

## Solutions for Developing Agricultural Economy to Adapt Climate Change In Ben Tre Province – Viet Nam (2011 - 2022)

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**ABSTRACTS:** In 2023, according to the Ben Tre Provincial Statistics Department: Ben Tre is still an agricultural province with 75.59% of agricultural land area, up to 89.75% of the population belongs to rural and labor areas. 328,706 people aged 15 and older working in the agricultural, forestry, and fisheries sector annually, accounting for 42.57% of the total number of workers at Ben Tre province in 2022 (772,229 people), the highest among all economic sectors. international. Facing the effects of climate change and saltwater intrusion, Ben Tre is considered one of the most heavily affected localities in the Mekong Delta, restructuring the agricultural sector and converting tree production Planting and raising livestock to adapt to climate change is one of the important issues that the province pays regular attention to. The content of the article will point out the causes, current situation and implementation of restructuring the agricultural sector to adapt to the increasingly serious situation of climate change and saltwater intrusion in Ben Tre in the period of 2011 - 2022, from 2011 to 2022. That points out the need to maintain and promote appropriate agricultural development policies in the province in the coming time.

**KEYWORDS:** Ben Tre Province, agriculture, climate change, solutions, economic development.

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### 1. INTRODUCTION

Ben Tre is one of 13 provinces in the Mekong Delta, with a natural area of 2,379.7 km<sup>2</sup> (2022). The average population of the province in 2022 is 1,298,006 people (Ben Tre Provincial Statistics Department (2023)). The entire Mekong Delta region has 9 estuaries, Ben Tre has 3 estuaries (Dai estuary, Co Chien estuary and Ham Luong estuary) with a 65km long coastline. Located at the end of the Mekong River, Ben Tre only receives 15 - 20% of the water from this river into our country every year. In addition, because it is made up of island land, Ben Tre's land is crisscrossed with rivers and canals with a total length of about 6,000 km and an area of 36,937.8 hectares (Union of Science and Technology Associations of Ben Tre Province (2020), p.26). The province's terrain is relatively homogeneous, the highest point in the Northwest gradually lowers to the Southeast in a fan shape and tilts towards the sea, the lowest point is less than 1 meter above sea level, flooded at high tide. , the average high point is from 1 - 2 meters high, accounting for over 90% of the province's area, only flooded during high tides in the last months of the year (lunar calendar) and the highest point is from 2 to 5 meters are sand dunes. , sandy area, suitable for farming and animal husbandry (Huynh Huu Han (2004), p.16). In terms of climate, Ben Tre belongs to the sub-equatorial tropical monsoon region with two distinct dry and rainy seasons. The average annual temperature is relatively stable at 27.30C; Average rainfall is from 1,250 - 1,500mm. Thus, the locality has a temperate climate, less affected by natural disasters (storms, thunderstorms, floods,...) so it is suitable for agricultural production activities (Doan Thi Ngoc Nhi, p.37- 38). The province's land is quite rich and diverse, divided into 4 main soil groups: sandy soil (6.4%), alluvial soil (26.9%), alum soil (6.74%) and saline soil ( 43.11%), of which over 66% of the land area is assessed as favorable or less restrictive for crops. Therefore, of the province's total land area of 237,970 hectares, 75.59% is agricultural land (179,885 hectares) (Ben Tre Provincial Statistics Department (2023)).

Due to the above terrain, climate, and land characteristics, under normal conditions, with abundant irrigation water, Ben Tre has long been famous as a rich land with coconut area in 2011 of 55,870 hectares, rice acreage of 76,962 hectares. hectares, sugarcane 424,248 hectares (Ben Tre Provincial Statistics Department (2012)), is the largest producer of self-bred fruit trees in Vietnam with more than 18 million seedlings per year recognized by the Guinness Book of Records Center. Vietnam confirmed in 2014,... But since 2011, under the impact of climate change and increasingly complicated saltwater intrusion, Ben Tre has been considered by experts to be one of the most The most severely affected region is the Mekong Delta. And in fact, there have been landslides, droughts, and saltwater intrusion that have severely affected the socio-economic situation of Ben Tre province in the years 2015 - 2016, 2019 - 2020 and are currently happening rapidly. harsh (from the beginning of 2024 to the end of April 2024).

