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OrganoRice

Assessment Report on Irrigation Strategy for Organic Rice Production

Executive Summary

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Optimal Irrigation Strategies for Organic Rice Production in the Mekong Delta, Vietnam

This report investigates optimal irrigation strategies for sustainable organic rice production in the Mekong Delta, Vietnam, focusing on the provinces of An Giang, Dong Thap and Vinh Long. The research, conducted as part of the OrganoRice project (Task 2.2.1), addresses the critical need for uncontaminated and efficient use of irrigation water in organic rice production, taking into account the complex hydrological context of the region and the challenges of coexistence with conventional agriculture. Through a comprehensive review of national and regional policies, combined with lessons learned from field trip in November 2024, this report identifies key gaps, proposes optimal irrigation strategies, and outlines a framework for implementation.

Key Findings

- **Optimal irrigation strategies:** synthesising data from literature review and interviews with provincial authorities, this report proposes optimal strategies for organic rice farming (ORF) in the Mekong Delta region including:
    - prioritizing areas with clean water and upgrading infrastructure
    - leveraging high-quality, low-emission rice areas for increasing organic farming opportunities
    - implementing more effective farmer training and engagement programs
    - adopting an integrated, phased approach

- **Future options and technology:** The report explores future options like smart sensors, pest traps, and sluice gates for improved water management and sustainable practices.
- **Irrigation policy support**: Existing national policies, including Decree 109/2018/NĐ-CP, Decisions 1898/QĐ-BNN-TT and 555/QĐ-BNN-TT, TCVN 11041-2:2017, and Decision 287/QĐ-TTg, support sustainable agriculture and improved irrigation, providing a foundation for organic rice development.
- **Lack of specific irrigation standards:** A critical gap is the absence of specific irrigation strategies and water quality standards tailored to organic rice. General regulations like QCVN 08:2023/BTNMT lack the detail needed for organic certification, creating confusion and contrasting with stricter standards used by private companies engaging farmers for organic rice production.

Future research gaps

- **Analysis of the implementation of standards in ORF approaches:** A comparative study is essential to examine how the Vietnamese organic standards (TCVN 11041-2:2017) align with international standards and private company practices (e.g., Lotus Rice) in organic rice production, particularly regarding water quality. The purpose of this comparison is to identify gaps and opportunities for better integrating Vietnamese standards with on-the-ground farming practices. By synthesizing these insights, the study aims to enhance the relevance and applicability of the standards, ensuring they support effective organic farming procedures and improve outcomes for farmers.
- **Implementation and enforcement:** Research is needed to understand the roles of different actors in implementing and enforcing organic standards, including farmer awareness and potential power imbalances in the certification process. This is crucial for transparency and integrity in organic rice production.

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1. Introduction:

Critical to national and international food security, the Mekong Delta faces the challenge of mitigating the environmental impacts of conventional rice production, characterised by the use of synthetic fertilisers and pesticides (Khong & Loch, 2021; Nguyen & Tran, 2022). Organic rice production offers a sustainable alternative, with environmental benefits, improved soil health, increased biodiversity and the potential for higher market prices (Nguyen & Tran, 2022; Panpakdee, 2023). However, transitioning to organic practices requires effective irrigation management to prevent contamination from neighbouring conventional fields (Bui et al., 2018) and to optimise realise the various social and environmental benefits linked to ORF including increased resilience to climate change impacts (AOI, 2023). This report addresses these challenges by investigating tailored ORF irrigation strategies that take into account the Delta's unique hydrological and topographical characteristics, including its complex network of rivers, canals and floodplains. Effective irrigation is critical to support natural soil fertility practices and ensure adequate water and nutrient supplies (Bouman et al., 2007; FAO, 2014).

2. Overview of Current Policies:

National policies in Vietnam provide a strong foundation for organic agriculture. Decree 109/2018/ND-CP establishes a legal framework and offers specific support measures, including financial assistance for production area identification, certification costs, and training for organic farmers. The Vietnamese Technical Standard for Organic Agriculture (TCVN 11041-2:2017) sets clear guidelines for organic rice production, particularly in soil and water management, while prohibiting synthetic inputs. Pest control is managed through preventive and biological methods, with approved substances permitted in case of outbreaks. Decision 1898/QĐ-BNN-TT promotes sustainable rice production by integrating organic standards and water-saving techniques, while Decision 555/QĐ-BNN-TT further supports organic rice through specific provisions such as encouraging advanced farming practices, identifying ecological zones for organic production, and promoting organic certification. Decision 287/QD-TTg (Mekong Delta Regional Plan) indirectly supports organic farming by promoting sustainable agriculture and modernized irrigation systems, which are essential for climate-resilient organic production.

At the regional level, policies in Vinh Long, An Giang, and Dong Thap focus on improving the efficiency and sustainability of agriculture and irrigation strategies. However, they generally lack a specific focus on organic rice. For instance, Vinh Long prioritizes irrigation modernization, which indirectly benefits organic farming. An Giang offers opportunities for integrating organic farming into broader agricultural planning through provincial planning (Decision 1369/QĐ-TTg), decentralized irrigation management (Decision 08/2023/QĐ-UBND), and the Long Xuyen Quadrangle (LXQ) irrigation system. This LXQ system operates through detailed procedures to manage irrigation systems, including sluices, canal networks, dikes, polders, dams and pumping stations for salinity control, water quality management, flood control and pollution prevention. The LXQ system also assists inter-provincial water management between the provinces of An Giang, Can Tho and Kien Giang. Dong Thap focuses on irrigation development (Decision 19/QĐ-UBND.HC), financial incentives (Decision 47/2021/NQ-HĐND), and a pilot model for sustainable rice production that demonstrates advanced irrigation and sustainable practices.

