

Adaptation Options for Rice-Based Cropping Systems in Climate Risk-Prone Provinces in the Mekong River Delta: An Assessment Report

Working Paper No. 245

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

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RESEARCH PROGRAM ON
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Abstract

This report highlights 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 in association with the five offices of the Department of Agriculture and Rural Development in the Mekong River Delta provinces of An Giang, Can Tho, Dong Thap, Long An, and Tra Vinh.

The meetings underlined progress made by the provinces on climate change adaptation and mitigation, options for risk reductions, crop production, conversion, management and practices as mandated in various circulars, directives, and decisions notably Decision No. 1915/QD-BNH-KH issued by the Ministry of Agriculture and Rural Development that approved the Master Plan for Rice Production Development in Mekong River Delta to 2015, Vision to 2030 under the context of Climate Change.

This assessment report also looks at various issues that affect the agricultural transformation of the region such as failure to recognize risks brought about by climate change, unpredictable prices of agricultural products in the local and world market, lack of linkages between farmers and potential markets, lack of knowledge and skills in growing new crops, and spontaneous breaching of provincial government plans in changing cropping systems, and more investments in modernizing agricultural infrastructure, among others.

The report draws upon the critical importance of the master plan mentioned earlier in rice restructuring within the context of the whole Mekong Delta to guide and shape the actions of the visited provinces. Climate-related risks maps and adaptation plans (CS MAP), which is applied in the five Mekong Delta Region provinces, are found to be valuable in complementing the planting calendar of rice seasons.

Keywords

Climate change, adaptation plans, cropping systems

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Acronyms

CCAFS SEA	CGIAR Research Program on Climate Change, Agriculture and Food Security
CLUES	Climate Change Affecting Land Use in the Mekong Delta: Adaptation of Rice-based Cropping Systems
CS MAP	Participatory development of climate-related risk maps and adaptive plan or Climate Smart MAP
CPO	Crop Protection Office
CSA T&P	Climate Smart Agriculture Technologies and Practices
DARD	Provincial Department of Agriculture and Rural Development
DCP	Department of Crop Production
FAO	Food and Agriculture Organization
Global GAP	Global Good Agriculture Practice
GDP	Gross Domestic Product
GIS	Geographic Information System
HMO	Hydrology Management Office
IRRI	International Rice Research Institute
ISET-Rockefeller	Institute for Social and Environmental Transition-International
MD	Mekong Delta
MONRE	Ministry of Natural Resources and Environment
MRD	Mekong River Delta
NGO	Non-government organization
PPC	Provincial Peoples Committee
PPMU	Provincial Project Management Unit

VietGAP	Vietnam Good Agriculture Practice
VND	Vietnam Dong
VnSAT	Vietnam Sustainable Agriculture Transformation Project

I. Rationale

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 for the 13 provinces in the Mekong River Delta (MRD) (Son et al , 2018).

After several consultations and discussions, DCP and the Provincial Department of Agriculture and Rural Development (DARD) offices in the Mekong River Delta (MRD) identified common climate-related risks across the provinces. The identified levels of risks (i.e., 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 for developing climate change adaptation plans for rice production (Figure 1).

The current adaptation plans contain two measures: changing of cropping system and adjusting planting and/or sowing dates. The adaptation plans show the rice areas that need to shift from three-rice cropping to two-rice cropping 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 for implementation of the options have not been assessed as well.

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

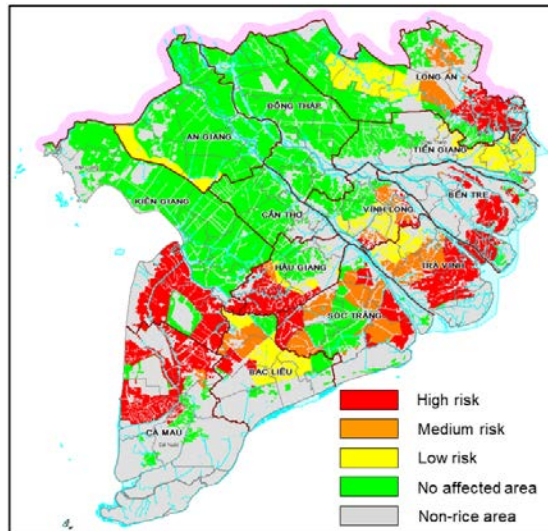


Figure 1 A. Mekong River Delta salinity intrusion risk map.

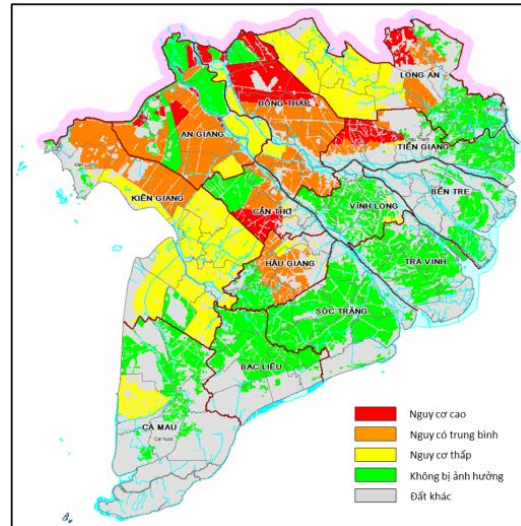


Figure 1 B. Mekong River Delta flood risk map.

Figure 1. Mekong River Delta risk map.

II. Objectives

In general, the mission supported DCP in the implementation of the directive from the Ministry of Agriculture and Rural Development in accordance with Decision No.1915/QĐ-BNN-KH dated 28 May 2018 issued by MARD in approving the Master Plan for Rice Production Development in Mekong River Delta to 2025, Vision to 2030 under the Context of Climate Change. Based on the salinity, drought, and flood risk scenarios currently available, five provinces/city were initially selected, namely: Long An, Tra Vinh, Dong Thap, An Giang, and Can Tho. The team evaluated the rice areas' transformation progress and identified potential alternatives for the upcoming years to ensure effective agricultural transformation.

In general, the mission supported DCP in the implementation of the directive from the Ministry of Agriculture and Rural Development in accordance to the Decision No.1915/QĐ-BNN-KH, dated on 28 May 2018, issued by MARD on approving the Master Plan for Rice Production Development in Mekong River Delta to 2025, Vision to 2030 under the Context of Climate Change. Based on the salinity, drought, and flood risk scenarios currently available, five provinces/city were initially selected namely: Long An, Tra Vinh, Dong Thap, An Giang, and Can Tho. The team evaluated the rice area transformation progress and identified the potential alternatives for the upcoming years to ensure effective agricultural transformation.

To achieve these objectives, the team has:

1. Reviewed the result of rice area transformation progress in selected provinces;
2. Identified economically feasible adaptation options for the risked areas under the two scenarios in the target provinces;
3. Analyzed the market potential and economic opportunities for the identified adaptation options inside and outside the target provinces;
4. Assessed current capacity and human resource and financing needs for the identified adaptation options; and
5. Assessed the relevance of adaptation options to the overall development plan of the province and MRD.

III. Expected outputs

For each of the provinces:

1. A list of adaptation options identified for different risk areas and scenarios, with each option describing its technical feasibility;
2. Current capacity and needs for implementation; and
3. The relevance of identified adaptation options to the development plan of MRD and overview of supporting policies and programs for implementing the options.

IV. Methodology

The consultation meetings were participated in by international and national experts from IRRI, CCAFS, DCP, and DARD offices. The focus group discussions dealt on: (1) the progress on the rice area transformation per MARD Circular No.19/2016/TT-BNNPTNT; (2) the climate-related risks maps and adaptation plan of the province; and (3) the possible options for each risk areas under different scenarios. The discussions also included pre-collected data on the following: (a) cropping calendar, (b) crop production practices during summer seasons characterized by heavy rainfalls, (c) constraints to crop production and post-production, and (d) capacity development needs.

V. General status of agricultural transition in the Mekong Delta

According to the Comprehensive Program for Developing Sustainable Agriculture and Adaptation to Climate Change in the Mekong River Delta (MRD) by MARD, it is possible to divide the MRD into six agro-ecological sub-regions, namely, Long Xuyen Quadrangular (Tu Giac Long Xuyen); Dong Thap Muoi; Middle zone between Tien and Hau rivers; West of Hau river (Tay Song Hau); East Coastal Estuaries; and Ca Mau Peninsula (Figure 2).

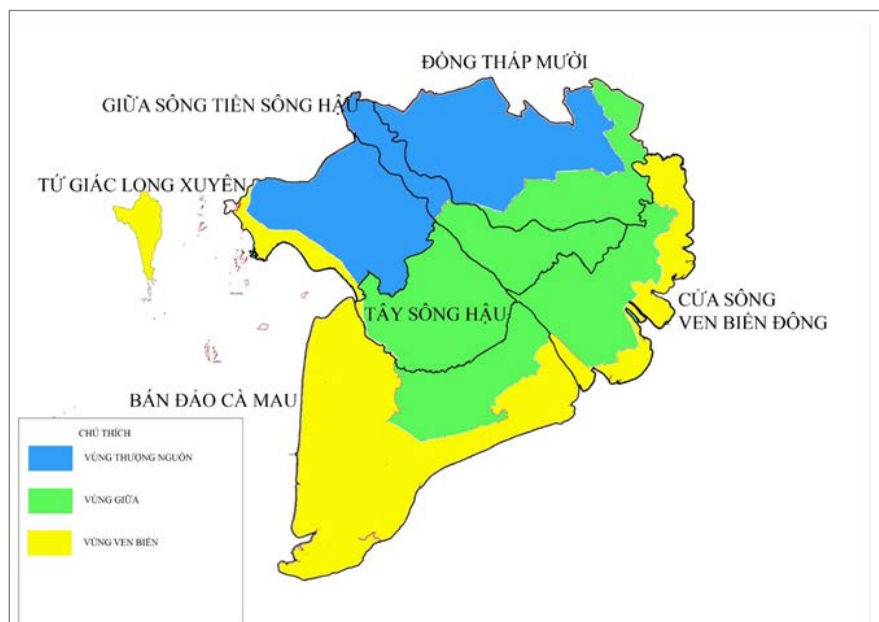


Figure 2. Ecological zoning for agriculture development in the MRD (MARD 2017).

Over the past three decades, the change in farming systems in the MRD has been influenced by a combination of government's policies (Resolution 09/2000/NQ-CP; Decision 899/QĐ-TTg...) on irrigation expansion, export markets, technological advances, environment and climate change, and urbanization and industrialization, in which economic factor is the key driving force (ICEM, 2015). With the government's policy on food security and development of dyke systems, the area of rice production increased dramatically in the period 1990-1999, and there had been a strong shift from one rice crop to two rice crops and, later on, to three rice crops. This led to the transformation from 1 rice crop into 2-3 high-yield crops with short cultivation period and forming the specialized production area of three rice crops in some areas

In 2000-2007, rice production area decreased due to the government's policy on encouraging crop diversification towards minimizing risks and improving economic returns. However, the area of paddy increased again to mainly three rice crops. According to MARD (2017), three rice crops accounted for about 45% of total paddy land in the MRD, mainly in Long Xuyen Quadrangular and Dong Thap Muoi.

The MRD experienced transformation from 2 or 3 high yield rice crops into 1 rice crop and 1 or 2 rotated cash crops. The shift in farming system from specialized rice production to rotated rice and cash crops (i.e., vegetables and corn) or specialized cash crops occurred in some provinces in Long Xuyen Quadrangular; Middle zone between Tien and Hau rivers; East Coastal Estuaries (An Giang, Vinh Long, Soc Trang). In 2000 to 2013, cash crop area increased by 7% per year.

Transformation from 2 or 3 rice crops to mixed rice and aquaculture farming (rice-giant freshwater prawn-*Macro brachium rosenbergii*) or rotational rice and aquaculture farming (rice – tiger shrimp/white-leg shrimp) or specialized shrimp farming rapidly increased in coastal areas of provinces in East Coastal Estuaries and Ca Mau Peninsula. By 2014, the area of rice-shrimp farming doubled to 152,980 ha, accounting for 27.98% of the total brackish water shrimp area in the MRD region (Pham Anh Tuan et al., 2016). Kien Giang has the largest area of rice-shrimp farming with about 71,500 hectares, followed by Ca Mau (43,290 ha), Bac Lieu (28,290 ha), Soc Trang (7,810 ha), and Ben Tre (4,830 ha). In some areas, the people unloaded sewers to prevent salinity and turned them into specialized shrimp (Ca Mau) farming. In some areas, local people left off the sluice gate for getting saline water to farm shrimp.

Over the last 10 years, there has been a shift from 2 or 3 high yield rice crops to fruit trees in Dong Thap Muoi, Middle Zone between Tien and Hau rivers, and East Coastal Estuaries that included upstream districts.

For the past 30 years, the above trend allowed the rapid increase of fruit trees in Tien and Hau rivers, starting from Dong Thap, Tien Giang, Vinh Long, and Hau Giang, further expanding in areas with a closed dyke system and less influenced by floods. In 2010–2016, the total fruit area of the MD increased by 53% with 323,000 fruit trees. Long An province has experienced an increase in fruit production area by 300%, followed by Vinh Long (66%), Hau Giang (58%), and An Giang (50%).