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Therefore, ensuring the livelihood of farmers, which depends on the production conditions of agricultural lands, is one of the top issues of concern to the province. And the conversion of crops and livestock to sustainably develop the agricultural sector to adapt to climate change and the situation of saltwater intrusion deeper and deeper into the mainland, ensuring livelihoods for farmers to stick to the land and countryside. Huong not only increases production to feed herself and her family, but also participates in socio-economic development, which is one of the key contents of many conferences and seminars held in Ben Tre. And in fact, this transformation has been applied initially and brought positive results. Ben Tre farmers have been able to gradually get used to the current conditions, adapt well and make a positive contribution to growth province's economy.

### **2. CONTENT**

#### **2.1. Climate change situation in Ben Tre province**

According to the assessment of the Intergovernmental Panel on Climate Change (IPCC), Vietnam is one of five countries that will be seriously affected by climate change and sea level rise. Among them, the Mekong Delta region is expected to be flooded the most. If the sea level rises by 1m, about 10% of the population will be directly affected, with a loss to GDP of about 10%; If sea level rises 3m, about 25% of the population will be directly affected and the loss to GDP will be up to 25%.

Ben Tre is one of 13 provinces and cities in the Mekong Delta region ranked among the provinces most at risk from climate change and sea level rise, because Ben Tre borders the East Sea with a length of 65 km, the river Intertwined streams, over 90% of the entire province's area is 2m or less above sea level. In fact, in the past, storm No. 5 (in 1997) and storm No. 9 (in 2006) landed on the mainland of Ben Tre, which was an unusual phenomenon and caused great damage to people and material, which are signs that Warning signs about climate change directly impact Ben Tre.

In the years 2013 - 2020, due to the negative impacts of climate change, natural disasters plus the Covid-19 epidemic (2020), the average GRDP growth rate of Ben Tre province only reached 5.22%, lower than the growth rate of the whole country (6.35%) and the Mekong Delta (6.0%). Especially since two severe droughts and saltwater intrusions (the first at the end of 2015, early 2016 and the second at the end of 2019, early 2020)(), the average growth rate in the period 2016 - 2020 reached 5.18%, lower than the period 2011 - 2015 (5.25%), lower than the average growth rate of the country (6.29%/year) and the Mekong Delta. The scale of GRDP of Ben Tre province ranked 46th in the country in 2020, GRDP per capita ranked 7th in the Mekong Delta (Ben Tre Provincial Party Committee (2023), p.1).

Symptoms of climate change in the province include: Drought, unseasonal rain, erratic heavy rain, impact of El Nino, increased temperature during the year, increased saltwater intrusion, high tide causing flooding, The trend of storms from the East Sea directly impacting... the impact on daily life and economic development of the province is increasingly evident. The trend of rising sea levels pushing the salinity boundary deeper inland and the climatic abnormalities, the appearance of the El Nino phenomenon, combined with the amount of Mekong River water flowing dry in the dry season, Ben Tre province has to suffer 02 The drought and saltwater disaster caused serious damage over a period of 90 years. In addition, riverbank and coastal landslides in Ben Tre province are becoming more complicated and becoming more serious, causing great damage to production and people's lives. According to statistical results on river bank erosion, by 2020, the entire province will have a total length of about 114.5 km of landslides, causing damage to houses and loss of productive land for hundreds of households, of which: Ham Luong 50.0 km; Tien River 11.0 km; Cua Dai River 2.3 km; Co Chien River 20.7 km; Ba Lai River 1.3 km; 3.1 km Giao Hoa canal and 26.1 km of inland dikes, local embankments, rural roads... Regarding coastal erosion, as of 2020, a total length of about 19 km has lost about 200 hectares of land and 54 hectares of protective forest in 03 coastal districts, of which, Ba Tri district had a landslide length of about 4.0km, causing the loss of about 45 hectares of land and 09 hectares of protective forest; Thanh Phu district had a landslide length of about 10.0 km, causing the loss of about 56 hectares of land and 37 hectares of protective forest; In Binh Dai district, the landslide length was over 5.0 km, causing the loss of about 100 hectares of land and 08 hectares of protective forest (Ben Tre Provincial Party Committee (2023), p.2).

