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Assessing the effectiveness of environmental protection work in An Giang province in 2024: Achievements, challenges and orientations for sustainable development

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ABSTRACT: This study evaluates the effectiveness of environmental protection efforts in An Giang Province, Vietnam, in 2024, focusing on key areas such as air and water quality, waste management, biodiversity conservation, and policy implementation. The findings reveal that air quality in the province remained relatively good, with most parameters meeting national standards, although localized pollution was observed in urban and industrial areas. Surface water quality, however, faced significant challenges, with increased pollution levels in areas affected by tourism and aquaculture activities. The province's two natural heritage sites, Tra Su and Tan Tuyen Melaleuca Forests, demonstrated successful biodiversity conservation efforts, hosting numerous rare and endangered species. Waste management improved slightly, with 78.66% of solid waste collected and treated, yet the reliance on landfilling and inadequate wastewater treatment infrastructure highlighted ongoing challenges. Strengths included enhanced air quality monitoring, community engagement, and policy support, while weaknesses centered on limited financial resources and insufficient environmental infrastructure. Key opportunities lie in adopting advanced technologies and leveraging national policies for sustainable development, whereas threats include climate change impacts and rapid industrial expansion. The study concludes with recommendations for improving wastewater treatment, transitioning to advanced waste management technologies, strengthening climate adaptation measures, and promoting green economic practices. These efforts are essential for achieving sustainable environmental management in An Giang Province, balancing economic growth with ecological preservation.

KEYWORDS: Environmental protection, air quality, water pollution, waste management, biodiversity conservation, An Giang Province, Vietnam.

I. INTRODUCTION

In the context of climate change and environmental degradation becoming global challenges, environmental protection at local levels plays an important role in ensuring sustainable development[1], [2], [3]. An Giang Province, one of the key provinces in the Mekong Delta, not only has great potential for agriculture and aquaculture but also faces many complex environmental problems, from water pollution, soil erosion to the impact of climate change[4], [5].

In 2024, An Giang Province implemented many programs and policies to improve environmental quality, including solid waste management, water resource protection, and ecosystem restoration. However, the implementation of these solutions still faces many difficulties due to limited resources, public awareness[6], and the complexity of environmental issues. This paper aims to evaluate the effectiveness of environmental protection measures in An Giang province in 2024, analyze the achievements, and propose sustainable solutions to address the remaining challenges. The research results are not only meaningful for An Giang province but also contribute to environmental policy making for other localities in the Mekong Delta and the whole country.

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II. DATA AND RESEARCH METHODS

2.1. Data sources

This study uses the following main data sources: Report No. 129/BC-UBND of An Giang Province in 2024[7]: This is the main data source, providing detailed information on environmental protection activities, achievements, and remaining challenges in 2024. Statistical data from the Department of Natural Resources and Environment of An Giang Province: Including data on environmental quality (water, air, soil), the amount of solid waste treated, and the area of forest restored. Field surveys: Data from surveys in key localities in the province, including opinions of people and businesses on the effectiveness of environmental protection programs.

Secondary data: Reports and studies related to environmental protection in the Mekong Delta and neighboring areas.

2.2. Research methods

The research was conducted based on the following methods:

Data collection and synthesis: Information from report No. 129/BC-UBND and secondary data sources were collected, classified and synthesized according to the main topics: waste management, water resource protection, ecosystem restoration, and raising public awareness.

SWOT analysis: Assess the strengths, weaknesses, opportunities, and threats in environmental protection in An Giang province.

Descriptive statistics: Analyze environmental indicators (water quality, air, soil) and waste treatment efficiency.

Regression analysis: Evaluate the relationship between factors such as financial investment, public awareness, and environmental protection efficiency.

III. RESULTS AND DISCUSSION

3.1. Environmental quality assessment

3.1.1. Air quality

In 2024, the air quality in An Giang Province was generally maintained at a satisfactory level, with most monitored parameters complying with national technical standards for ambient air quality. However, localized pollution hotspots were identified in urban areas, industrial zones, and tourist destinations. For instance, monitoring data from Chau Doc Market revealed elevated levels of PM10 and noise pollution, primarily due to high traffic density during peak hours. Compared to 2023, PM10 concentrations showed a slight decrease, while noise pollution levels also dropped marginally. These improvements can be attributed to stricter enforcement of traffic regulations, enhanced public awareness, and the implementation of noise reduction measures in urban planning. Nevertheless, the persistence of localized pollution underscores the need for targeted interventions in high-traffic and industrial areas.