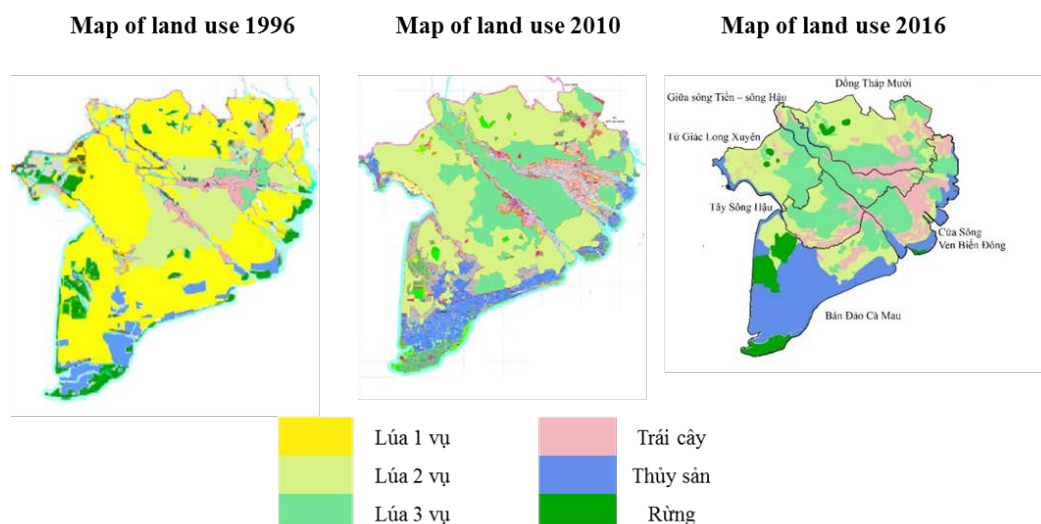


Figure 3. Land use map over 1996, 2010 and 2016 (MARD 2017).

In recent years, along with the shift towards intensive farming, agricultural farming systems in the MRD are also moving towards high quality, safe, and organic production due to market-oriented forces and technological advances.

Over the past 30 years, MARD (2017) indicated that farmers in the MRD switched from local rice varieties with long growth duration to high-yield varieties with shorter growth duration to increase their crops. About 41 new rice varieties were released for production In 2011-2017. Results show that there are short-growth duration rice varieties with better quality and higher salt and flood tolerance that helped farmers avoid salinity and flood.

In most sub-regions, there has been a shift from low-quality to high-quality varieties of sticky rice, which accounts for about 83% of the area. In the coastal and domestic-use production areas, the trend in returning to local rice varieties with high quality, better hygiene, and food safety has also been observed.

Additionally, farmers have also changed their practices from using lots of fertilizers and pesticides for improving yield to more sustainable production and better adaptation to climate change. Some of the prominent practices include: “3 Reductions, 3 Gains”¹; “1 Must Do, 5 Reductions”²; and “1 Must Do, 6 Reductions”³. In economical watering techniques, VietGAP and GlobalGAP standards are also increasingly applied.

¹ Reductions: seed rate, pesticides and Nitrogen fertilizers used; 3 Gains: Improved productivity, quality and economic efficiency/income.

² Must Do: using certified seed; 5 Reductions: seed rate, pesticides, fertilizes, water used, and harvest loss.

The crop structure was also adjusted to avoid drought–salinity intrusion in the late Winter-Spring and early Summer-Autumn crop in coastal areas, reducing Spring-Summer rice and increasing Autumn-Winter crop. As a result, the area of Spring-Summer rice has decreased by 30,000 ha, and the area of Autumn-Winter rice increased from 472,000 ha in 2005 to 824,000 ha in 2016.

IV. General information of the five provinces, transformation plans, general observations and recommendation during the mission

A. Long An Province

Background information

Long An is one of the four provinces with the largest rice production area in Mekong River Delta. It has a planted rice area of 526,862 ha in 2017 and a total production of 2.6 million ton of paddy/year (see Table 1).

Rice is the major crop in the province, which accounts for 90% of the total cultivation area. Vegetable is the second major crop (13,551 ha), with the production of 222,000 ton, in which fruit vegetables (i.e., tomato, cucumber, melon, etc.) account for 63% and only watermelon accounts for 50%. Other major crops are dragon fruit (9,419 ha, which is about 43% of the total cultivation area of perennial crop) and lemon/lime (8,374 ha).

Figure 4 (4a and 4b) shows the proposed cropping pattern of Long An province as the basis for rice conversion.

³ 1 Must Do: using certified seed; 5 Reductions: seed rate sowing, pesticides, fertilizers, water used, harvest loss and Greenhouse emissions.

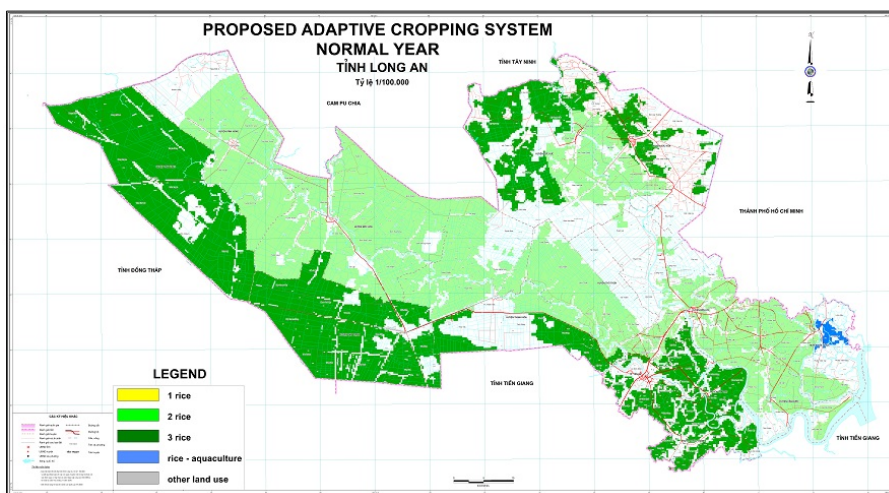


Figure 4 A. Proposed rice cropping pattern for normal years.

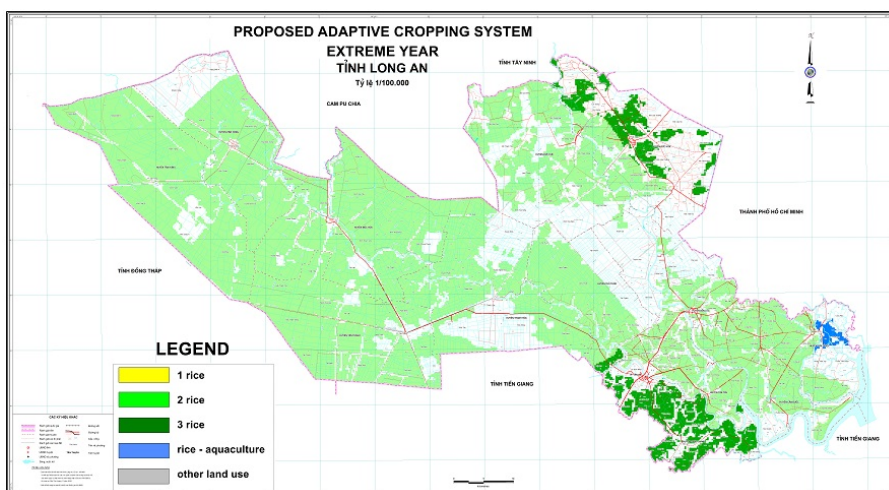


Figure 4 B. Proposed rice cropping pattern for extreme years.

Figure 4. Proposed rice cropping pattern map of Long An province.

Table 1. Current status and plan of crop and aquaculture conversion of Long An province to 2030.

No.	Crops/commodities	Area, ha				2030 vs 2017
		2017	2020	2025	2030	
1	Rice for the whole year	562,862	526,437	507,298	502,814	89.3
	- Winter-Spring rice crop	234,241	226,425	219,681	212,446	90.7
	Summer-Autumn rice crop	224,050	220,198	218,847	212,446	94.8
	- 3 rd rice crop	2,178	1,800	1,650	1,300	59.7
	Autumn-Winter rice crop	66,249	39,613	19,315	17,961	27.1
2	Fruit trees	20,698	26,241	31,550	37,359	180.5
	- Dragon fruit	9,419	10,621	11,240	11,872	126.0
	- Lemon	8,374	9,227	10,128	11,328	135.3
	- Pineapple	916	960	1,271	1,683	183.7
	- Mango	636	1,219	1,970	2,635	414.3

	- Banana	496	1,198	2,011	2,905	585.7
3	Vegetable	13,551	17,449	21,606	26,557	196.0
4	Corn	1,393	3,519	10,748	14,520	1042.4
5	Sesame	524	1,620	2,640	3,613	700.9
6	Feed plant	1,589	1,635	1,909	2,364	167.5
7	Cassava	1,564	1,175	1,101	982	62.8
8	Sugarcane	9,333	3,706	0	0	-
9	Aquaculture	9,170	13,183	-	13,199	143.9
9a	Freshwater aquaculture	2,754	8,493	-	9,089	330.0
9b	Salty and blackish aquaculture	6,416	4,690	-	4,109	64.0

Source: Long An Department of Agriculture and Rural Development, August 2018.

General information on rice conversion

In general, the rice sector transformation has achieved initial results, many converted crops have brought higher income: (200-400 million VND/year or about USD 8,700 -17,400⁴) for dragon fruit and 70-150 million VND/year (USD3,000-6,522) for lemon. However, rice area conversion is still lower than expected (see Table 2). Some converted crops failed (i.e., sesame, corn, and peanut) due to the unstable market and/or impact of climate change and natural disaster.

Table 2. The result of rice area conversion in the first six months of 2018 in Long An province. (ha)

	1 rice crop	2 rice crops	3 rice crops	Intensive rice production	Total
Annual crop	117	9,154	1,855	7,255	18,381
Vegetable	113	4,208	1,498	3,845	9,664
Watermelon		2,500	595		3,095
Peanut					
Tuber crop		2,537	310		2,847
Corn		1,100	42		1,142
Lotus	4	1,190	5		1,199
Perennial crop	107	1,688	333		2,128
Lemon	5	620	55		680
Dragon fruit	14	252	202		468
Pineapple	85	674	21		780

⁴ All USD conversion estimates were computed at an exchange rate of VND23,000 to USD1

Rice - aquaculture		1,311			1,311
Rice - cat fish		1,311			1,311
TOTAL	224	13,153	2,188	7,255	21,820

Problems and constraints in rice conversion

1. The farmers lack knowledge and skills on the production and management of converted crops, like fruit trees and orchard development.
2. Lack of good quality seedlings for fruit trees.
3. The infrastructure and facilities for fruit tree production are still poor (i.e., irrigation and drainage, protection dyke system).
4. The conversion of rice area to other crops sometimes does not follow the projected plan. Many farmers spontaneously converted their paddy field into orchard. There are some cases where people from other provinces rent the paddy field to grow dragon fruit.
5. The linkage between production and consumption is weak. It is difficult to develop a value chain program for some key agricultural commodities for lack of large firms that can lead the value chain.
6. The market for fruit trees and other converted crops (including aquaculture) is unstable due to fluctuating prices.

Recommendation for provincial DARD

1. The Provincial People Committee and DARD to identify the appropriate crops for conversion taking into consideration both domestic and export market.
2. Identify specific area suitable for crops (i.e., fruit, vegetable, rice) and communicate with farmers to follow the best management practices for better yield and high-quality product that could demand higher a market price.

Climate change risk

The period with severe risk of drought and salinity intrusion was from December 2015 to July 2016, causing severe losses to agriculture sector. Total rice area affected by salinity intrusion was 9,490.89 ha, of which 30-50% of the 8,696.20 ha was damaged, 50-70% of 1,676.9 ha

was destroyed, and higher than 70% of the 5,811.23 ha was devastated. The total economic loss in agriculture sector was 191.43651 billion VND (about USD8.324M).

In 2011, the rice area affected by severe flood and tidal wave was 5,633 ha, and about 2,847 ha was totally lost. The area affected by flood was 8,126 ha for vegetable and industrial crops and 1,294 ha for aquaculture.

In mid-July 2017, flood with high tide came earlier than normal (Summer-Autumn, Autumn-Winter), which led to increased water level in the districts of Dong Thap Muoi to about 10-17 cm/day, causing 70% damage and loss in 1,494.3 ha for rice production.

Implementation of CS MAP

Based on the risk maps produced in 2017, the DARD office of Long An worked with the Center for Agricultural Planning, National Institute of Agricultural Planning and Projection to develop maps to complement the planting calendar of three rice seasons in the province. The risk maps, as well as the adaptation plans, are key guides for DARD to manage rice production in their area. Currently, the provincial Crop Production Office manages and updates the maps.

However, the lack of technical knowledge among officials at the district level keeps the CS MAP from being downscaled in the province. Consequently, the maps are currently utilized at the provincial level only.

Adaptation measures in climate change

1. Strengthen the hydromet observation and early warning system.
2. Encourage the farmers to build up/rehabilitate the dyke system to protect the summer-autumn crop.
3. Raise public awareness on the impact of climate change and mobilize social organizations (i.e., youth, war veterans, women union) to join forces in responding to natural disasters.
4. Communicate with farmers to encourage them to follow the advisories on planting time, strengthening dyke system during flood season, and storing water during drought season.

5. Long An province will develop and issue the Natural Disaster Prevention and Response Plan annually. DARD is also revising and updating the Climate Change Adaptation Plan in agriculture sector.

Proposed adaptation options

1. In Dong Thap Muoi area, apply the acid sulphate and saline tolerance rice varieties with short growth duration .
2. Apply the 1 Must-Do 6 Reductions approach.
3. In southern districts and lower parts of Can Duoc, Can Giuoc, Chau Thanh, and Tan Tru (particularly rainfed and saline area), apply 2 rice – 1 cash crop model.
4. In the area with high level of saline intrusion, introduce brackish water shrimp culture and fruit trees (i.e., coconut).
5. Construction of a storage reservoir of 100 ha each in Thanh Hoa district to supply irrigation water is recommended during dry season.