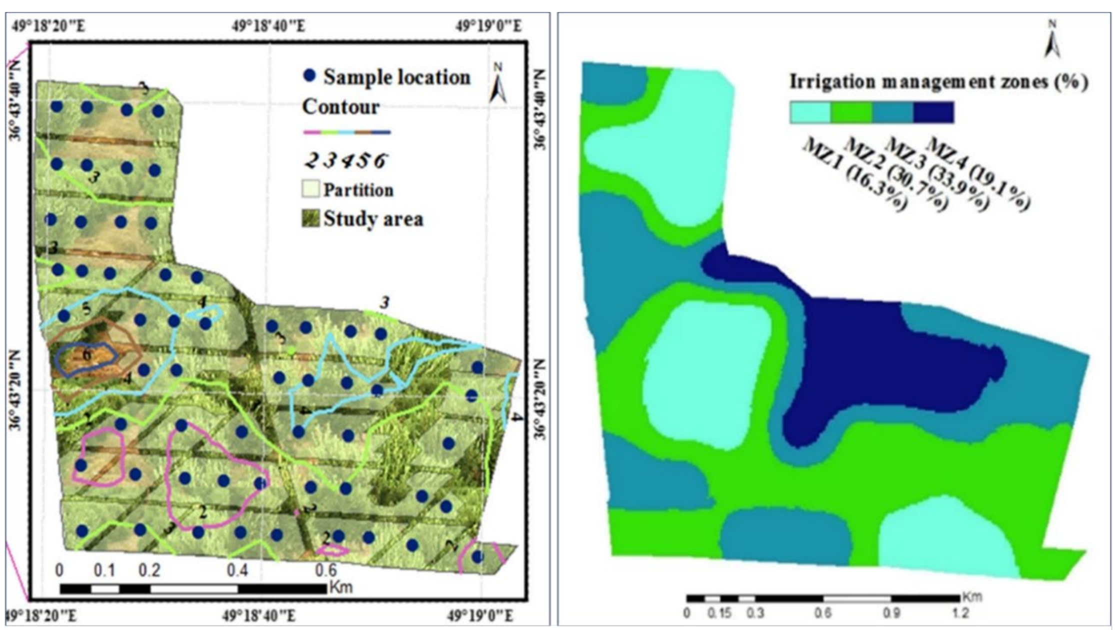
These regional initiatives offer synergies with organic farming but need further refinement and integration to better support the expansion of organic rice. National gaps also include a lack of specific organic irrigation planning and policy, cross-contamination risk management, and a specific water quality standard for organic rice irrigation. However, there are opportunities to leverage existing initiatives and infrastructure plans, including leveraging existing legal frameworks, increasing sustainability awareness, and integrating existing irrigation projects to support specific organic transition programmes. Thus, key consideration in improving ORF irrigation strategies include developing specific organic irrigation strategies, integrating irrigation with certification, supporting research and innovation, and promoting market access for organic products.

3. Potential Irrigation Strategies:

This report proposes irrigation strategies at provincial and inter-provincial scales, guided by sustainability, equity, climate resilience, and organic farming compatibility:

Provincial Scale:

i. **Irrigation zoning and water source separation (Figure 1):** Create dedicated irrigation systems for organic rice to prevent contamination (Furihata et al., 2019; Gilles et al., 2007; Hou et al., 2020; Irham et al., 2024; OFFER, 2008; Trinh et al., 2017; Vahedi et al., 2023). This process begins with mapping farms and water resources using GIS technology to identify the locations of organic and conventional farms and assess water sources such as rivers, canals, and groundwater for their suitability based on water quality standards. Water sources are then zoned by physically separating irrigation systems for organic and conventional farms. This can include constructing dedicated canals, reservoirs, or piping systems that draw water from unpolluted sources, such as rainwater or groundwater reservoirs established exclusively for organic farms. Finally, infrastructure development and monitoring are critical to ensuring clean water for organic farming. This involves building or modifying irrigation infrastructure, such as installing filtration systems to remove contaminants, and setting up a monitoring system to regularly test water quality at critical points in the irrigation network. Enforcement measures, such as penalties for contamination, ensure compliance with organic standards.



(a) (b)

***Figure 1. Modelling spatial distribution patterns to delineate irrigation zoning**. Source: (Vahedi et al., 2023)*

To optimize irrigation in a super-high-density olive orchard, Vahedi et al. (2023) delineated irrigation management zones (IMZs) using a combination of geostatistical analysis, principal component analysis (PCA), and fuzzy k-means clustering. Soil and leaf samples, collected at the georeferenced points shown in Figure 1-a , were analyzed for various properties. Co-kriging method interpolated these properties across the orchard, and PCA identified the most influential variables. These components, along with irrigation rate and salinity, were used to define four distinct IMZs (Figure 1-b). These zones represent areas within the orchard with similar soil characteristics and irrigation requirements, enabling targeted irrigation management strategies for each zone to optimize water use efficiency and potentially improve yield. The spatial distribution of the IMZs reflects the underlying variability in soil properties observed in the sample locations (Figure 1-a), particularly the influence of salinity and soil physical properties like sand content, bulk density, and available water capacity

ii. **Buffer zones between farms (Figure 2 & Figure 3):** Establish buffer zones (on land and/or in waterways) to mitigate agrochemical drift and runoff (Bouagnimbeck et al., 2009; CAFTCenter, 2017; Coleman, 2012; LoginEKO, 2024; OFC-FBC, 2024; USDA, 2024; Abonyi et al., 2024; LandscapeDNA, 2024). Buffer zones act as intermediate spaces or structures that serve as physical and ecological barriers, filtering out pollutants and reducing the risk of contamination. On land, buffer zones can be created by planting native vegetation, such as trees, shrubs, or grasses, which trap pollutants, reduce soil erosion, and improve water infiltration. In waterways, vegetation planted along irrigation channels can filter out agrochemicals before they reach organic fields. Key parameters to consider include the appropriate width of the buffer zone, which depends on factors such as topography, hydrology, and the risk of contamination, as well as the selection of suitable plant species that enhance biodiversity and provide ecological benefits. For example, vetiver grass (cỏ hương lau) is often used due to its deep roots and ability to trap pollutants. Buffer zones not only protect organic farms but also promote biodiversity by creating habitats for beneficial organisms, such as pollinators and natural pest predators, while contributing to long-term environmental sustainability.