3.1.2. Water quality

Surface water quality in An Giang Province remained a significant concern in 2024. Monitoring data indicated widespread pollution from organic matter, suspended solids, and microbial contaminants, rendering most surface water sources unsuitable for direct domestic use without prior treatment. The Hau River exhibited relatively better water quality compared to the Tien River and other inland water bodies such as canals, lakes, and ponds. However, areas impacted by urban development, industrial activities, and tourism, such as the Vam Nao flood control zone and aquaculture regions, showed elevated pollution levels. Notably, the number of monitoring locations classified as severely polluted increased from 3 in 2023 to 4 in 2024, highlighting the growing pressure on water resources from anthropogenic activities. This trend calls for urgent measures to improve wastewater treatment infrastructure and enforce stricter regulations on industrial and agricultural discharges.

3.1.3. Natural heritage and biodiversity

An Giang Province is home to two critical natural heritage sites: Tra Su Melaleuca Forest and Tan Tuyen Melaleuca Forest. These areas are recognized for their rich biodiversity, hosting a wide range of flora and fauna, including several rare and endangered species. For example, Tra Su Melaleuca Forest is home to 70 bird species, 23 fish species, and 140 plant species, including the Indian Painted Stork (Mycteria leucocephala) and the Oriental Darter (Anhinga melanogaster). Similarly, Tan Tuyen Melaleuca Forest supports 63 bird species, 82 fish species, and 154 plant species, including the Giant Barb (Catlocarpio siamensis) and the Jullien's Golden Carp (Probarbus jullieni), both listed in the IUCN Red List. Despite these conservation successes, challenges remain in managing wetland ecosystems and conducting comprehensive surveys to assess their ecological value. The lack of detailed data on wetland areas hampers efforts to implement effective conservation strategies and secure their long-term sustainability.

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3.2. Waste management and pollution control

3.2.1. Solid waste management

In 2024, An Giang Province collected and treated approximately 959.62 tons of solid waste per day, achieving a collection rate of 78.66%, a 1.79% increase compared to 2023. Urban areas accounted for 55.7% of the total waste generated, while rural areas contributed 44.3%. The province operates two solid waste treatment plants with a combined capacity of 150 tons per day and three sanitary landfills. However, these facilities are operating at or near capacity, and five non-sanitary landfills remain in operation. The reliance on landfilling as the primary waste treatment method highlights the urgent need for investment in advanced waste management technologies, such as waste-to-energy plants and recycling facilities, to reduce environmental impacts and meet future waste management demands.

3.2.2. Wastewater treatment

Wastewater management remains a critical challenge in An Giang Province. Only two out of 22 urban areas—Long Xuyen and Chau Doc—have centralized wastewater treatment systems. Industrial zones and clusters lack adequate wastewater treatment infrastructure, leading to the discharge of untreated or partially treated wastewater into surrounding water bodies. This issue is particularly acute in areas with high concentrations of aquaculture and tourism activities, where wastewater from these sectors contributes significantly to water pollution. Addressing this gap requires substantial investment in wastewater treatment infrastructure, stricter enforcement of environmental regulations, and the promotion of sustainable practices in key sectors such as agriculture and tourism.

3.3. Strengths and opportunities

3.3.1. Strengths

Improved Air Quality Monitoring: The installation of automatic air quality monitoring stations has significantly enhanced the province's ability to track and respond to pollution incidents. Real-time data from these stations is publicly accessible, increasing transparency and enabling timely interventions to address air quality issues.

Biodiversity Conservation: The successful conservation of Tra Su and Tan Tuyen Melaleuca Forests demonstrates the province's commitment to preserving its natural heritage. These efforts have not only protected rare and endangered species but also promoted eco-tourism, contributing to local economic development and raising awareness about the importance of biodiversity conservation.

Community Engagement: Extensive public awareness campaigns and community-based environmental protection models, such as the Veterans' Environmental Protection Clubs, have fostered a sense of responsibility among residents and businesses. These initiatives have been instrumental in promoting sustainable practices and encouraging active participation in environmental protection efforts.