General observations and recommendation during the mission

Observations

In Long An province, a large area of about 40,000 ha lacks protective dykes. Insufficient support is given to farmers in converting rice to fruit production because of severe shortage of good seedlings and planting practice of fruit trees. Consequently, the transformation was done by farmers spontaneously. The farmers' decision to grow fruit trees depend on the availability of rice land for rent rather than follow the provincial planning and recommendations. There is a lack of linkage in the supply chain and contract farming even for the production areas under transformation. Price of agro products like watermelon and upland field crops has fluctuated, and market has been volatile. The investment in infrastructure to serve transformation is limited. On the other hand, organic agriculture and high-tech agriculture are in the early stage of development.

Field visit in the conversion of rice crops to fruit crops at the household of Mr. Tran Van Chin, Truong Cong Y hamlet, Tan Lap commune, Tan Thanh district:

Mr. Tran Van Chin and his family owns 9 hectares of rice land, of which 3 hectares of the land are converted into dragon fruit plantation, and some parts are allocated to durian. This is a typical alkaline land of Dong Thap Muoi.

According to Mr. Van Chin, dragon fruit has been harvested with high efficiency (5-6 times more than rice cultivation). Durians have just been planted. However, the householder said that the conversion was completely spontaneous and not technically instructed. Also, the seedlings were bought from the local market without any certification and guarantee. In theory, dragon fruit has a high disease and market risks without the support from specialized agencies and management. Durian and perennial fruit trees that are arranged in low lining (beds) as specified in the model exhibit unsure safety especially when the trees reach 5 years when their roots may reach the acid sulphate-generated layer.



Figure 5 A. Consultation of the mission with officials of the Department of Agriculture and Rural Development, Long An province on 14/08/2018.



Figure 5 B. Conversion of rice farm to red dragon fruit farm in Truong Cong Y Hamlet, Tan Lap, Tan Thanh, Long An.



Figure 5 C. Conversion of rice farm into durian tree farm in Truong Cong Y Hamlet, Tan Lap, Tan Thanh, Long An (with Thai jack-trees along Liep field edge).



Figure 5 D. Use of spray irrigation system, straw and stubble to cover roots of newly-grown durians in Truong Cong Y Hamlet, Tan Lap, Tan Thanh, Long An.

Recommendations

The conversion of inefficient rice land into fruit trees is in the right direction especially in a flourishing fruit market. There are many models of successful rice land conversion into dragon fruit. However, the technical and market risks are very high since the conversion is not specifically planned.

Areas with no embankments and have temporary dykes will be easily flooded during Autumn-Winter rice crop, which may pose great losses. Therefore, it is necessary to plan the concentrated rice areas for effective dike construction and flood control. It is recommended for the area with stable embankments to farm the 3rd rice crops, but should use short-growth duration varieties so harvest could be done in July to avoid the risk of early and high flood. For the area with temporary and unstable embankments, farm only Winter-Spring and Summer-Autumn crops. Autumn-Winter crops can be omitted to get alluvium, improve the field, or grow lotus and macre. It is also possible to raise fish in cages where it is appropriate. The conversion to fruit trees should have good certified seedlings. However, the province has not planned building seedling centers or associated seedling production. It is important to note that technical training from planting to postharvest handling should be carried out.

DCP approves the release of existing varieties (i.e., glutinous variety OM85) planted on large area in the province, but has not yet officially ordered their release. Machines for direct (wet) seeding of rice are needed as the expansion of transplanting by machines is difficult to carry due to high cost. Caution for the increased infection of Bacterial Leaf Blight (BLB) on rice is required. Production of certified seeds should be improved to lower the price so that farmers can afford to buy.

Based on immediate review of existing models, promulgate a set of appropriate policies and mechanisms to encourage and/or limit the conversion of rice land to ensure efficiency and avoid risk.

The subsidy policy to support transformation as proposed by the province should be expanded since growing maize to replace rice was only subsidized so far. Services like technology transfer through farmers' training and good seed supply can be improved. Government can also support marketing promotion by seeking market for potential products like blue dragon fruit, lemon, taro, etc. Nafoods Group has invested over 400 billion VND in a fruit processing plant in Long An province that has a condensing line with a capacity of 7,000 tons per year, and an IQF line with a capacity of 2 tons per hour. Therefore, the province should plan to establish raw material areas for this plant to ensure effective product output and stabilize the market.

Long An has a very effective banana production model in An Huy Long An Co., Ltd. in Hiep Hoa commune, Duc Hoa district, with an export capacity of 10,000 tons per year. Its Fohla

banana brand is exported to the demanding markets of Japan, Korea, and Singapore. It is recommended for Long An to follow and expand this model because bananas are easy to grow, less prone to disease, and have a large market.

On the other hand, the cultivation of corn should be carefully calculated in terms of technique and postharvest treatment system, especially in drying. In our opinion, the plan to increase the area of corn up to 10 times from 1,343 ha to 14,520 ha (see Table 1) is not feasible due to low competitiveness (production cost is 30-40% higher than that of imported ones), limited infrastructure (i.e., irrigation), and unsatisfactory drying process.

Poor irrigation system in the southern part of the province is affected by rain water or salinity intrusion. Recommended climate change adaptation model of Long An can be 2 rice crop – 1 annual crop. In high risk areas, brackish water shrimp farming or making beds for fruit trees can be applied to grow coconut and custard. The gray terrain has high terrain, increasing area of shallow plants, especially fruit trees, vegetables, and sesame.

Crop-animal integrated system

Some farmers plant forage grasses in small patches of saline paddy fields. Most farmers in the village have at least 2 heads of cattle they use in farming activities. By growing improved forage grasses and forage legumes, these will serve as feeds for cattle and for confined goat raising as well. The wastes of cattle and goat can be used as manure or organic fertilizer for growing forages or other high value crops in the area, and as a medium for vermi-composting, a higher quality organic fertilizer with premium price in the market.

A community-based crop-animal production model can produce high quality milk or meat and compost as organic fertilizer to forage and other crops in the area, thereby increasing farm productivity and livelihoods in saline affected areas. Home-backyard vegetable gardening does not only provide additional income, but also improves human nutrition as well. The biomass and wastes from the crops can be used as substrate for vermi-composting.

Production of organic fertilizer is one way of increasing livelihood in the community, particularly for women and youth. If the target is growing organic products, branding of products coming from this area will make them unique or distinct from other localities. This system is also applicable to other provinces where crop-animal integrated system is feasible.

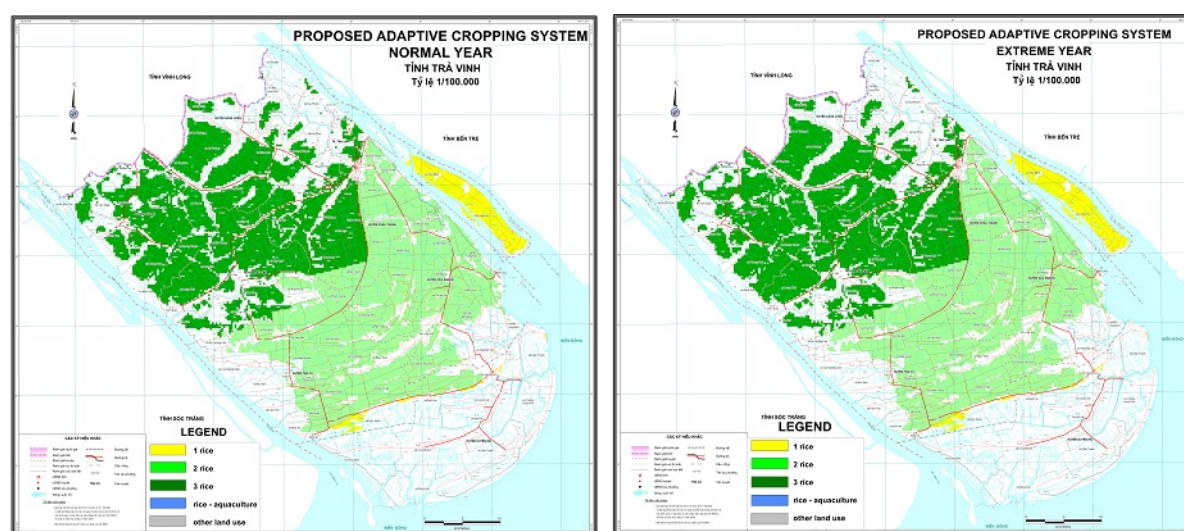
B. Tra Vinh Province

Background information

Tra Vinh achieved a significant change in agriculture after the approval of the production structure conversion plan. Compared to 2013, the area of rice cultivation in 2017 reached 220,200 ha with a 15,300 ha decrease (6.5%), with autumn-winter rice as the most decreased crop area (8%). Winter-spring rice and summer-autumn rice also decreased by 7.1% and 4.5%, respectively (see Table 3).

Areas planned for sugarcane, peanut, and corn are reduced. Corn decreased the most by 21%, while sugarcane decreased by 19.5%. Meanwhile, aquaculture area increased by 3-5%.

Figure 6 shows the proposed cropping pattern map of Tra Vinh province as basis for rice conversion.



6a. Proposed rice cropping pattern for normal years.

6b. Proposed rice cropping pattern for extreme years.

Figure 6. Proposed rice cropping pattern map of Tra Vinh province

Table 3. Changes in agricultural production in Tra Vinh 2013-2017.

No.	Items	2013	2017	2017 vs 2013	
		ha	ha	ha	%
A	Crops				
1	Rice in the whole year	235,503	220,218	- 15,285	93.5
1a	- Winter-Spring	64,458	59,915	- 4,543	92.9
1b	- Summer-Autumn	80,657	77,037	- 3,620	95.5
1c	- Autumn-Winter	90,388	83,266	- 7,122	92.1
2	Vegetable	27,424	29,769	2,345	104.6
3	Coconut	18,088	21,495	3,407	118.8

4	Fruit trees	17,272	17,647	375	102.3
5	Sugarcane	6,783	5,457	- 1,326	80.5
6	Peanut	4,645	4,376	- 269	94.2
7	Corn	5,274	4,169	- 1,105	79.0
B	Aquaculture				
1	Total Area	51,277	52,875	1,598	103.1
1a	- Salty, blackish water of which: Crab	46,613 18,243	49,820 18,890	3,207 647	106.9 103.5
1b	- Fresh water	4,664	3,055	1,609	65.5

Source: Tra Vinh Department of Agriculture and Rural Development, August 2018.

Rice conversion general information

The province is restructuring its agriculture sector towards increasing the proportion of aquaculture. In 2013, the structure of agriculture sector was 50.6% for crop production, 11.72% for livestock, and 28.3% for aquaculture. In 2017, this figures were 47.9%, 9.22%, and 34.1%, respectively.

In crop production, the total cultivation area decreased from 288,138 ha (in 2013) to 272,994 ha (in 2017), with rice production area decreasing by 220,218 ha. The average rice yield in 2017 was 5.2 ton/ha (total rice production of Tra Vinh was 1.14 million tons).

Since 2014, 13,294 ha of rice production area has been converted into other crops and livestock, in which 8,843ha was converted into vegetable and other cash crops. Meanwhile, 2,262 ha was converted into perennial trees including 1,699 ha of fruit trees and 562 ha of coconut. In addition, 740 ha was converted into rice-aquaculture, and 1,447 ha was converted into intensive aquaculture production area (see Table 4).

Table 4. Results of rice area conversion from 2014 to 2018 in Tra Vinh province (ha).

	2014	2015	2016	2017	2018 (6 months)
1. Annual crop	1,994.74	1,959.79	2,335.51	1,862.35	601.32
Corn	220.63	794.99	565.69	124.68	279.8
Peanut	267.62	59.91	47.65	61.55	28.8
Sugarcane			7.45		
Tuber crop	0.77	1.5	11.7	1.5	11.5
Vegetable	1,418.61	913.39	1,550.9	1,381.55	255
Grass	76.61	69.7	47.65	156.07	26.22
Other	10.50	120.3	104.47	137	
2. Perennial crop	130.59	365.2	553.25	1097.14	116.53
Fruit	108.29	310.68	457	734.87	89.13

Coconut	22.3	54.52	96.25	362.27	27.4
3. Aquaculture	798	369.9	610.89	235.08	174.95
Rice-aquaculture	224.1	128.5	266.64	86.48	35.09
Intensified aquaculture	573.9	241.4	344.25	148.6	139.86
Total	2,945.32	2,710.04	3,509.28	3,237.27	892.74

Appreciations are given to effective extension work as well as applicable technology and scientific researches that enable the farmers in Tra Vinh province to apply the innovated crop management (3 Gains, 3 Reductions; 1 Must 5 Reductions).

There are currently 27 rice production sites following the “Large Field Model” of contract farming with the private sector (4,330 ha).

High quality and organic rice production are attracting much interest from the farmers as there are now 173 households in Long Hoa and Hoa Minh Districts participating in the production of 161 ha organic rice and 100 ha of VietGAP rice.

Climate change adaptation

Under the financial and technical support of Oxfam GB, 12 natural disaster risk maps were developed, while 76 wireless loud speakers were provided for the most vulnerable communes of Duyen Hai, Chau Thanh, Cau Ngang districts, and Duyen Hai town. DARD is responsible for monitoring the condition of dyke system (sea dyke and river dyke). DARD also invests a huge amount of money in rehabilitating the dyke system to protect the coastal communities against natural disasters.