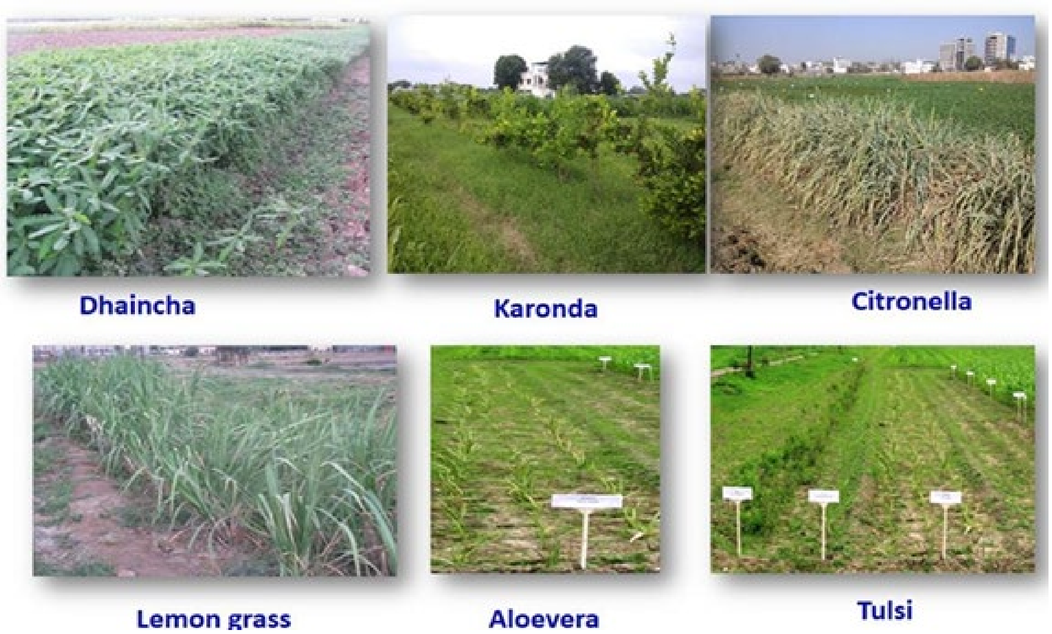


Figure 2. Different types of vegetation species used for terrestrial buffer zones Source: (CAFTCenter, 2017)

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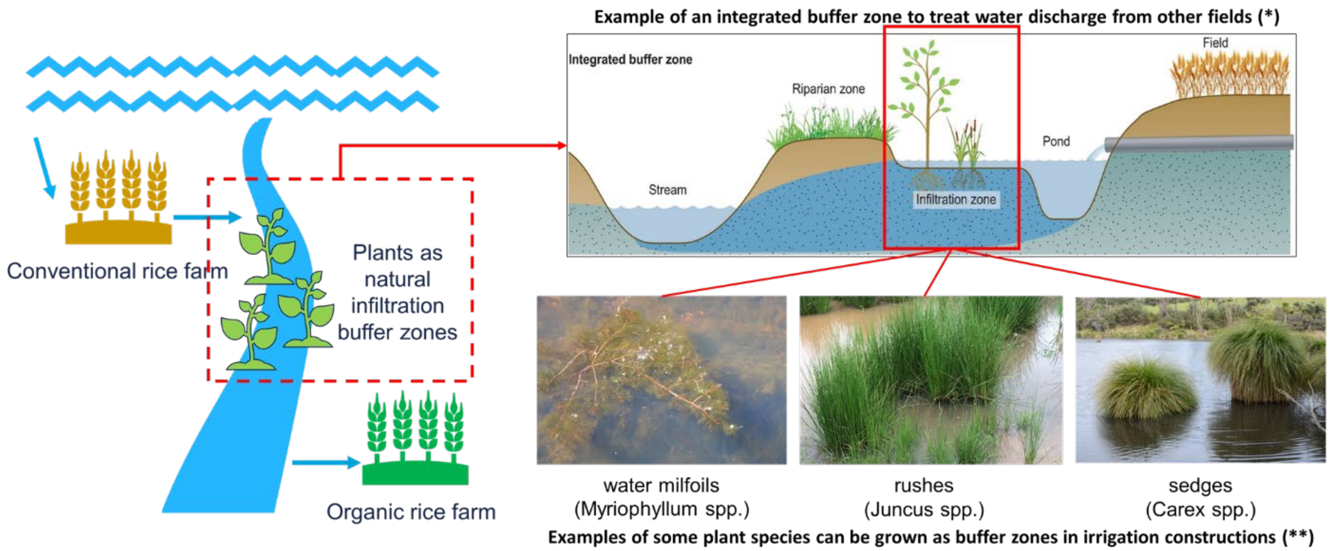