#### **2.2. Impact of climate change on agriculture and the economic life of farmers**

The 2012 report "Rapid integrated assessment of climate change vulnerability and adaptation capacity in three coastal districts, Ben Tre province" by the World Wide Fund for Nature (WWF - Vietnam) pointed out In addition, the average temperature of Ben Tre in the period 1977 - 2010 increased rapidly, of which 2010 had the highest temperature (29.60C); Air temperature has increased by about 0.5°C; In the years 2013 - 2020, Ben Tre's temperature continued to increase, in which 2016 (27.70C) and 2020 (27.90C) were the two years with the highest average temperature. On the contrary, rainfall in Ben Tre increases and decreases unstably. From an average rainfall of 1,307mm (2013), it decreased to 995mm (2015), increased again to 1,342mm (2018), then continued to decrease to 754mm (2019), then increased again to 1,663mm (2020) (Ben Tre Provincial Statistics Department (2012), (2016), (2021)). This unusual weather situation has created two historic periods of drought and saltwater intrusion in 2015 - 2016 and 2019 - 2020 in the province as well as the entire Mekong Delta region and directly negatively affected the production situation. production and life of farmers in the Mekong Delta, including Ben Tre.

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Regarding cultivation, at the end of the 2016 dry season in the Winter-Spring rice crop in Ben Tre, over 70% of the planted area was damaged, of which about 40% of the area was lost; Rice fields in Thanh Phu, Ba Tri, Chau Thanh, Giong Trom and Binh Dai districts suffered the greatest rice damage. In addition, the whole province has over 510 hectares of crop areas with reduced productivity due to salt water irrigation. Particularly, rambutan, durian, and jackfruit trees in Chau Thanh and Cho Lach during the period affected by drought and salinity suffered damage from leaf burn to tree death at a rate of 50 - 80%. Citrus trees such as oranges, tangerines, and green-skinned grapefruits also suffer from leaf burn, slow growth, and reduced productivity. Most of the seedlings and ornamental flowers in the districts of Cho Lach, Mo Cay Bac, and Chau Thanh suffered severe damage due to drought and salinity (Pham Thanh Vu, Phan Hoang Vu, Pham Thi Chinh and Nguyen Duy Can (2020), p.126). In the dry season of 2019 - 2020, crop losses are even more serious: In the entire province, more than 5,100 hectares of Winter-Spring rice crop were damaged because people did not sow seeds according to the province's recommended time; 6,674 hectares of orchards are affected from 30 - 70%, 2,603 hectares are affected over 70% and 274 hectares are dead; 1,490 hectares of vegetables, more than 1,000 hectares of seedlings and ornamental flowers are at risk of serious damage due to lack of irrigation water. Particularly for coconut trees, about 72,320 hectares of coconut trees were damaged out of a total of 73,997 hectares of coconut trees in the province, of which, although the quantity supplied to the market increased compared to the previous year, the output of coconut trees was affected. Due to drought and salinity in the first months of the year, the fruit is small and the water sweetness is reduced, causing the selling price to decrease (People's Committee of Ben Tre province, 2020).

Regarding livestock production, in early 2019, the foot-and-mouth disease epidemic in pigs broke out with 6 outbreaks in 6 hamlets in 6 communes of Mo Cay Bac, Mo Cay Nam, Giong Trom districts, the total number of infected cattle is 148 children. By July 2019, the province had African swine fever again. From the date of discovery to December 15, 2019, 1,174 households had the disease, the total number of pigs destroyed was 42,545 (total weight). 1,909 tons) compared to the total herd of 296,356 pigs, accounting for 14.36%. As for the poultry herd, the province also destroyed 1,026 birds weighing 934.7 kg affected by the H5N6 influenza epidemic (Ben Tre Provincial Statistics Department (2020)).

Regarding forestry, forest areas, especially mangrove forests and coastal protection forests, are threatened by landslides. By the end of 2020, with a total length of about 19 km of coastline being eroded, about 200 hectares of land and 54 hectares of protective forest were lost in 03 coastal districts, of which, Ba Tri district lost about 45 hectares of land and 09 hectares of land. protection forest, Thanh Phu district 37 hectares of protection forest; Binh Dai district lost about 08 hectares of protective forest (Ben Tre Provincial Party Committee (2023), p.2). Besides being affected by landslides, the area of mangrove forests also decreased because people arbitrarily changed the area for aquaculture.