National and provincial policy in rice production and conversion, natural disaster response

Tra Vinh PPC issued Decision No. 22/2017/QD-UBND to implement Decision No. 49/2012/QD-TTg in supporting farmers to recover agriculture production after natural disasters. Implementing this decision in 2016, Tra Vinh DARD allocated 56.73 billion VND (USD2.5M) to support 56,672 households affected by salinity intrusion and rice blast.

DARD has been implementing Decision No.915/QD-TTg issued by the Prime Minister to support 988 households in converting 425 ha of paddy land into corn production with 1.27 billion VND (USD55,218) budget.

To achieve the agriculture restructuring objectives set by the government, Tra Vinh PPC issued Resolution No.15/2016/NQ-HDND to support farmers develop vegetable production,

orchards, and other investments. In 2018, PPC has approved the allocation of 27.4 billion VND (USD1.192M) for its implementation.

Problems and Constraints in Rice Conversion

1. Unstable market is identified as a challenge. The production depends on the market where middlemen have the power to adjust the price and make decision whether to buy or not.
2. Private companies in Tra Vinh provinces are all small and run through micro-enterprises with low capacity to meet the needed capital for investment. The linkage between companies and farmers is still weak. Bigger companies hesitate to invest in Tra Vinh as it is quite far with poor transportation infrastructure and logistic facilities.
3. Irrigation infrastructure in Tra Vinh is mostly used for rice production and cannot support the required irrigation for converted crops (i.e., fruit trees and aquaculture).

Recommendation for DARD

1. Review and update (if applicable) the projection and planning for agriculture restructuring. Develop the specialized/intensive agriculture production area for selected products (i.e., rice, coconut, fruit tree, aquaculture, etc.), and establish value chain for the major agriculture products.
2. Enhance the application of technology and science to improve seed quality of rice and fruit tree, adapt with climate change, mechanization, innovative crop and livestock management, reduce chemical fertilizer and pesticide application, and integrated pest and disease management.
3. Develop the irrigation system toward multi-function/task orientation (for different sub-sectors, not only for rice). The irrigation system will have the task to supply brackish water for shrimp and aquaculture and maintain fresh water supply to irrigate the orchard and rice production areas.
4. Improve the early warning system, enhance community-based disaster risk reduction, and continue to raise public awareness on climate change adaptation and disaster risk reduction.

Implementation of CS MAP

The proposed planting calendars for rice in the province were developed based on the CS MAP in 2017 and with the support of DCP and CCAFS. DARD officials agreed that these

calendars reflect the adaptive plan of the province and will be implemented in line with the main development plan of the province.

The map on salinity intrusion in normal years is suitable for the province and can even be updated yearly by DARD. However, they can only be referred to in cases of extreme events, which do not occur as often as in other provinces.

In Tra Vinh, the main constraint in implementing CS MAP is the lack of technical capability among DARD officials. They have no one in their office who specializes in mapping and GIS. As a result, downscaling the maps from the provincial to district or commune level for actual implementation is a challenge. Furthermore, rice is only one of the crops in a cropping system (e.g., rice-rice-cash crops).

Implementing adaptive measures for rice (i.e., adjusted planting calendar) must then consider the risks and corresponding adaptive measures for other crops. In this regard, the CS MAP must be customized for other crops that are popularly incorporated in rice-based systems.

General observations and recommendation during the mission

Observations

Linkage between farmers and companies is weak, particularly for main product like coconut. Coconut price dropped sharply at the time of this trip.

Farmers spontaneously converted paddy land to fruit trees, including coconut. Conversion of the acid sulfate affected area with water shortage in dry season poses a high risk.

Field visit in the conversion of rice grown in saline soils to growing coconut in Ap Rach Hamlet, Hung My commune and fruit trees in Rach Kinh hamlet, HoaThuan commune, Chau Thanh.

The trend is suitable because rice yields are low and unstable due to acid sulfate soils and frequent saline water intrusion. With the model of converting to coconut plantation, the tree is well grown and resistant to submerged-saline condition. However, there are problems in market output. At the time of the survey, coconut price was only 2,500 VND/fruit (9 pieces per USD 1), so people had to plant forage grass on the beds alternated with coconut trees to increase income.

The model of converting to fruit trees without the recommendation of a professional agency remains spontaneous, ineffective, and unsustainable. Some households converted the paddy

land in trying custard-apple, grapefruit, apricot, and plants for animal feed, which are not stable.

Recommendations

Coconut is planted in a large-area (over 21,000 ha) only after Ben Tre, so it should be considered as the main plant of the province to have appropriate and effective investment policy from planning, construction of seedling centers, to farmer training especially in forming associated model of production, consumption, and processing chain. Coconut is the main product of the province and suitable to coastal conditions, including adaptation to salinity like Tra Vinh. Hence, effort should be made further to form the coconut supply chain to attract companies to link with farmers. Other potential plants are green grapefruit, red pulp dragon fruit, watermelon, and purple onion.



Figure 7 A. Consultation of the mission with officials of the Department of Agriculture and Rural Development, Tra Vinh province on 15/08/2018.



Figure 7 B. Model of coconut conversion in saline soil-alum area previously grown to rice in Rach Giua Hamlet, Hung My, Chau Thanh, Tra Vinh



Figure 7 C. Model of mangoes, custard-apples, and apricot blossom in saline soil-alum area not favorable for growing rice in Rach Kinh Hamlet, HoaThuan, Chau Thanh, Tra Vinh.



Figure 7 D. Saline soil-alum area not favorable for growing rice in Rach Kinh Hamlet, HoaThuan, Chau Thanh, Tra Vinh, Some beds were made for transferring plants .

The province has not promulgated any specific policies for the conversion of paddy land, but on central policies. Specifically, the province has converted 425 ha for corn (988 households) with the support of 1.27 billion VND (about 3 million VND or US\$150/ha. However, corn is not the best choice since people only do such conversion because of the financial support for corn, while crops with good and effective market such as fruit trees and vegetables are not supported. Therefore, the province should immediately evaluate the existing models of conversion of rice land as a basis for promulgating appropriate policies and mechanisms for localities, especially planning, infrastructure (flood prevention), good seedling supply, training, production organization, and attracting enterprises for investment to ensure effectiveness at lowest risk.

It is seen that vegetable models are more effective. Fruit and coconut trees are also exploratory because of technical and market factors. The conversion to fruit trees needs good set of seedlings. On the other hand, seedling centers or associated seedling production are not planned by the province. The availability of good coconut seedlings for farmers is an urgent need.

The alluvial soil in Cang Long, Cau Kieu, Tieu Can districts, and North Chau Thanh district requires farming three rice crops using high quality seeds and concentrated commodity production. For small areas, they are allowed for land accumulation, change for rice production, or shifting to dry-farming crop and aquaculture.

Saline areas in Cau Ngang, Tra Cu, and a part of Duyen Hai, Chau Thanh districts with low-yielding rice land are converted into organic, especially rice, vegetables, or brackish water aquaculture. However, this area must have solutions for salinity control by creating and maintaining fresh water source for proactive production. Salinity areas need to focus on the development of the rice-shrimp/crab model because the province has a very effective breeding culture, which has a farming area of over 18,000 ha and condition for expansion. These models can be in the direction of organic and high added value crops. In addition, salinity-tolerant vegetables such as purple onions, watermelon, and Japanese sweet potato can be planted in this area. Experts suggest optimal exploration of rice-fish rotation in areas affected by salinity intrusion, which can be applied to organic production to increase the value added and sustainability.

C. Dong Thap Province

Background information

In 2017, the total cultivation area of Dong Thap province was 602,396 ha (see Table 5), while the total production value was 23,088 billion VND (USD1B).

The province has identified five major agricultural products to be developed. These include rice, mango, flower and bonsai, cat-fish, and duck. The development objectives are to reduce production cost, produce according to GAP standard, contract farming, increase quality, and application of advanced technology.

For rice, DARD allocated 800 ha to produce organic rice using two varieties, which are IR50505 and VD2. The goals are to reduce the production cost to 20% and to establish contract farming area of 200 ha in Tam Nong district.

Dong Thap VnSAT PPMU organized many training courses for farmers on 3 , 3 Gains, 1 Must-Do, 5 Reductions programs, and supported the cooperatives in rehabilitating some construction works (i.e., pumping stations, machinery, etc.).

Figure 8 shows the proposed cropping pattern map of Dong Thap province as basis for rice conversion.

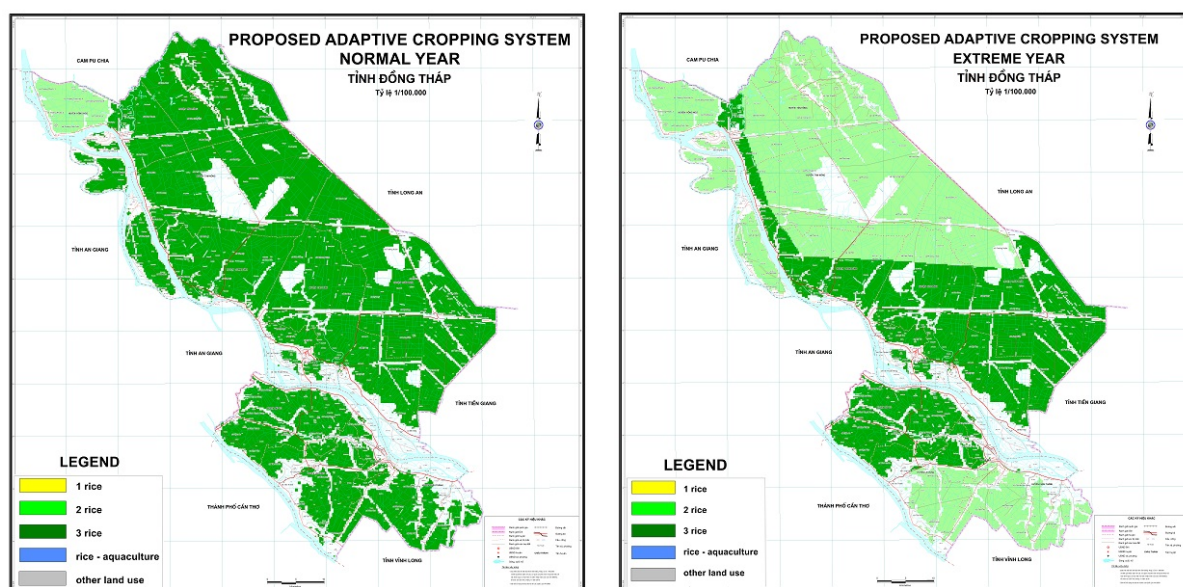


Figure 8 A. Proposed rice cropping pattern for normal years.

Figure 8 B. Proposed rice cropping pattern for extreme years.

Figure 7. Proposed rice cropping pattern map of Dong Thap province.

Table 5. Dong Thap Agricultural Production area in 2015-2019.

No.	Items	Implemented, ha			Planned, ha		2019 vs 2015, %
		2015	2016	2017	2018	2019	
1	Total cultivated area	607,096	616,938	602,396	598,542	594,120	97.86
2	Annual crops	583,489	590,961	574,270	568,469	563,970	96.65
3	Perennial crops	23,607	25,977	28,126	30,073	30,150	127.72
4	Rice of the whole year	545,987	553,425	538,348	533,449	525,700	96.28
	- Winter-Spring	204,880	208,757	208,906	205,711	205,700	100.40
	- Summer-Autumn	197,058	196,573	198,502	197,738	195,000	99.96
	-Autumn-Winter	144,049	148,095	130,940	130,000	125,000	86.78
5	Fruits	22,974	25,352	27,526	29,476	29,550	128.62
	- Citrus	4,592	5,856	7,700	7,915	7,950	173.13
	- Mango	8,289	8,522	9,200	9,746	9,750	117.63
	- Longan	4,305	4,446	4,610	4,180	4,850	112.66
6	Vegetables, beans	10,643	16,000	22,893	21,220	23,370	219.58
7	Corn	4,560	4,700	5,240	6,000	6,500	142.54
8	Sesame	8,474	8,532	5,162	3,000	5,000	59.00
9	Sweet potato	3,649	2,800	4,150	4,000	4,000	109.62
10	Flower, bonsai plants	2,012	2,100	2,200	2,200	2,300	114.31
11	Lotus	1,265	840	982	900	1,000	79.05
12	Peanut	206	155	160	100	150	72.82
13	Soybean	290	27	53	100	100	34.48
14	Aquaculture	7,592	7,200	7,725	7,897	8,065	106.11
	- Catfish	2,116	2,120	2,345	2,450	2,600	122.87
	- Other fish	4,798	4,520	4,600	4,620	4,630	96.50
	- Giant fresh water prawn	678	560	780	827	835	123.16

Source: Dong Thap Department of Agriculture and Rural Development, 2018.

General information on rice area conversion

In 2017, Dong Thap province converted 13,813 ha of paddy land to different crops including 10,116 ha of annual crops (3 rice: 7,606 ha; 2 rice: 1,086 ha; 1 rice: 1,423 ha) and 3,697ha of perennial crops (3 rice: 3,316ha; 2 rice: 277 ha; 1 rice: 102 ha).

The rice conversion is still slow because the farmers are concerned about market failure, price fluctuation, and diseases. The rice conversion to fruit tree is more popular in the southern districts of Dong Thap with more favorable condition. The orchard areas are protected inside the high dyke system. However, the loss and damage of orchards will be more severe than the annual crop when severe floods occur, which might break the protection of the dyke.

DARD developed the cropping calendar and risk maps under the instruction of DCP.

However, it needs to be revised with updated information on dyke system.

Table 6. Plan for rice conversion from 2018 to 2020 in Dong Thap province (ha).