Figure 3. Example of planting vegetation in irrigation systems as aquatic buffer zones to treat incoming water for organic fields and/or outgoing water from conventional fields *Source: (**Abonyi et al., 2024; *LandscapeDNA, 2024)*

iii. **Community-based water management:** Form Water User Associations (WUAs) for equitable water distribution and sustainable use (Aarnoudse et al., 2018; ADB, 2017; DAI Global LLC, 2018; Schmidt et al., 2023). WUAs ensure equitable water distribution, sustainable water use, and effective conflict resolution through participatory decision-making. Key elements include capacity building for farmers on water management techniques, establishing clear water allocation rules that prioritize fair access during scarcity, and creating mechanisms to resolve disputes. The benefits of WUAs include promoting social equity by ensuring smallholder farmers, particularly organic rice producers, have access to clean water; improving water use efficiency through local decision-making and water-saving practices; and fostering community cohesion by empowering farmers to collaborate on sustainable water management. This approach has been successfully implemented in regions such as sub-Saharan Africa, China, and Southeast Asia, demonstrating its effectiveness in addressing water scarcity and competition while supporting sustainable agriculture.

iv. **Farmer training for water-efficient practices:** Train farmers on water-saving techniques like Alternate Wetting and Drying (AWD), Aerobic Rice System (ARS), Saturated Soil Culture (SSC), Direct Seeded Rice (DSR), Drip Irrigated Rice (DIR), and Smart Irrigation (SI) (Beforest, 2023; Biosillico, 2024; European Commission, 2012; IRRI, 2016; Johannes et al., 2019; Leon & Izumi, 2022; Mallareddy et al., 2023; Spanu et al., 2024; Tabbal et al., 2002; Yamaguchi et al., 2019). This strategy involves training programs, demonstration farms, and incentives to encourage adoption. AWD, for example, reduces water use by up to 30% while maintaining or improving yields and lowering methane emissions, a potent greenhouse gas. These practices also improve drought resilience by optimizing water use, making farms more resilient to climate-related stresses. Additionally, water-efficient practices reduce irrigation costs, such as pumping expenses, making farming more economically viable. These co-benefits make water-efficient practices a critical component of an organic rice strategy.

Inter-provincial Scale:

- **Interprovincial water allocation agreements**: Establish agreements for equitable water sharing, enforced by a regional authority (European Commission, 2012; UNECE, 2021). This requires stakeholder engagement, water assessments, and a monitoring body. These agreements ensure that all provinces, including upstream and downstream regions, receive a fair share of water, reducing the risk of water shortages for organic rice farms. For example, provinces like An Giang and Dong Thap could collaborate on sharing water from the Mekong River, prioritizing organic rice farming during dry seasons.
- **Joint infrastructure development and maintenance:** Develop and maintain shared infrastructure to prevent contamination and ensure efficient use (CADRI Partnership, 2020; Sadoff et al., 2015; Sun et al., 2023). This necessitates a joint committee, assessments, plans, funding, and protocols. Shared infrastructure, such as reservoirs and canals, can improve water delivery efficiency and reduce costs for organic rice farmers. For instance, a joint reservoir between Dong Thap and An Giang could ensure a reliable water supply for organic rice farming during droughts.
- **Climate-resilient infrastructure investments:** Invest in climate-resilient systems (Buchanan, 2019; GCF, 2019; Lückerath et al., 2022; OECD, 2024). This requires vulnerability assessments, resilient design, funding, and pilot projects. Climate-resilient infrastructure, such as flood-resistant canals and drought-tolerant irrigation systems, ensures long-term water availability for organic rice farming, even under extreme weather conditions. For example, a flood-resistant canal in the Mekong Delta could protect organic rice fields from flooding during heavy rainfall.

Mekong Delta Scale: strategies at the delta scale scale are logical, considering the hydrology of water and chemical flows in the region requires management at the landscape-scale to address large-scale issues. Such strategies could include (i) Integrated Water Resource Management (IWRM) at the delta (Abdelwahab et al., 2020; MARD, 2016; World Bank, 2011; Xu et al., 2021), (ii) delta-wide water sharing agreements (Global Water Security, 2012; OECD, 2014; Pronatura-noroeste, 2022), and (iii) integration of long-term climate projections, are presented as preliminary concepts (Fathi et al., 2024; OECD, 2024).

4. Current picture

Field trips to the Mekong Delta in November 2024 gathered information from Department of Agriculture and Rural Development (DARD), Irrigation Center (IC) representatives, cooperative managers, and certified and transitioning organic rice farmers. Dong Thap and An Giang authorities highlighted the lack of organic-specific irrigation strategies and aging infrastructure as key challenges, while opportunities lie in adapting existing infrastructure and implementing AWD. Cooperative managers in Tra Vinh and Ca Mau demonstrated different organic irrigation practices, with some relying on river water and AWD (Tra Vinh province-**Figure 5**) and others relying solely on rainwater (Ca Mau province-**Figure 6**). Certified organic farmers in both provinces reported improved water quality but lacked in-depth knowledge of organic standards. Transitioning farmers in Vinh Long (**Figure 7**) and Tra Vinh face cross-contamination and infrastructure limitations, respectively.