Regarding the fisheries industry, with a relatively large area of brackish and freshwater areas, Ben Tre is a province with advantages in aquaculture. However, under the influence of climate change and saltwater intrusion, the province's aquaculture situation has recently encountered many difficulties due to an increase in epidemics and depletion of water sources for aquaculture. During the 2019 - 2020 dry season, all of the province's freshwater farming areas were affected with 2,110.1 hectares severely affected; Of which, over 700 hectares of giant freshwater shrimp farming area suffered less than 30% damage, about 1,100 tons of clams died. In addition, because the salinity in some ponds exceeds the allowable threshold, combined with raw fish consumption prices falling to low levels due to the impact of the Covid-19 epidemic, the total area of intensive pangasius farming in 2020 is only estimated. about 583 hectares, down 4.58% over the same period last year (Ben Tre Provincial Statistics Department (2021)).

The above situation has a direct impact on the proportion of Ben Tre's agricultural sector in the province's economic structure, in addition to gradually decreasing (from 44.6% in 2011 to 35.37% in 2022) due to restructuring. Economically, the proportion of agriculture, forestry and fishery in the period 2011 - 2022 increases by an average of 3.348%/year, lower than the period 2005 - 2010 of 7.70%/year. The labor structure in the agricultural sector also decreased accordingly. Laborers aged 15 and older working in agriculture, forestry and fisheries decreased from 454,659 people out of a total of 759,194 people, accounting for 59.89% in 2011, to 328,706 people out of a total of 772,229 people, accounting for 59.89%. rate of 42.57% in 2022, still accounting for the highest proportion of the total number of workers working in the entire economic sector. However, the unemployment rate in rural areas is still higher than the rate of the province's general unemployed labor force in the 2022 age group, which is 2.04% compared to 2% (Ben Tre Provincial Statistics Department (2012),(2023)). This has had a negative impact on the implementation of the province's poverty reduction policies, causing the poverty rate of the entire province in the period 2016 - 2020 to be 4.59%, a negligible decrease compared to the period 2011 - 2015 of 5%. .5% (Ben Tre Provincial Party Executive Committee, 2015).

### **3. SOLUTIONS FOR RESTRUCTURING THE AGRICULTURAL INDUSTRY TO ADAPT TO CLIMATE CHANGE**

To adapt to the situation of climate change and saltwater intrusion in the area, since 2011, the province has issued many programs, resolutions and plans to focus on implementation such as Action Program No. 29-CTr/ TU September 23, 2013; Directive No. 10-CT/TU dated May 19, 2016 of the Provincial Party Standing Committee on improving capacity to respond to climate change,

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strengthening resource management and environmental protection; National target program to respond to climate change for the period 2012 - 2015; National target program to respond to climate change and green growth in 2016 - 2020; Resolution on developing Ben Tre towards the East in the period of 2021 - 2025 and vision to 2030 (No. 04-NQ/TU, dated January 29, 2021 of the Provincial Party Committee), Development planning of Ben Tre province in the period of 2021 - 2030, vision to 2050 (issued under Approval Decision No. 1399/QD-TTg of the Prime Minister), etc. Through that, many proposed tasks and solutions have been and are being applied effectively, including solutions to transform agricultural structure to adapt to climate change, building value chains based on key agricultural products; Strengthen scientific resources and investment in livelihood projects to adapt to climate change, especially in the three coastal districts (Binh Dai, Ba Tri, Thanh Phu) which are most affected. Restructuring the province's agricultural sector towards sustainable agricultural development, promoting the development of modern agriculture, clean agriculture, and organic agriculture to adapt to climate change; Improve the quality, reputation, and competitiveness of the province's agricultural products associated with protecting the ecological environment, contributing to increasing income for people in rural areas.