	2018	2019	2020	Total
Annual crop	13,690	27,116	27,191	67,997
Perennial crop	2,387	3,496	4,029	9,912
Total	16,077	30,612	31,220	77,909

Problems and constraints

- Lack of accurate information on market, natural disaster early warning, and El Nino/La Nina warning.
- Large amount of provincial budget for climate change adaptation and natural disaster risk reduction has been allocated for strengthening the irrigation system and other disaster prevention structure.
- There is little investment in postharvest technology. Almost all the products are sold fresh without any processing.

Capacity building needs

- Technical officers lack knowledge and skills on agricultural technologies and practices that will help to adaptation withto climate change.
- Technical officers and farmers lack knowledge and skills on market analysis and market orientation production.

Implementation of CS MAP

CS MAP is highly appreciated by the Crop Production officials and DARD leaders. The DARD office in the province has shared risk maps and planting calendar to districts for their agricultural planning. The Crop Production Office will review and update information together with the districts. In Dong Thap, the CS MAP is being used as the basic material to adjust the planting calendar and update the adaptation plan.

Although some officials in Dong Thap DARD attended training courses on GIS, using GIS tools to manage CS MAP is still a challenge. As recommended by the head of the Crop Production Office, a simpler tool to manage and update information on risks, damages, crop production, crop variety, and pests and diseases based on the existing CS MAP will be helpful for the end users. Such tool will be also valuable for the staff working in districts and communes, who have limited knowledge on GIS.

Suggestions from the DARD

- Develop software or digital map integrating other information on early disaster warning, pest and disease, and varieties to better support crop production management and direction.
- Develop a policy to attract investment for contract farming, postharvest, and processing to ensure the added value of agriculture products.
- Research new varieties which have market potentials and capacity to adapt to climate change.
- Develop early warning report based on hydro-meteorology information in 1 year and 6-month time with trustable variation, which can be used as foundation for developing the adaptation plan.

General observations and recommendation during the mission

Observations

Dong Thap is one of the few provinces in the Mekong River Delta that has selected the five major products, namely, rice, mango, flowers and bonsai plants, catfish, and duck. The selection is based on the competitive advantage of each type of product. In addition, Dong Thap is also the leader in producing organic rice with over 800 ha. Technically, the province is at the forefront of information technology application in production management and technical guidance with the "1 touch - 5 knowledge" program (cooperative program with

IRRI, which uses smart phones to determine quantity of sowing, fertilizer formulation, water and pest management, and estimated emissions of greenhouse gases/ha/crop). Laser-controlled equipment for leveling rice fields and rice planting machine instead of direct sowing are widely used in Dong Thap.

There are several policies in Dong Thap that have been released to support the conversion of paddy land such as Resolution 138/2017/NQ-HDND of the People's Council of the Province (dated 07/12/2017) and Guideline No. 02/HD-SNN (dated 09/3/2018) of the DARD on supporting the concentration of land in rice and fruit tree cultivation. Up to now, there are 1,059 ha of rice land, 4.2 million VND/ha (USD183) on average; 56.6 ha of fruit land is supported, on average 10.8 million VND (USD470)/ha. However, not all districts are eligible to register for support because of the small and scattered land lots especially in the southern districts of the province. In addition, individuals renting land with too many landlords who must sign contracts are difficult to deal with. If the local government does not have the land hired, then it will be rehired to such households as done in other localities.

Dong Thap province issued Decision No. 1349/QD-UBND-HC (dated 06/11/2017) and the joint Finance-Agriculture Guidance No. 13/HDL-SNN-STC (dated 28/12/2017) regarding the support for corn seedlings to convert rice land targeted at 760 ha increase by 2018 and 1,260 ha by 2019 as compared to 2017 (see Table 4).

The province has strongly advocated the "Linkage field" for the development of linkage between farmers and companies in rice production, and has identified main products of the province for developing the supply chain. A good example is the mango supply chain linked with special brand "Xoai *Cat Chu* Dong Thap" (Dong Thap *Cat Chu* Mango).

The flooding rotation system with a cycle of 2 years was applied covering a large area. It is observed that the conversion of paddy lands to fruit trees is still spontaneous.

Field visit in the conversion of three rice crops into fruit tree (Xoan orange) land at Tan Dong B Village, Thanh Binh District

The model of 3 hectares of orange was very effective. However, the model has not been supported in terms of seedlings, cultivation technologies, and consumption. Farm gate orange price is only 25-30% of the market price.

A visit to the flood discharge area after harvesting summer-autumn rice in Tan My Commune at Thanh Binh District shows that Dong Thap releases the policy of flood discharge in

rotation for each plot. Released policy is for flood reduction (also called flood storage), field sanitation, and soil improvement (increased alluvium). In 2018, it is forecast that flood occurs early and at peak. Autumn-winter rice is only produced in areas with high and stable embankments; flood waters at a 30-120 cm depth level will be discharged from the remaining area of about 81,570 ha from August to October within 90-120 days. However, to be active in the winter-spring crop, it is impossible to wait for natural supply of water from upstream. Hence, the province needs to improve the pumping system to pump out the water to ensure sowing at the end of October to December. Through satellite images (see Annex 4), a very large area of Dong Thap is still flooded due to early occurrence. Hence, the policy of flood discharge is very appropriate and scientific.

A good experience with Dong Thap is that, districts need the consent of the people in surrounding areas between the flood-discharge area and the production area to avoid conflicts. The agricultural sector has also clearly planned areas for flood control and thorough flood management (areas for flood control and areas with flood discharge when cultivating 2 rice crop). In some areas where rice production in the same embankment is the main crop, there are some households that grow annual crops and fruit trees. Therefore, it is difficult to ask for consent. However, if these households are determined to spontaneously convert paddy land into fruit tree or annual crop, flood discharge is still being done by the province. According to DARD, flood discharge in the area is not only a flood storage, but also helps farmers to raise their collective awareness, respect the regulation on planning, increase association to produce the same crop, and create large-scale concentrated commodity zones.



Figure 9 A. Consultation of the mission with officials of the Department of Agriculture and Rural Development, Dong Thap province on 16/08/2018.



Figure 9 B. Conversion of rice farm to mango farm in Tan Dong B cluster, Thanh Binh district, Dong Thap province.



Figure 9 C. Conversion of rice farm to orange fruit farm in Tan Dong B cluster, Thanh Binh district, Dong Thap province.



Figure 9 D. Flood discharge after summer-autumn rice crop in Tan My, Thanh Binh, Dong Thap (16/08/2018). It can be clearly seen that the embankment was very low.

Recommendations

To ensure the effective conversion of rice land, Dong Thap requires the formation of a concentrated production area and possible use of existing infrastructure without destruction so that it can be re-used for rice production, if necessary. The priority crops converted from paddy land are mango, citrus, longan, sesame, and corn. With land for rice production combined with aquaculture, 20% of the area can be converted into ditches whose depth is not more than 120 cm as stipulated. Conversion of rice land should be monitored closely, and suitable measures undertaken to limit the spontaneous conversion for attaining sustainability. It is also said that the conversion of rice land into other crops has not met the plan because of the unstable market and infrastructure for new crops, especially that of irrigation, which has not met requirements. Likewise, associated production and consumption are not sustainable.

In the fruit tree restructuring program, the province has supported the pilot mango cultivation on 98.2 ha/188 participatory households in Tinh Thoi commune and Ward 6 in Cao Lanh City, and 43.2 ha/94 households and 55 ha /90 households in My Xuong commune, Cao Lanh district. However, the results of flowering rate throughout the crop is still low; and it is necessary to synthesize and get support from specialized agencies.

Conduct study on building fresh water reservoir to store water during rainy season for use in the dry season in the downstream. This will provide a long-term solution for climate change adaptability of the region.

The area of catfish farming is quite large occupying 100-150 ha. and increasing each year. However, there are observed potential risks such as unchecked breed and spontaneous digging

of ponds not in accordance with the planning. This can pollute the environment and can make consumption difficult since catfish are mostly for export. Meanwhile, ducks are good in the domestic market with low investment and fast turnover. With over 229,000 ducks that give 187 million eggs/year and meat productivity of nearly 6,000 tons, the product should be expanded.

In order to improve the capability of flood drainage, development of sustainable livelihoods, and to adapt to climate change for Dong Thap Muoi flood plain, the livelihood models are selected as: winter-spring rice + summer-autumn rice + field/natural fishes; winter-spring rice + summer-autumn rice + giant freshwater prawns; winter-spring rice + ducks + summer-autumn rice + duck + field/natural fishes; winter-spring rice + farm produce + field/natural fishes; winter-spring rice + summer-autumn rice + field/natural fishes, aquatic plants (lotus, *Sesbania sesban*, etc.); winter-spring rice + seasonal rice + shrimp, field/natural fishes; and lotus + field fishes + travel.

D. An Giang Province

Background information

An Giang is the key agricultural province of the Mekong River Delta with 644,000 ha of rice and ranked second after Kien Giang. However, the province also has a large area of Autumn-Winter rice crop with 170,000 ha, while the area of Winter-Spring rice is 236,000 ha, and Summer-Autumn is 232,000 ha (see Table 7).

Table 7. Rice production in An Giang province.

Crops	2013	2017	2017 vs 2013	
	1000 ha		1000 ha	%
Winter-Spring	238.1	236.2	-1.9	99.20
Summer-Autumn	234.7	232.6	- 2.1	99.11
Autumn-Winter	163.2	169.8	6.6	104,04
TOTAL	641.4	643.6	2.2	100,34

Source: An Giang Department of Agriculture and Rural Development, 2018.

The conversion of inefficient rice land into other crop production or aquaculture is not known. Even the area of rice cultivation in 2017 also increased by 2,200 ha in comparison with 2013, of which the area of Autumn-Winter rice crop increased by up to 6,600 ha (4%), contrary to other provinces' trend of reduced production of this crop.

The conversion of crop structure in rice land in An Giang was slower than in other provinces. In 2016, the whole province converted 4,000 ha to vegetables and annual crops, mainly corn and sesame. The area of vegetables was very low at only 316 ha. In 2017, the total converted area was 6,553 ha (68% of the plan). However, there was a remarkable shift to vegetables with 2,816 ha and fruit trees with 892 ha In the first half of 2018. The converted area increased to 4,610 ha, with 1,792 ha for vegetables, 1,548 ha for fruit trees, and 1,270 ha for annual crops.

According to local assessment, the conversion of inefficient paddy land into other crops is hugely supported by the community. Not only it increases income, but also creates more jobs for the people. Fruit production has shifted from self-sufficiency to export-orientation, in which the three-color mangoes exported to Australia is a good example. However, the change of crop structure is largely unconnected with market and remains at high risk. Moreover, the infrastructure is not suitable for converting many kinds of crops with different demands on water, soil fertility, etc.

Figure 10 shows the proposed cropping pattern map of An Giang province as basis for rice conversion.

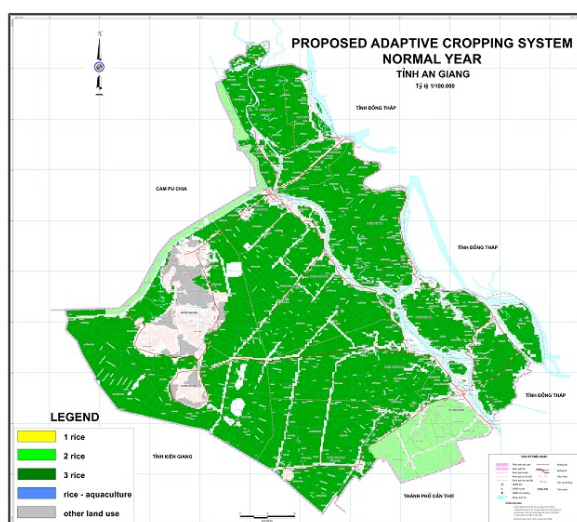


Figure 10 A. Proposed rice cropping pattern for normal years.

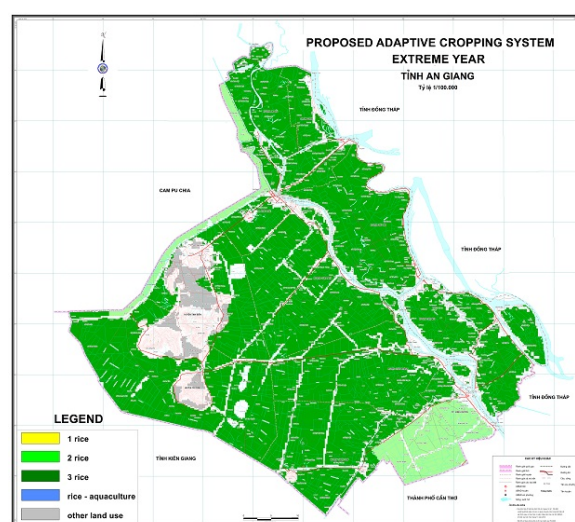


Figure 10 B. Proposed rice cropping pattern for extreme years.

Figure 10. Proposed rice cropping pattern map of An Giang province.

General information on rice area conversion

An Giang PPC issued Decision No.3410/QD-UBND approving rice area conversion land into vegetable, cash crops, and fruit trees from 2017 to 2020.

To implement this decision, An Giang province has converted 13,523 ha for rice production. This includes 3,314 ha in 2016, 4,331 ha in 2017, and an estimated area of 5,878 ha in 2018 (see Table 7). The paddy field was converted mostly to vegetable (i.e., leafy and fruit), corn (i.e., baby corn and hybrid corn), cash crops (i.e., peanut, soybean, green bean, and sesame), and fruit trees (i.e., mango, banana, longan, citrus, and others).