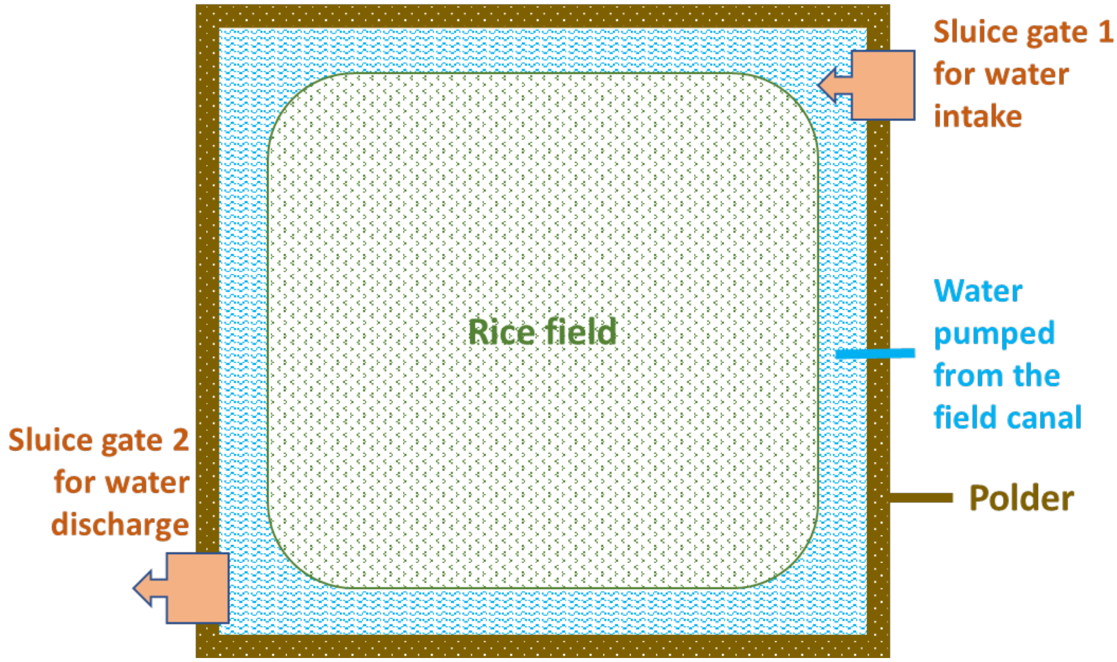

Figure 4. Diagram of current irrigation scheme for rice field provided by farmers in Tra Vinh

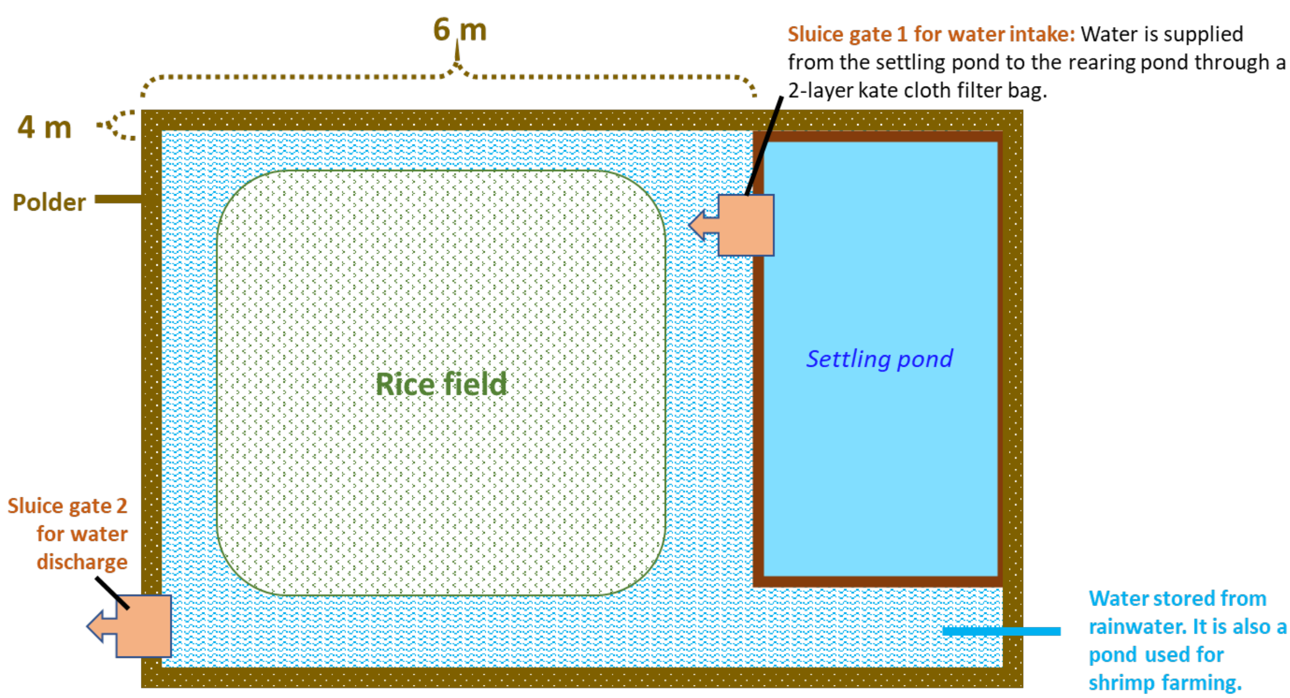

Figure 5. Diagram of current irrigation scheme for rice field provided by farmers in Ca Mau