The province has proactively prevented, combated, and limited the impacts of high tides, flooding, and saltwater intrusion due to sea level rise by implementing key irrigation projects such as: South Ben Tre and North Ben Tre irrigation systems. Ben Tre Water Management project, domestic water supply in Minh island area in the context of climate change and saltwater intrusion, Kenh Lap freshwater reservoir in Ba Tri district, infrastructure serving the development of sustainable livelihoods for people in the coastal area of Ba Tri to adapt to climate change, infrastructure serving the development of sustainable livelihoods for people in the coastal area of Thanh Phu to adapt to climate change. The current situation by 2022 is that the province has not been able to proactively source water for production and daily life in the context of prolonged natural disasters of saltwater intrusion. However, it is expected that by 2025, the system of key irrigation works will be complete and self-contained. The province will proactively minimize damage caused by the negative impacts of climate change and natural disasters of saltwater intrusion. (Ben Tre Provincial Party Committee (2023), p.4).

To be consistent with the planning and development trend of the Mekong Delta region, adapt to climate change and exploit the potential of marine economic strengths, Ben Tre province pivots its development to the East, developing its economy. marine, tourism and ecological agriculture; Focus on implementing tasks on the complete irrigation system of South and North Ben Tre, ensuring fresh water supply and adapting to climate change; wastewater and garbage treatment; Focus on developing a circular, low-carbon economy to effectively manage and use resources, especially land, water, and renewable energy resources; Promote the implementation of wind power projects in coastal areas with the goal of having at least 1,500 MW put into operation, invest in upgrading sea dikes; River bank erosion protection embankment projects, aim to minimize damage caused by natural disasters, contributing to the socio-economic development tasks of the province.

In addition, the province implements functional zoning based on ecological characteristics, resource potential and adaptation to climate change as a basis for development planning; Marine space planning plan associated with land development space with 03 ecological sub-regions: Fresh ecological zone developing freshwater fisheries and fruits; coastal salt-brackish ecological zones for salt-water and brackish-water aquaculture on shore and at sea; fishing; restore and develop coastal mangrove forests associated with protecting biodiversity and coastal strips; The freshwater - brackish transition zone is between specialized brackish water fisheries and rotation with rice and vegetables in accordance with seasonal water conditions.

**Table 1. Area and output of some key crops in Ben Tre province (2011 - 2022)**

Year		2011	2015	2020	2022
Rice	Acreage	76.962	61.109	16.762	23.607
	Output (tons)	362.168	278.769	59.052	110.914
Coconut	Area (ha)	55.870	68.545	73.997	78.019
	Output (tons)	427.900	573.139	645.468	686.279
Grapefruit	Area (ha)	4.144	6.205	9.262	9.246
	Output (tons)	35.997	50.762	83.984	96.620
Orange, tangerine	Area (ha)	3.141	1.880	1.600	1.402
	Output (tons)	22.929	14.799	13.696	13.690
Sugarcane	Area (ha)	5.340	2.085	133	3
	Output (tons)	424.248	158.803	11.154	242

Source: Ben Tre Provincial Statistics Department.

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**Table 2. Situation of livestock and poultry farming in Ben Tre province (2011 - 2022)**

Unit: animal

Year	Buffalo	Cow	Pig	Horse	Goat	Chicken	Duck, Goose
2011	1.788	157.399	446.522	43	34.679	3.431.100	1.978.800
2015	869	176.571	502.095	30	95.370	3.740	1.014
2020	261	223.432	283.528	-	185.792	6.839	1.721
2022	270	214.773	335.648	11	202.195	6.570	1.008

Source: Ben Tre Provincial Statistics Department.

(2012, 2016, 2023).

**Table 3. Situation of aquaculture in Ben Tre province 2011 - 2022**

Year	2011	2015	2020	2021	2022
Aquaculture area (ha)	43.073	46.458	37.287	35.890	36.640
Aquatic production (tons)	330.100	444.233	531.303	531.786	588.006
Production value (billion VND)	13.472	16.542	14.033	16.318	18.449

Source: Ben Tre Provincial Statistics Department (2016, 2023) and the author's research results.