Problems and constraints in rice conversion

- Lack of market information and market forecast (i.e., quantity, variety, price, quality, processing requirement, and potential market).
- There are very few processing factories in the province and few companies to establish contract farming with local farmers.
- Irrigation and disaster risk prevention infrastructure have not yet been completed. The highly protected area by dyke system is still small and does not satisfy the requirement for large scale conversion.
- The application of mechanization and other machinery in agriculture is still low due to high investment cost.
- Fragmented and scattered agriculture production caused problems in applying large scale technology and practices (i.e., planting, harvesting, land leveling, etc.).

Table 8. Result of rice conversion from 2016 to 2018 of An Giang province (ha).

	2016			2017			2018
	Winter-Spring	Summer-Autumn	Autumn-Winter	Winter-Spring	Summer-Autumn	Autumn-Winter	6 months
Corn	133	229	418	251	315	118	318.65
Sesame	527	885	10	136	571	1	157.11
Legumes	561			391	434	13	77.76
Peanut		56	8				
Green bean		40	12				
Taro			6				
Cassava			69				
Sweet potato			18				
Melon			26	191	200	109	
Vegetable			316			594	1,792
Tuber crop				115			716.21
Cash crop							1,269
Fruit tree				29	324	539	1,547.9

Recommendation for DARD

- An Giang PPC and DARD continue to implement Decision No.3410 on rice area conversion and strengthen communication with local authorities and farmers to follow the developed projection and plan. DARD will strengthen and rehabilitate the irrigation and dyke system in order to ensure adequate area for conversion to other crops.
- There is a need to develop a policy to attract investment from private sector in agriculture, and establish an information exchange platform to update information on market issues (i.e., demand, quality, amount, price, and potential buyers).
- DARD and PPC should consider developing a policy for providing incentives or support to the farmers that convert low quality rice area to other crops (i.e., support to buy seeds and seedlings and agriculture insurance).

For cropping calendar

- An Giang has been recording statistical data for crop production in the province since 2010, and has a large and accurate data for developing the cropping calendar map/software. There are officers from DARD and Crop Production Division who received training on GIS and remote sensing and are able to use the GIS software.
- The field plots in homogenous areas are coded differently by Crop Production, Irrigation and Water Resource, and Economic Divisions. Thus, it is difficult to update the information on the map.
- There are many rice varieties currently planted in one plot. Hence, it is difficult to monitor the growing periods by remote sensing and satellite images.

General observations and recommendations during the mission

Observations

As of this time, flood is a predominant situation, but drought may occur during dry season. On the other hand, the plan to convert 20,000 ha-25,000 ha of rice up to 2020 has so far converted 19,000 ha.

The model of planting baby corn (5-6 harvest /year) that is consumed as vegetable has given a high return (200-300 million VND /ha/year or USD8,700-13,000). Planting baby corn can support cow raising and vermin-compost production as practiced by several household farms in Cho Moi district.

Specific zones for growing fruit trees have been established like the orange farms in Cho Moi or the mango zone in the three districts located along the island of the province. It is noted that mango is being exported to Australia.

Established rice zone is specified for growing glutinous rice or japonica rice (variety ĐS1) in Phu Tan district. Spontaneous conversion to fruit tree inside the protective dykes still existed. Area under Autumn-Winter rice is still large, including the areas outside the protective dykes. Severe river bank erosion in many sites of the Mekong Delta River caused significant land loss.

Field visit to the converted paddy land to baby corn of Mr. Le Tan Nhat, My Trung Hamlet, My An Commune, Cho Moi Commune.

With a 3-year-old orange orchard, the yield of 40 tons/ha with a price of 17,000-30,000 VND (USD0.70-1.3)/kg gives higher profit than that of rice. However, the price offered by the farmer is only 30-40% of the market price in the city because there is no producer and consumer association.

Field visit to the converted paddy land to baby corn of Mr. Le Tan Nhat, My Trung Hamlet, My An Commune, Cho Moi Commune.

With average sowing of 1.7 kg of seed /1.000m², 200-300kg of baby corn per 1kg seed are obtained that gains 4-5 million VND (USD174-218)/1.000m²/crop. With 5-6 baby corn crops per year, farmers can earn 300-350 million VND (USD13,000-15,217/ha/year). This is 10 times higher than that of rice, which does not consider the baby corn stalks used as cow feeds (average of 15- 20 cows/ha of baby corn). Of course, this model needs the support of the vegetable processing factory that commits to purchase the whole product from the people.



Figure 11 A. Consultation of the mission with officials of the Department of Agriculture and Rural Development, AnGiang province on 17/08/2018.



Figure 11 B. Conversion of rice farm to oranges farm in An Thai, Hoa Binh, Cho Moi, An Giang (17/08/2018).



Figure 11 C. Conversion of rice farm to baby corn farm in My Trung Hamlet, My An, Cho Moi, An Giang (17/08/2018).



Figure 11 D. The lady owner (center) of the orange farm in An Thai, Hoa Binh, Cho Moi, An Giang (17/08/2018).

Recommendations

The maps on climate risks and adaptation plans of An Giang set up based on field observations and indigenous knowledge of local officials truly reflect the rice situation in the province. Deemed valuable by officials, they are now integrated into the development strategies of the province.

Adjusting cropping systems and rice planting calendars occur over the province. However, the definition of risks as used in CS MAP should be simplified to avoid confusion during the implementation phase. For example, areas not affected and areas currently applying adaptation options must be distinguished from each other.

An Giang is also piloting the application of remote sensing in risk monitoring and crop yield estimation. Integration of CS MAP and remote sensing outputs can provide valuable information in deciding agricultural production.

For cropping calendar

- An Giang is recording statistical data for crop production in the province since 2010 and has a large and accurate database for developing the cropping calendar map/software. Officials from the DARD and the Crop Production Division received training on GIS and remote sensing and can now use the GIS software.
- The field plots in homogenous areas are coded differently by the Crop Production, Irrigation and Water Resource, and Economic Divisions and, therefore, difficult to update the information on the map.

- Many rice varieties that are currently planted in one plot. Monitoring by remote sensing and satellite images the growing periods of many rice varieties currently planted in one plot remains a challenge.

Government should support solving the river bank erosion problem in the rice areas. DCP should also approve releasing the new rice variety DS1 because of its high market high like in Korea.

In recent years, flood water discharge as planned by many districts failed because of low flood water level, thus affecting the completed production under the 3-year/8-crop process. This prompted the local government to consider stopping land cultivation and prevent alluvium accumulation in the field. Area planted to the Autumn-Winter crop can be reduced further, particularly in areas outside the protective dykes. In addition, the controlled flooding cycle can be shortened from 3 to 2 years to have more alluvial soil deposits.

E. Can Tho City

Background information

Can Tho is a fast-urbanized city, and rice area only ranks 7th out of the 13 provinces of the Mekong River Delta, accounting for approximately 240,000 hectares. Similar to the situation in An Giang, the transfer of rice land to other plantations or aquatic production land is undefined. The rice cultivation area in 2017 even increased by 3,500 ha compared to that in 2013. While Autumn-Winter rice area increased by 6,600 ha (9.85%), other provinces' rice production decreased during this season (see Table 9).

Table 9. Rice production in Can Tho province

Season	2013	2017	2017 vs 2013	
	1,000 ha		1,000 ha	%
Winter-Spring	88.0	85.4	- 2.6	97.05
Summer-Autumn	81.6	81.1	- 0.5	99.39
Autumn-Winter	67.0	73.6	6.6	109.85
Total	236.6	240.1	3.5	101.48

Source: Can Tho Department of Agriculture and Rural Development, 2018.

General information on rice conversion

The crop structure transformation in Can Tho City took place slowly. In 2017, fruit trees production is mostly mangoes, longan, banana, star apple, and oranges (see Table 9). Not much of the other plants were transformed. However, a centralized fruit tree production area has been founded with a scale of nearly 5,000 ha in the whole city.

Regarding vegetables, the total area has reached 11,475 ha, while the transformed area has expanded to 1,748 ha. However, the vegetable transformation is mainly spontaneous and not centralized in one area, which makes it hard to control flood, food safety, and hygiene (see Table 10).

Table 10. Can Tho centralized fruit tree production area in 2016

STT	Tree	District/ Town	Area, ha
1	Mango	Co Do, O Mon, Binh Thuy	1,380
2	Durian	Phong Dien	350
3	Star apple	Phong Dien	980
4	Longan	Cai Rang, O Mon, Phong Dien, Thot Not	1,433
5	Citrus tree	Cai Rang, Phong Dien	1,906

Source: Can Tho Department of Agriculture and Rural Development, 2018.

Table 11. Can Tho vegetable production in 2013-2017

Year	Area, ha	Changes compared to previous year	
		ha	%
2013	9,727	-	-
2014	9,447	- 280	-2,97
2015	9,884	437	4,63
2016	11,475	1,601	16,20
2017	11,475	0	-
Total in 2013-2017		1,748	17,97

Source: Can Tho Department of Agriculture and Rural Development, 2018.

Figure 12 shows the proposed cropping pattern map of Can Tho City as basis for rice conversion.

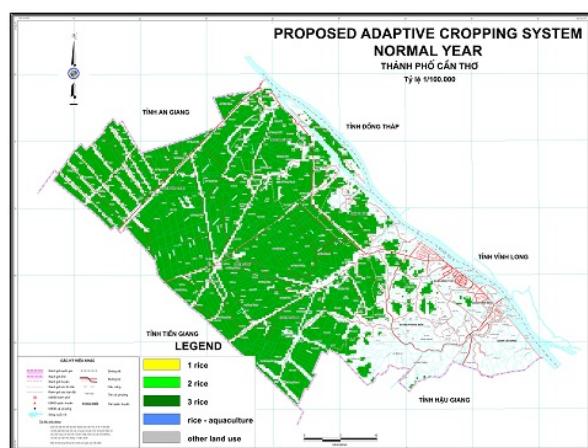


Figure 12 A. Proposed rice cropping pattern for normal years.

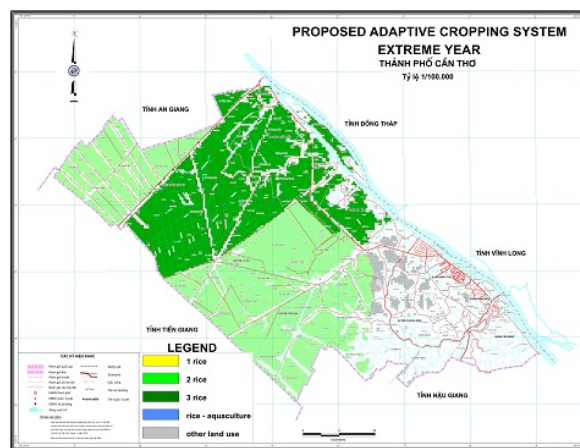


Figure 12 B. Proposed rice cropping pattern for extreme years.

Figure 115. Proposed rice cropping pattern map of Can Tho province

Agriculture restructuring

Can Tho City aims to reduce the production cost and maintain or increase crop yield while increasing the quality. It is suggested to establish and strengthen the linkage of agriculture production to ensure stable benefits for farmers.

Development of intensive fruit tree production area and intercropping of vegetable in paddy field area is also recommended, as well as development of the sub-urban vegetable and fruit tree farming for domestic consumption and agro-tourism attraction.

Adaptation to climate change

To adapt with drought brought about by climate change, Can Tho develops specific areas for vegetable and cash crops with strengthened protection dyke system and irrigation reservoir.

While adapting to flood, Can Tho plans to transform rice area to rice and aquaculture.

In 2014, Can Tho DARD issued the Action Plan on Adaptation to Climate Change for Agriculture Sector to 2020 and Vision to 2030, with main tasks identified for all sub-sectors:

Crop production

- Apply 3 Reductions, 3 Gains; 1 Must-Do, 5 Reductions, and ICM for rice production;
- Enhance capacity for farmer and crop management officials in GAP and organic standards and encourage the farmers to produce accordingly; and
- Apply innovation in agricultural technologies and practices to mitigate the negative environmental impact and enhance the climate change adaptability.

Livestock

- Produce according to VietGAP standard and motivate farmers to apply biogas technology.

Aquaculture

- Develop aquaculture with two major fishes - Mekong giant catfish and Siamese giant carp (*Pangasianodon gigas* and *Catlocarpio siamensis*).

Irrigation and water resource: rehabilitate the irrigation and dyke system

- Can Tho city has received financial and technical supports from different partners in strengthening the adaptation to climate change (i.e., CLUES project, ISET-Rockefeller project, and TA8012-REG project).

- In 2013, Can Tho DARD developed the Action Plan to Adapt with Salinity Intrusion for the Period 2012-2020 and Vision to 2030. The plan presented the different scenarios for salinity intrusion in the city based on different climate change scenarios and identified the prioritized activities for adaptation.

For agriculture, the plan listed the following activities:

- Study salinity tolerance varieties for rice, cash crop, and fruit trees;
- Study and apply climate smart technologies and practices;
- Rehabilitate and improve the irrigation infrastructure;
- Shift crop system and crop calendar to adapt to climate change;
- Store water and construct water reservoir and
- Research new livestock and aquaculture practices adaptable to climate change.

In 2017, Can Tho City People Committee issued the Plan for Agriculture Restructuring Toward Higher Added Value and Sustainable Development to 2020 and Vision to 2030.

The plan aimed to: (1) increase the added value in agriculture production and enhance the competitiveness of products; (2) identify and develop major products, project, and plan the intensive production area for major products to create suitable condition in applying high technology (i.e., mechanization, planting, land leveling, etc.); and (3) establish market linkage to ensure market stability.

