai Tao, Lecturer of Fisheries Department, Can Tho University
CCAFS	1	Mr. Nguyen Duc Trung CCAFS SEA
	2	Mr. Duong Minh Tuan CCAFS SEA

#### Appendix 4. Working schedule and survey locations

Time		Work
10/12/2018	Afternoon	Move from Hanoi to Can Tho- Rach Gia (Kien Giang)
	Evening	Stay at Hotel Sea Light, Rach Gia
11/8/2018	8:00 - 12:00	Working with Kien Giang DARD: Mr. Nguyen Van Tam, Director of DARD and related branches
	13:30 - 17:30	Field trip at i) Bao Tram Cooperatives, Nam Yen commune, An Bien district: Director of the cooperative: Mr. Luong Van Nham and Mr. Nguyen Van Lien, Deputy Head of Agriculture Department of An Bien District; ii) Visiting the Rice-Shrimp model at Nga Bac village, Dong Hung B commune, An Minh district, Kien Giang
	17:30-21:00	Move from Kien Giang to Ca Mau. Stay at Muong Thanh Hotel
12/12/2018	8:00-11:30	Working with Ca Mau DARD: Mr. Nguyen Van Tranh, Deputy Director of the Department of Agriculture and Rural Development and its branches.
	13:30 - 17:30	Field trip at (i) Vien Phu Farm (Green Farm) at U Minh ha-Ca Mau Director: Mr. Vo Minh Khai; (ii) Super high yield farming model (Mr. Nguyen Thanh Ha, Chong My village, Ham Rong commune, Nam Can district
	17:30 - 20:00	Move from Ca Mau to Bac Lieu, Stay at Sai Gon Hotel
13/12/2018	8:00-9:30	Working with Bac Lieu DARD: Mr. Trinh Hoai Thanh, Deputy Director of Department and related branches.
	9:30-12:00	Working with Viet-Uc Shrimp Corporation at Giong Nhan village, Hiep Thanh village, Bac Lieu city.
	13:30 - 16:30	Visiting the organic onion production model at Au Tho B village, Vinh Hai, Vinh Chau, Soc Trang (Mr. Chiem Liet's household)
	16:30 - 19:00	Move to Soc Trang. Stay at Que Toi hotel, 278 Phu Loi, ST
14/12/2018	8:00-11:30	Working with Soc Trang DARD: Mr. Luong Minh Quyet, Director of DARD, Mr. Nguyen Thanh Phuoc (Head of Sub-Department of Cultivation - Plant Protection); Mr. Duong Tan Truong (Director of Fisheries Sub-Department); Mr. Ha Tan Viet (Head of Irrigation Sub-Department)...
	13:30 - 15:30	Visiting the model of converting rice land to red onion at Lich Hoi Thuong commune, Tran De district
	15:30 - 17:00	Visiting the model of converting sugarcane land to taro, sorghum, Idor longan, Thailand origin at An Nghiep A village, An Thanh 3 commune, Cu Lao Dung district
15/12/2018	8:00-10:30	Visiting Ho Quang company in Soc Trang City, specializing in producing ST rice varieties suitable for export and rice production in the Shrimp-Rice model
	10:30 - 12:30	Expert meeting
	Afternoon	Move Soc Trang - Can Tho - Ha Noi



RESEARCH PROGRAM ON  
**Climate Change,  
Agriculture and  
Food Security**



The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is led by the International Center for Tropical Agriculture (CIAT). CCAFS is the world's most comprehensive global research program to examine and address the critical interactions between climate change, agriculture and food security. For more information, visit us at <https://ccaafs.cgiar.org/>.

Titles in this Working Paper series aim to disseminate interim climate change, agriculture and food security research and practices and stimulate feedback from the scientific community.

CCAFS is led by:



International Center for Tropical Agriculture  
Since 1967. Science to cultivate change

Research supported by:



Ministry of Foreign Affairs of the Netherlands