In the agricultural sector, leaders of Ben Tre province advocate restructuring, plant varieties, and livestock associated with crop adjustment, agricultural production techniques to adapt to climate change, gradually reducing crops and livestock. farming with low efficiency, while gradually increasing livestock and crops with high economic efficiency associated with promoting the application of science and technology to increase productivity. From tables (1, 2, 4) it can be seen that in the period 2011 - 2022, in cultivation, the area planted with key crops of the province such as rice, sugarcane, oranges, and tangerines gradually decreased due to too much dependence on agricultural resources. fresh water for irrigation, while the area of coconut and grapefruit trees is continuously increasing because coconut trees can withstand salinity, and for grapefruit trees, farmers use reserved irrigation water sources and install drip irrigation pipes; In livestock farming, the total number of herds of buffaloes, horses, chickens, ducks, geese and geese decreased due to limited output markets and often unstable prices. Although the pig herd decreased, it still remained high due to high prices. conditions are more stable, farmers are profitable and diseases are basically controlled, the herd of cows and goats is continuously increasing because farmers are switching from growing rice to growing grass to raise cows and goats with higher economic value and higher income. import is more stable (in the years 2021 - 2022, due to the impact of the Covid-19 epidemic, the number of cows will decrease but not much because the consumption market is limited, the price of beef cattle exported from the barn will decrease); Aquaculture area has decreased but still remains high. Thanks to promoting the application of science and technology to aquaculture, output and production value are continuously increasing, especially high-tech shrimp farming adapted to climate change. Queen. The forest area remains stable, the scale of newly planted forest area is quite good, the value of forestry production is increasing, but not significantly, the reason is that people often destroy forests to cut down trees for firewood and destroy forests. for aquaculture.

The above results have been achieved thanks to the fact that in recent times, the province has selected salt-tolerant rice varieties and carried out many scientific research projects as a basis for policy planning associated with piloting and replication. farming models to adapt to climate change ( ). At the same time, the province has promptly set out policies and applied solutions to implement agricultural restructuring in the direction from small, retail, and fragmented production to concentrated-scale production (farms, cooperatives, groups). cooperation), implementing the construction of concentrated production areas associated with developing the value chain of the province's key agricultural products including 08 agricultural products: coconut chains, green-skinned grapefruit, rambutan, longan, ornamental flowers, and beef. , pigs (pigs) and marine shrimp, which promotes the development of high-tech shrimp farming. In addition, the Provincial People's Committee issued Plan No. 2790/KH-UBND dated May 27, 2021 to restructure the agricultural sector of Ben Tre province for the period 2021 - 2025. As a result, by 2022, the total number of farms There are 46 farms in the province (17 livestock farms, 24 aquaculture farms, 02 crop farms, 03 salt production farms), the total land area of the farms is 203.69 hectares. By the end of 2022, the whole province has 27 cooperatives, 47 cooperative groups with a scale of 5,194.9 hectares and 6,573 members, specifically: Coconut industry has 27 cooperatives, 35 cooperative groups with a scale of 5,013 hectares. 5 hectares and 6,263 members, the total coconut output the enterprise has purchased is 26,163,009 coconuts; building a concentrated organic coconut production area, resulting in the area of coconut produced according to organic standards being 13,125.16 hectares, of which the certified area is 7,249.2 hectares (Ben Tre Provincial Party Committee (2023), p.7).

## 4. CONCLUSION

Climate change and saltwater intrusion are objective, rule-based impacts of climate and weather that take place on a global scale and have been directly affecting many countries, especially coastal countries. , including Vietnam. The Mekong Delta,

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including Ben Tre province, is considered the most heavily affected area of the country. Therefore, in addition to promptly setting out guidelines and policies to respond and adapt to climate change, the economy must also restructure accordingly, ensuring sustainable development. For Ben Tre province, the agricultural sector depends heavily on water sources, weather and climate, so it is most easily affected. Therefore, converting the structure of planting and livestock to suit is an important issue that the province has focused on researching and applying from 2011 to present. In particular, key irrigation projects and farming models adapted to climate change and saltwater intrusion have been implemented, initially bringing practical results to farmers. The province's agricultural economy is shifting towards green, reducing emissions with wind energy projects in coastal areas, organic agriculture, and high technology; Adapting to climate change in accordance with ecological regions, exploiting the potential and strengths of the marine economy. Land management is gradually perfecting the mechanism to exploit clean land funds and form large concentrated production areas. The management of the environment, water resources, forest resources, and biodiversity has gradually improved, without establishments causing serious environmental pollution, etc. In the coming time, if localities continue to maintain and promote the same growth rate as in 2011 - 2022, believing that Ben Tre will maintain a positive growth rate and will soon achieve the goal of becoming a well-developed province in the delta region. Mekong River in 2025./.

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