The main tasks for agriculture are:

- Develop large field model for high quality rice production;
- Develop safe/organic vegetable production area;
- Develop urban and suburban agriculture model;
- Develop fruit tree production area/orchards integrating with agro-eco-tourism; and
- Develop the large -scale livestock production.

Implementation of CS MAP

Can Tho is one of the first provinces that generates geo-referenced data on rice planting calendar and production. With CS MAP, plans on planting are now adjusted based on the distribution and level of climate risks. However, maps are only well-adopted at the provincial level. Downscaling the CS MAP to the district or lower management units is still a challenge

due to lack of trained staff and infrastructures. Training courses on CS MAP development and maintenance must then be provided to all relevant government officers.

General observations and recommendation during the mission

Observations

Can Tho has more favorable conditions for rice cultivation with high density of canals convenient for restoring fresh water in the rainy season. The soil conditions are less affected by acid sulfate or salinity. This is perhaps the reason why the province in its plan to 2020, the scale of rice area to be converted is rather small.

Can Tho has a large area allocated to jasmine rice (up to 60% in Winter-Spring season) with high yield and good quality for high export value. The rice area on contract with companies is about 20,000 ha, while only 2,000 ha is reported to have applied VietGAP.

Some efficient forms of urban agriculture (flower or vegetable in net house) have been adopted in surrounding cities. This can be expanded further if the supply chain is improved since Can Tho is becoming a major tourist site in the Mekong Delta.

It is observed that Can Tho is rather cautious in converting rice land into fruit trees as the area under spontaneous conversion was limited. The land area converted so far is 3,000 ha.

The areas planted to upland crops tended to reduce due to unstable price, for example, sesame.



Figure 13. Officials of the Department of Agriculture and Rural Development of Can Tho join members of the team mission in this photograph.

Recommendations

The rice area of autumn-spring season (third crop) is still large. For the area that is not recommended for this season, it can be reduced or a flooding rotation system can be applied. The Spring-Summer rice crop can be replaced by an upland crop.

It is recommended to increase the area under contract farming to take advantage of the large area allocated for jasmine rice. The areas applied to VietGAP cannot be expanded without contracts with companies. Correspondingly, attracting investment in fruit processing should be encouraged.

Having Can Tho University and Cuu Long Delta Rice Research Institute in the province is advantageous since Vinamilk at Song Hau Farm invested on a high-tech dairy farm to be established in Can Tho.

The value chain in the province does not guarantee sure means of livelihood. The number of enterprises investing in agriculture is absolutely low (below 2%). The link between enterprises and farmers remains loose. Despite various policies of the government, no mechanism for effective implementation has been provided.

Can Tho may rise as a center for rice seed production, thanks to favorable conditions for producing all year round supply of seeds for the Mekong Delta and other parts of the country. However, it is also highly suggested to improve key product research investment on crops other than rice.

The state will have to provide exclusive policies so that Mekong River Delta has the capacity to serve as a safety storage valve on national food security under all circumstances. Hence, the government requires that the transfer of rice land to other plantation or maritime product growing land must ensure the capacity of transferring inversely in case of rice production demand. From the viewpoint of rice's roles in the Mekong River Delta as shown above, a question remains on how much area of rice land should be maintained in Mekong River Delta out of the current available rice land area of 1.85 million ha.

It is determined that the priority specialized rice growing area in Mekong River Delta is a favorable production area ensuring 2 highly productive rice crops. It is necessary for the state to make worthwhile investments in this region to complete the infrastructure synchronization to support production, postharvest, processing, trading, 100% mechanization, 100% collective

production, joint venture, partnership, and application of advanced and high technology in the value chain.

Besides the two major rice crops in this region that are subject to actual conditions, it is possible to produce one more annual crop (rotation of 2 rice crops, subsidiary crops and beans) or three-crop rice (three rice crops/year). The rotation of two rice crops and biennial trees should be encouraged; three-rice-crop structure should be applied only for safe investment and with good rice prices. Also, it is necessary to cut three-crop alternately for alluvium. The rice land area of specialized priority area should be maintained at about 800,000 ha. This area is specialized in growing aromatic rice with higher quality.

The production areas of aromatic rice specialty and organic rice subject to climate change adaptation and ecological conditions are the area of shrimp-rice rotation in the coastal provinces and one-crop winter rice in Ca Mau Peninsula. It is necessary for the state to invest in completing the irrigation system to support the shrimp-rice rotation structure (an efficient irrigation system makes it possible to increase shrimp-rice rotation by 100,000 ha and improve the existing shrimp-rice area by about 150,000 ha). In addition to the irrigation system, the state needs to support the selection of specialty rice strains and provide policies to encourage organic rice production. It is possible for this region's rice products to become a specialty rice market segment with the highest prices in the current world market.

The rest of the region can apply flexible one-crop rice rotation with upland crops or shift to specializing in biennial upland crops (i.e., vegetables, beans, secondary crops, flowers, and grass to support cattle-breeding). It is possible to shift to rice cultivation when necessary.

V. General Recommendation

A. Agricultural restructuring

Through discussions with the officers in the five provinces and the observations obtained from the field visits, the following issues should be addressed to overcome the most common obstacles in agricultural restructuring:

All the five provinces have developed plans on agricultural restructuring for the periods up to 2020 or 2025. But in many cases, farmers made their own decisions in production restructuring, including land use change without following the plan of the province or

reporting to the local authorities as legally mandated. As a result, the new production establishments are isolated or fragmented, causing contradiction to the existing production systems in the locality. This negative trend was not prevented effectively or overlooked by the local authorities.

It seems that in agricultural restructuring, the provinces tended to focus more on production alternatives for high value added as compared to rice production, rather than on coping with climate change, while the risk factors are almost neglected. For the provinces in the Mekong Delta, agricultural restructuring should be placed in the context of climate change. Lack of consideration on the risks due to climate change in agricultural restructuring may lead to severe loss. For example, the planting of fruit trees to replace rice in low-lying and flood prone or acid sulfate affected areas is highly risky.

The price of agricultural products has not been stable, and price change is difficult to predict. Meanwhile, the proportion of farms with linkages or contracts with companies buying their products is very minimal, and the farmers' organizations like cooperatives are weak and inefficient. The supply chain of most agro-products is almost absent, and farmers have to depend on intermediary traders in selling their products. The risk due to price uncertainty is a common concern across the provinces. This issue may be solved basically by facilitating the supply chain formation based on efficient farmers' organizations and their linkage with companies, which is supported by other activities like land consolidation, marketing promotion, and market information systems.

Investment for improving infrastructure to meet the demand of agricultural restructuring is beyond the capability of the provinces, while investment from the central government for the provinces has not been enough at present. However, the increase of investment from the central government can be expected in terms of investment in climate change adaptation and mitigation in the Mekong Delta. In addition, financial resources from international agencies, private sector, and PPP can be explored to serve the agricultural restructuring in the Mekong Delta.

In most of the sites visited, it was commonly seen that farmers lack knowledge and skills to produce new crops, particularly in fruit production, while the extension systems of the provinces provided little support for agricultural restructuring. Lack of reliable supply of fruit tree seedlings remains a high risk in fruit production as reported by most farmers. Therefore,

providing adequate technology guidance and services, including credit supply, should be improved to support farmers in agricultural restructuring.

Rice sector restructuring

Rice land conversion for production of fruit trees or fisheries is an important decision, which should be done cautiously because the conversion is almost irreversible or the conversion back to the rice land is very costly. The present status observed in the study trip is that farmers converted their rice land spontaneously without reporting to the local authority as legally required. This trend should be inspected closely to ensure that land use conversion is profitable and sustainable.

The adjustment of rice cropping area to minimize risks has not been given adequate attention due to lack of guidance by local authorities. For example, farmers still grow Autumn-Winter crop (the third rice crop) in flood-prone areas outside the protection dyke systems.

Unfortunately, the flood this year which came earlier with higher intensity as compared to the average, has caused severe damage to hundreds of hectares under rice in An Giang and Dong Thap provinces. This experience calls for a scientific zoning of rice areas based on risk assessment to guide farmers. This is an approach IRRI has done to support the DCP and MARD in mapping risk zones of rice production in the Mekong Delta. Risk mapping should be made at district or lower scale so that local officers and farmers can apply it in adjusting the sown area and planting calendar.

Diversifying the rice cropping systems has been recommended for a long time, but it is not easy to practice because of the price of upland crops, including field crops. Vegetables are unstable or low, while the cost of production is high. For example, the government has encouraged the planting of corn to replace rice by giving subsidy, but it is still unattractive for farmers to grow. Because of this, upland crops occupied only less than 10% of the total cropping areas in the Mekong Delta, and it seems that a faster increase in the area under upland crops is still a challenge in rice sector restructuring. On the contrary, the rotation of rice-fisheries, particularly rice-shrimp rotation, promises a rice-based system in terms of good adaptation to climate change and high income for farmers.

For the rice sector restructuring, technology innovation and adoption play an important role. Although some good practices in rice production like "3 reductions, 3 Gains " or "1 must do, 5 reductions" are well-established, the scale of application is still limited. It is reported that in

Can Tho, rice production following VietGAP standard only covers a few thousand hectares, which are considered a very small area. This indicates that there is an urgent need to scale-up available technologies. Meanwhile, more innovations on climate-smart technologies in rice production, including new rice varieties adapted to climate change, should be developed and transferred to production. All major steps in rice cultivation at present have been mechanized, except the planting. Common practice of planting in the Mekong Delta is direct (wet) seeding by manual broadcasting or drum seeding. The introduction of transplanting machines recently opened up an opportunity to mechanize rice planting. However, as transplanting by machines is still costly, the application of seeding machines is necessary to complement transplanting machines. Therefore, the development of seeding machines suitable to rice cultural conditions of the Mekong Delta is urgently needed as proposed by the provinces.

The model of "Large field" or "Linkage field" as defined by Dong Thap province has not expanded as expected to facilitate the formation of the rice supply chain. The bottleneck of this constraint lies in weak farmers' organizations and weak company capability. Hence, strengthening the capability of both farmers' organizations and companies, mainly private sector, is critical to increasing the efficiency of the rice sector in the Mekong Delta particularly in coping with climate change.

Since rice restructuring requires suitable infrastructure, increasing investment in modernizing the infrastructure is vital in making rice restructuring inclusive and resilient to climate change.

As rice restructuring in each province should be placed in the context of the whole Mekong Delta, based on the decision of MARD in 2016 endorsing the project, "Restructuring of the Vietnam Rice Sector to 2020 and a Vision Toward 2030," a plan for rice restructuring in the Mekong Delta should be developed to guide the provinces in this region to formulate or revise their plans. The plan can be prepared by DCP and MARD, with the support of IRRI and FAO.

CS MAPs are valuable in complementing the planting calendar of rice seasons in the overall thrusts to boost rice production in five Mekong Delta Region provinces.

In Long An, risk maps and adaptation plans serve as key guides for DARD in managing rice production, but these are being used at the level only due to lack of technical knowledge among officials in the district level.

In Tra Vinh, CS MAP is only useful in cases of extreme salinity intrusion events, while An Giang calls for a simplified definition of risks to avoid confusion during the implementation

phase. At the same time, applying remote sensing and satellite images during the growing periods of many rice varieties planted in one plot remains a challenge. However, An Giang's application of remote sensing in risk monitoring and in estimating crop yield is now in its pilot stage.

Meanwhile, although Can Tho is one of the first provinces that generate geo-referenced data on rice planting calendar, finds CS MAPs well-adopted only at the provincial level.

The DARD office in Dong Thap is sharing risk maps and planting calendar to districts for agricultural planning, although its Crop Production Office is calling for a simpler tool to manage and update information on risks, damages, and crop production, among others, based on existing CS MAP.

In the 5 provinces visited in this study, the limited technical knowledge on suitable climate change actions and CSA options among officials in the district and provincial level constraint the application of CS MAP in rice production in the current climate scenario.