3.3.2. Opportunities

Policy Support: National policies, such as the National Environmental Protection Plan (2021-2030) and the Provincial Development Plan (2021-2030), provide a robust framework for An Giang to implement sustainable environmental management practices. Access to funding from central government and international organizations can further support these initiatives.

Technological Advancements: The adoption of advanced waste treatment technologies, such as waste-to-energy and decentralized wastewater treatment systems, offers opportunities to improve environmental outcomes while reducing reliance on landfilling. These technologies can also contribute to resource recovery and energy generation, aligning with global trends toward circular economy practices.

Economic Growth and Green Development: The province's economic growth, particularly in agriculture, industry, and tourism, can be leveraged to promote green development practices. For example, sustainable agriculture techniques, eco-friendly tourism, and green industrial practices can reduce environmental impacts while enhancing economic resilience.

3.4. Weaknesses and challenges

3.4.1. Weaknesses

Inadequate Wastewater Infrastructure: The lack of centralized wastewater treatment systems in most urban and industrial areas poses a significant risk to water quality and public health. This issue is exacerbated by the rapid expansion of urban and industrial zones, which increases the volume of wastewater generated.

Overburdened Waste Management Facilities: Existing waste treatment facilities are operating at or near capacity, highlighting the urgent need for investment in new infrastructure and technologies. The reliance on landfilling as the primary waste treatment method is unsustainable and contributes to environmental degradation.

Limited Financial Resources: Budget constraints hinder the province's ability to invest in critical environmental infrastructure and

technologies, delaying progress in addressing pollution and waste management challenges. This limitation underscores the need for innovative financing mechanisms and partnerships with the private sector.

3.4.2. Challenges

Climate Change and Natural Disasters: As part of the Mekong Delta, An Giang is highly vulnerable to climate change impacts, including flooding, saltwater intrusion, and extreme weather events[8]. These challenges complicate efforts to maintain environmental quality and require integrated adaptation strategies that balance development with environmental protection.

Industrial and Urban Expansion: Rapid economic growth, particularly in industrial and urban areas, increases pressure on natural resources and ecosystems. Balancing development with environmental protection remains a key challenge for the province, requiring careful planning and the implementation of sustainable practices.

Public Awareness and Compliance: While awareness of environmental issues has improved, compliance with environmental regulations among businesses and residents remains inconsistent. Strengthening enforcement mechanisms and promoting behavioral change are essential for achieving long-term environmental goals.

3.5. Policy recommendations

To address these challenges and capitalize on existing strengths and opportunities, the following recommendations are proposed:

Enhance Wastewater Treatment Infrastructure: Prioritize investment in centralized and decentralized wastewater treatment systems, particularly in industrial zones and urban areas. This includes upgrading existing facilities and constructing new ones to meet growing demand.

Adopt Advanced Waste Management Technologies: Transition from landfilling to more sustainable waste treatment methods, such as waste-to-energy and recycling, to reduce environmental impacts. Encourage private sector participation in waste management through public-private partnerships.

Strengthen Climate Change Adaptation Measures: Develop integrated strategies to address climate change impacts, including flood control, saltwater intrusion prevention, and ecosystem restoration. This includes investing in resilient infrastructure and promoting sustainable land use practices.

Promote Green Economic Development: Encourage sustainable practices in agriculture, industry, and tourism through incentives, regulations, and public-private partnerships. This includes supporting eco-friendly tourism initiatives and promoting the adoption of green technologies in key sectors.

Increase Public Awareness and Participation: Expand environmental education programs and community-based initiatives to foster a culture of environmental stewardship. This includes leveraging digital platforms and social media to reach a wider audience and promote sustainable behaviors.

IV. CONCLUSION

The assessment of environmental protection efforts in An Giang Province in 2024 reveals both progress and persistent challenges. While air quality improvements and biodiversity conservation efforts are commendable, water pollution and waste management issues require urgent attention. By leveraging policy support, technological advancements, and community engagement, the province can overcome these challenges and achieve sustainable environmental management. Future efforts should focus on integrated solutions that balance economic growth with environmental protection, ensuring a resilient and prosperous future for An Giang.

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