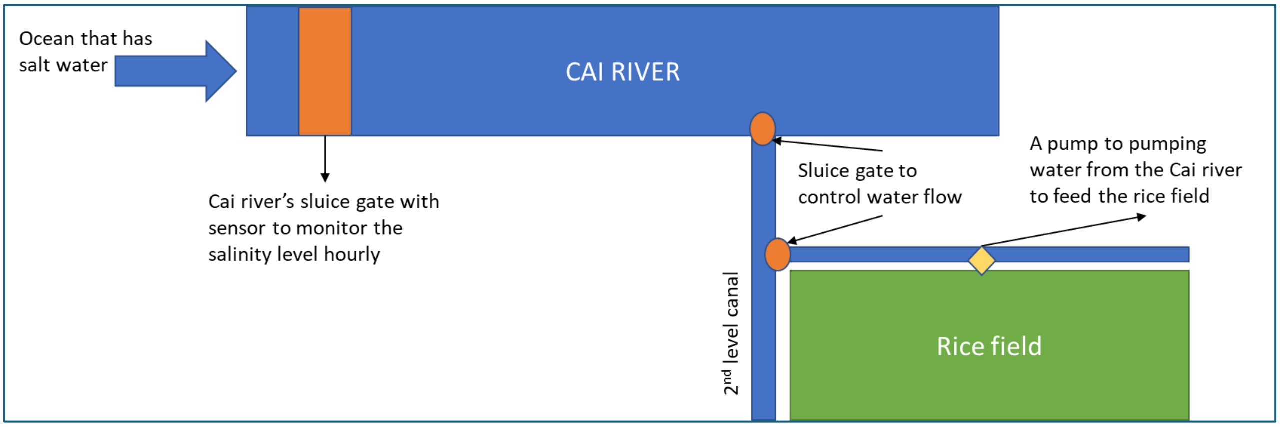

Figure 6. Diagram of current irrigation scheme for rice field provided by farmers in Vinh Long

Dong Thap DARD and IC proposes dedicated irrigation zones for high-quality rice, while An Giang IC suggests a phased approach within existing polders. Both reject buffer zones due to practical constraints. Community-based water management exists in both provinces, with Dong Thap emphasizing cooperative models and An Giang individual systems. AWD is promoted in both, with An Giang piloting drip irrigation. Local authorities generally support irrigation zoning and community-based management, while expressing reservations about buffer zones. They advocate for continued promotion of water-saving practices and training for organic farmers. **Figure 8** illustrates comments from DARD and IC on suggested options.

Irrigation Strategy	Dong Thap	An Giang
Irrigation Zoning & Separate Water Sources	Partial agreement/pilot project/conditional support	Partial agreement/pilot project/conditional support
* Dedicated Infrastructure	Partial agreement/pilot project/conditional support	
* Phased Approach (existing polders)		Partial agreement/pilot project/conditional support
Buffer Zones	Disagreement/rejection/infeasible	Disagreement/rejection/infeasible
* Land-based Buffer Zones	Disagreement/rejection/infeasible	Disagreement/rejection/infeasible
* Irrigation-based Buffer Zones	Disagreement/rejection/infeasible	Disagreement/rejection/infeasible
Community-Based Water Management	Planned future implementation/transitioning	Strong support/agreement/implementation
* Cooperative Model	Planned future implementation/transitioning	
* Individual/Collective Model		Strong support/agreement/implementation
Training on Water-Saving Practices	Strong support/agreement/implementation	Strong support/agreement/implementation
* Alternate Wetting and Drying (AWD)	Strong support/agreement/implementation	Strong support/agreement/implementation
* Drip Irrigation		Partial agreement/pilot project/conditional support

Strong support/agreement/implementation
Disagreement/rejection/infeasible
Partial agreement/pilot project/conditional support
Planned future implementation/transitioning

Figure 7. Summary of evaluation of irrigation options by provincial authorities

5. Proposed Optimal Irrigation Strategy:

This section presents refined irrigation strategies incorporating stakeholder feedback. At the provincial level, three options are proposed:

- **Option 1: Prioritize organic rice in suitable areas** where existing/future irrigation infrastructure can access clean water sources, upgrading existing infrastructure and developing specific water quality standards. This involves establishing a technical working group, assessing water quality, mapping and zoning potential areas, upgrading infrastructure, pilot implementation, and expansion based on results. Organic rice fields should be placed higher in canal flows (i.e., receiving water first) or closer to main water channels to ensure access to the cleanest water sources. Additionally, water quality assessments should include identifying pesticide flows from potential contaminant areas, such as conventional farms upstream, to mitigate risks of cross-contamination. Challenges include securing clean water, maintaining quality, investment costs, and farmer resistance.
- **Option 2:** Utilize existing high-quality, low-emission rice areas, leveraging upgraded infrastructure like smart irrigation systems, upgraded sluice gates, and field-level monitoring technologies (**Figure 9**). This involves assessing suitability (**Figure 10**), upgrading infrastructure (**Figure 11**) where needed, supporting farmer transition, integrating organic practices into existing areas, and monitoring. For example, the pilot project in Dong Thap's Thap Muoi District focuses on sustainable rice production with reduced emissions, aligning with organic principles. The upgraded infrastructure, including smart irrigation systems, ultrasonic water level monitoring, and real-time water quality monitoring, ensures precise water management and minimizes contamination risks, making these areas highly suitable for organic rice production. Challenges include adapting to organic standards and ensuring market outlets. Challenges include adapting to organic standards and ensuring market outlets.