Annexes

Annex 1. Existing policies on transformation of rice areas, land use, etc

Documents related to rice production and rice land conversion in Mekong River Delta

Documents	Document No.	Main related contents
1. The Decree on rice land management and use	No. 35/2015/ND-CP, dated 13/04/2015	<p>1. Conditions for conversion from rice cultivation to annual crops or rice cultivation integrated with aquaculture:</p> <p>(i) Do not lose the proper conditions to cultivate rice again: do not distort the ground, do not damage irrigation works in service of rice cultivation;</p> <p>(ii) In accordance with the plan of conversion from rice cultivation to annual crops or rice cultivation integrated with aquaculture commune level;</p> <p>(iii) In the case of rice cultivation integrated with aquaculture, up to 20% of the rice land area can be utilized to lower the aquaculture land, but the ground is restored when going back to cultivate rice.</p> <p>(iv) Land users register to change the crop structure on rice land with commune-level People's Committees.</p> <p>2. The People's Committees of the provinces and city shall determine the types of annual crops or types of aquatic resources appropriate for converting crop structure on rice land in the locality.</p>
2. The Decree on amending and supplementing the enforcement of the Land Law	No. 01/2017/ND-CP, dated 06/01/2017	<p>Article 7a. The conversion of the crop structure on rice land into perennial by households and individuals shall comply with the following provisions:</p> <p>a / Households and individuals must register the conversion of the crop structure on the rice land at the commune-level People's Committees of the localities where land is located;</p> <p>b / The commune-level People's Committees of the localities where the land is located shall consider and decide on the type of perennial crops to be converted. The conversion to perennial crops does not lose proper conditions to cultivate rice again in order not to distort and pollute the ground, not degenerate rice land; not damage traffic works, irrigation works in service of rice production and in conformity with the plan on conversion crop structure from rice to perennial crops in communes;</p>
3. Project of "Agricultural restructuring toward enhancing added value and sustainable	Decision No. 899/QD-TTg by Prime Minister dated 10/6/2013	<p>(i) Maintain and use 3.8 million hectares of rice land to ensure food security in flexible manner.</p> <p>(ii) Expand corn growing area to yield more than 8.5 million tons</p> <p>(iii) Facilitate institutional arrangements for farmers to shift land use purpose within the agricultural sector, to</p>

development"		achieve higher land use effect, including the replacement of crop structure on rice land without prejudice to permanent rice production capacity.
4. Project of rice production development in Mekong River Delta by 2025, orientation to 2030 in the context of climate change	Decision No. 1915/QD-BNN-KH, dated 28/05/2018 by the Ministry of Agriculture and Rural Development	<p>Maintain the Mekong River Delta rice cultivated area of 4 million ha to 2025 and 3.8 million ha to 2030</p> <p>1. Areas affected by salinity intrusion in estuaries and sea ports:</p> <p>(i) Salt content < 4 ‰ (128-132 thousand ha): 3 rice crops (Winter-Spring – Summer-Autumn – Autumn-Winter crops: 22-27 thousand ha); Two rice crops-one annual crop (Winter-Spring – annual crop- Summer-Autumn rice crop: 67-82 thousand hectares); 2 rice crops (Winter-Spring: 15-23 thousand ha); 1 rice crop-1 annual crop (Summer-Autumn rice – annual crop: 12-14 thousand ha)</p> <p>(ii) Salt content > 4 ‰ (202-205 thousand ha): 1 rice crop - 1 brackish water shrimp (Summer-Autumn rice or Autumn-Winter-Shrimp: 184-194 thousand ha); Specialized in seafood or one rice crop production (11-18 thousand ha)</p> <p>2. The flooded areas (858-910 thousand ha), frequently flooded from July to November</p> <p>(i) Areas with strong and complete embankment dikes (395-440 thousand ha): 3 rice crops</p> <p>(ii) Areas with embankment and floodgate dikes in Autumn-Winter crops (288-325 thousand ha): Winter-Spring and Summer-Autumn rice crops.</p> <p>(iii) Areas without dikes (95-114 thousand ha): 2 rice crops - 1 crop of aquaculture (Winter-Spring – Summer-Autumn – sea product or lotus, caltrops)</p> <p>(iv) Remaining areas (50-70 thousand ha): 1 rice crop - 1 shrimp crop (Summer-Autumn or Autumn-Winter rice crop and shrimp aquaculture)</p> <p>3. Areas unaffected by saline intrusion and flood (485-500 thousand ha)</p> <p>(i) Active watering area: 3 rice crops (222-230 thousand ha)</p> <p>(ii) Non-active watering areas: 2 rice crops (189-194 thousand ha): Winter-Spring - Summer-Autumn crops and 3 rice crops can be made when the irrigation system is complete.</p> <p>(iii): Winter-Autumn rice crop - annual crops-Summer-Autumn rice crop</p> <p>(iv) Summer-Autumn rice crop (or Autumn-Winter rice crop) and Shrimp Farming or Summer-Autumn rice crop – annual crop.</p>
5. Project of "Restructuring Vietnam Rice	Decision No. 1898/QD-BNN-TT of the	(i) By 2020, the country will maintain about 7 million ha of rice land; convert 700-800 thousand ha in poorly-cultivated paddy areas or to other crops or combine

<p>Industry to 2020 and Vision to 2030".</p>	<p>Ministry of Agriculture and Rural Development</p>	<p>aquaculture.</p> <p>(ii) Mekong River Delta: freshwater alluvium, promoting strength of two rice crops/year, and rotation of 2 rice crops – annual crops where conditions are appropriate. The coastal zone is suitable for the production of high-quality rice or organic rice in the structure of shrimp - rice.</p> <p>(iii) Conversion of low-yielding rice areas to other crops or aquaculture, reduction of Spring-Summer rice fields and third rice crops (Autumn-Winter crop) where the conditions are not satisfactory.</p> <p>(iii) Ensuring profit for rice growers in the rice production area from 30% of total revenue or more.</p> <p>(iv) Reducing greenhouse gas emissions by 10% by 2020 and 20% by 2030 as compared to today.</p> <p>(v) Developing enterprises in the specialized cultivation areas on consumer products. Enterprises in affiliation with farmers are supported with land, capital, infrastructure, taxes and fees, marketing activities, brand building and extension training. In non-specialized cultivation areas, it is necessary to increase the scale, accumulation of land; support with seeds, techniques, support in organizing cooperatives and links with enterprises.</p> <p>(vi) Supporting large enterprises associated in production involving farmers in key material areas; identifying target markets, attracting big customers, building brands, connecting directly with the retail system.</p>
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Comment: There are currently 4 documents related to the production and conversion of rice land directly in relation to the Mekong River Delta. These documents have the same rules:

- a) Encourage the conversion of ineffective rice land into other crops or aquaculture on a scale of 200,000 ha to 2025.
- b) Rice land may be converted into other crops, but it must ensure that: (i) Suitable conditions for restoring rice cultivation are maintained; ground is not distorted; irrigation works in service of rice cultivation are not damaged; (ii) it is in accordance with the plan for conversion from cultivation of rice to annual crops or rice cultivation integrated with aquaculture at commune level; (iii) In the case of rice cultivation integrated with aquaculture, up to 20% of the rice land area can be utilized to lower the aquaculture land, but restore the ground when reverting to rice cultivation.
- c) However, as stipulated in Decree 01/2017/ND-CP, dated 6th January 2017, amending and supplementing a number of decrees detailing the implementation

of the Land Law, such as "conversion to perennial crops does not lose the proper conditions to cultivate rice again" is very difficult for the people because in planting perennial trees, it is necessary to make lining (beds) and dig gutters. However, this will deform the ground, disorder soil layers, lose the plow layer, and difficult to cultivate the rice again.

- d) Conversion of crop structure on rice land is only required to be registered at commune-level People's Committees. However, such conversion must be within the conversion plan identified by People's Committees or city.

Annex 2. Floods in Mekong River Delta in 2008

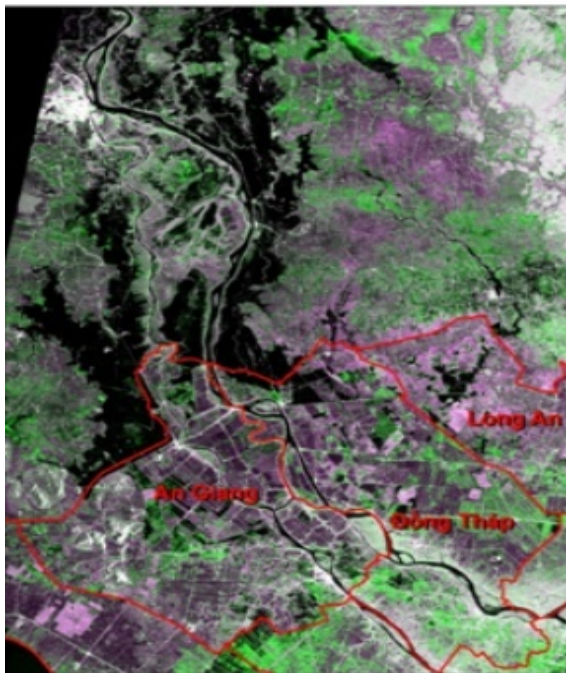
Radar remote sensing photos provided by satellite Sentinel-1 of the European Space Agency (Black locations are under-flood zones).



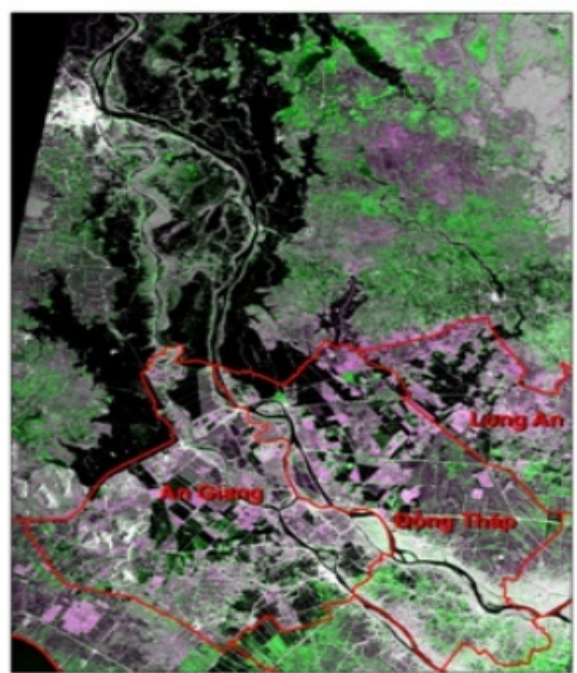
Photo taken on 11/07/2018 when the Department of Crop Production team began investigating. No signs of flooding were found.



Photo taken on 17/07/2018: Flooded areas began to be found in Mekong River fountain head, in An Giang, and Dong Thap (the date of investigation in Cho Moi district, An Giang).



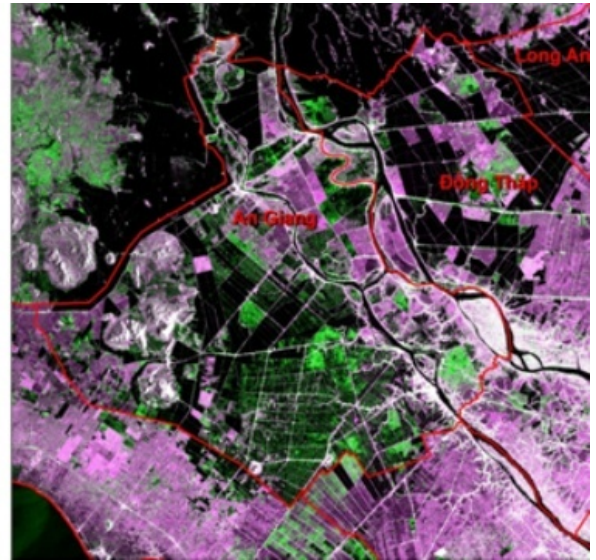
The flooded area increased remarkably in Dong Thap and Long An. An Giang suffered no flood due to a good dyke system. (04/08/2018 photo)



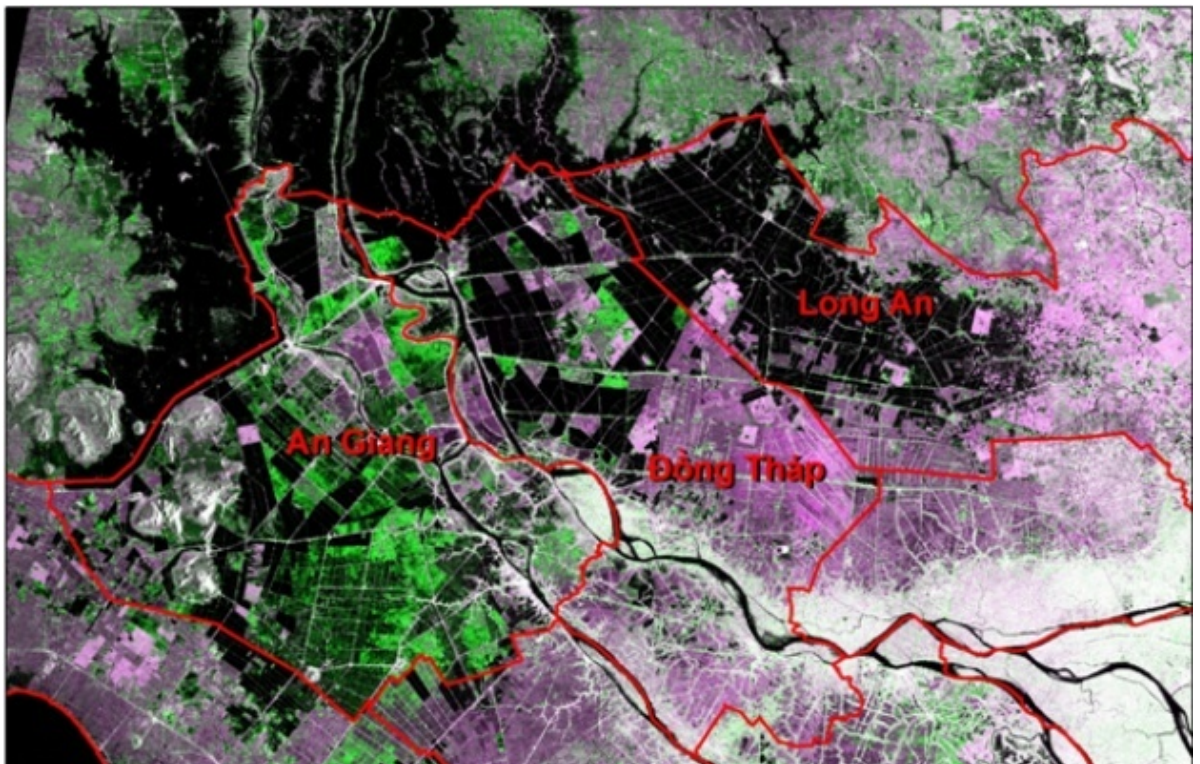
The flooded area increased remarkably in An Giang, Dong Thap, and Long An. (10/08/2018 photo)



Flooded area increased remarkably in Dong Thap and Long An. An Giang began suffering floods in the upstream area. (28/08/2018 photo)



Flooded area increased in Dong Thap and Long An. An Giang also suffered floods in about 30% of the upstream area. (03/09/2018 photo)



Over 50% of the area suffered floods in Dong Thap and Long An. An Giang also suffered floods in about 30% of the upstream area. (09/09/2018 photo)

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