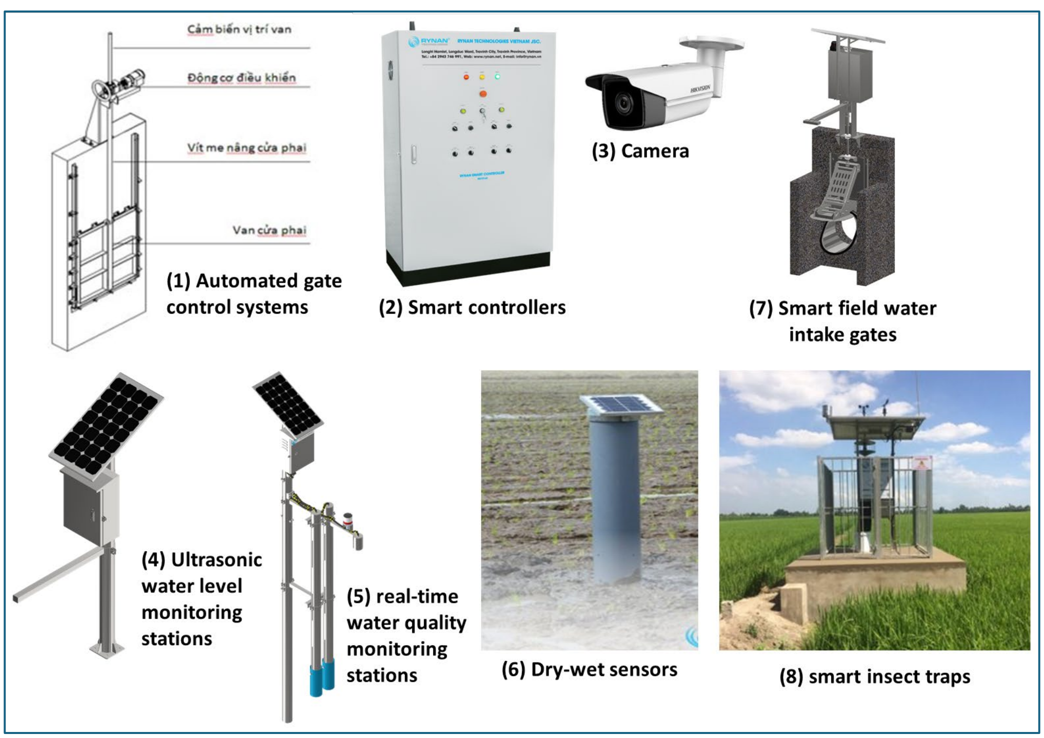

Figure 8. Examples of irrigation infrastructure to be improved under quality rice project

Source: Design Proposal *Report provided by Dong Thap province*

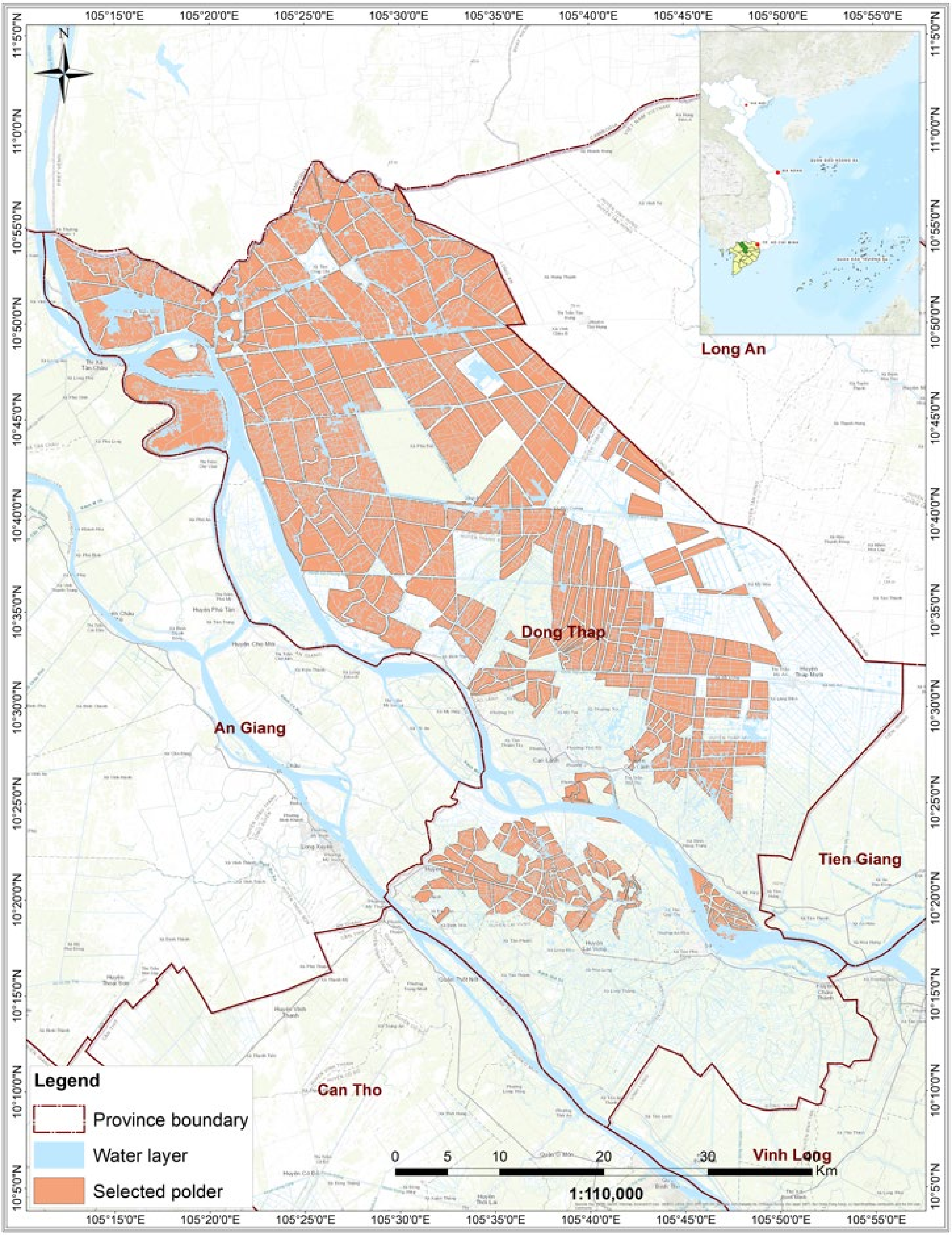

Figure 9. Map of selected polders for high-quality rice project in Dong Thap province

Data sources: Polder data and water layer of Dong Thap province provided by Dong Thap DARD and IC; Province boundary data taken from Vietnamese National Spatial Database; Base map layer taken from ESRI

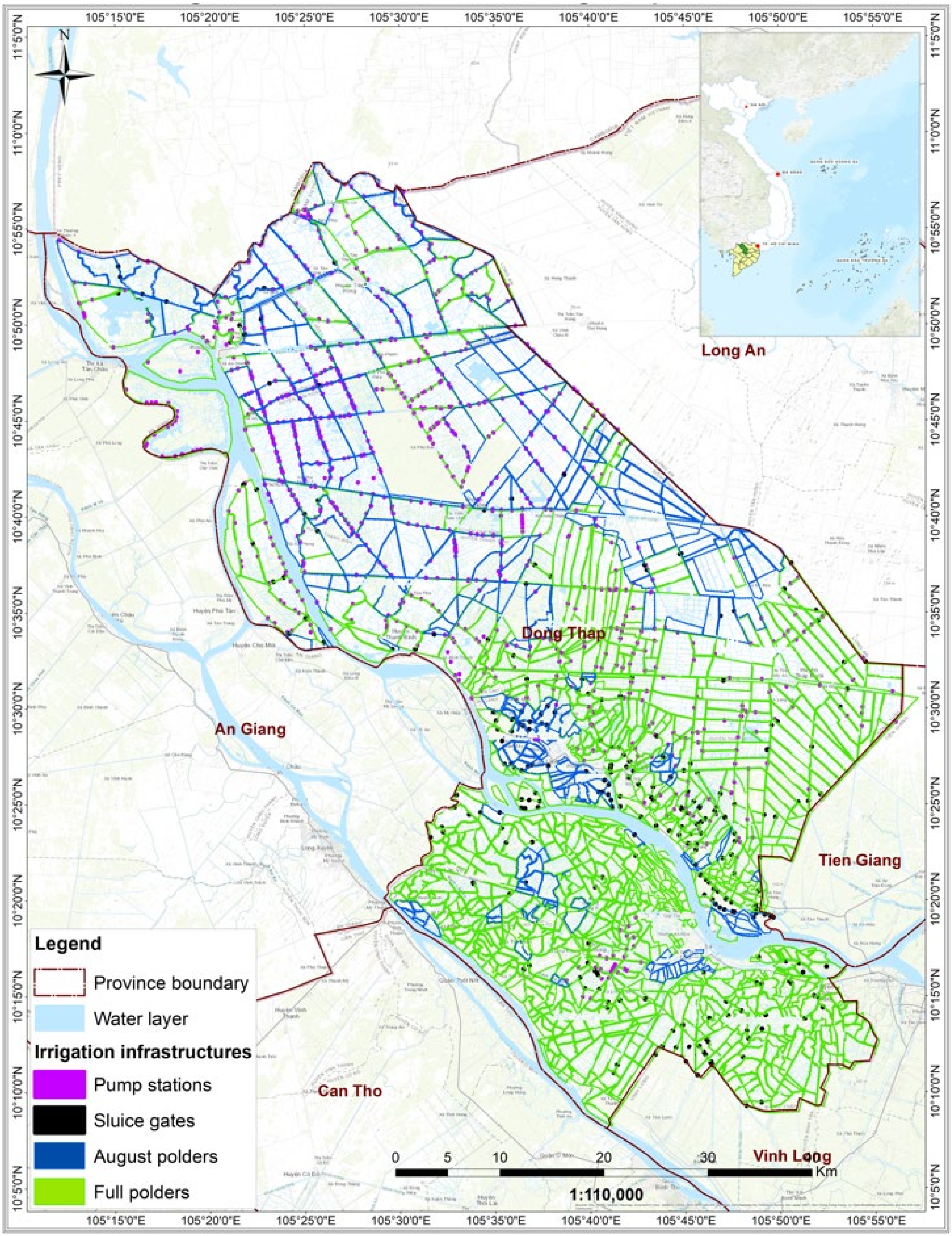

Figure 10. Map of Irrigation Infrastructures in Dong Thap province

Data sources: Irrigation infrastructures data of Dong Thap province provided by Dong Thap DARD and IC; Province boundary data taken from Vietnamese National Spatial Database; Base map layer taken from ESRI

Source: Design Proposal Report provided by Dong Thap province

- **Option 3:** Focus on farmer training in water management, organic cultivation, and certification. This involves needs assessments, curriculum development covering water-saving techniques, organic practices, and certification procedures, training implementation through various methods, ongoing support, and program evaluation. Challenges include training accessibility, changing practices, and resource costs.

An integrated strategy combines these options in four phases:

- **Phase 1 (Foundation):** Establish water quality standards and pilot projects in one-crop polders.
- **Phase 2 (Expansion):** Expand to other polders and adapt high-quality rice infrastructure.
- **Phase 3 (Scaling up):** Scale up production across the Mekong Delta and promote best practices.
- **Phase 4 (Long-term sustainability):** Ensure continuous improvement, adaptive management, and community ownership.

Inter-provincial and Mekong Delta scale strategies remain preliminary, pending stakeholder feedback after the March 2025 field trip. These strategies will be refined based on local input.

6. Conclusion:

This report analyses irrigation strategies that are critical for scaling up organic rice production in the Mekong Delta. While national policies provide a framework, effective implementation of organic rice irrigation is lacking. A field visit in November 2024 revealed gaps in farmers' knowledge of water quality requirements and management practices, further compounded by cross-contamination and climate change threats. Proposed optimal strategies, refined through stakeholder feedback, prioritise areas with clean water, infrastructure upgrades and strict water quality standards. Utilisation of future high quality, low emission rice areas and farmer training will also be key. Implementation will be phased, starting with pilot projects and scaling up gradually, incorporating lessons learned and adapting to local needs. Integrating climate change projections into long-term plans is critical for resilience. A field trip in March 2025 will further refine the strategies through stakeholder input, fostering collaboration for a sustainable organic rice sector in the Mekong Delta.

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