PATTERN BOOK

Towards a climate resilient rice production in the Mekong Delta of Vietnam

Ke Zhou
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COLOFON

This booklet is the design output of the graduation project: 'Feeding the Future, towards a climate resilient rice production in the Mekong Delta of Vietnam' by Ke Zhou

Delft University of Technology, The Netherlands
Faculty of Architecture and the Built Environment
Department of Urbanism

Research group	Planning Complex Cities
Student	Ke Zhou
Student number	5563356
First mentor	Marcin Dabrowski
Second mentor	Inge Bobbink
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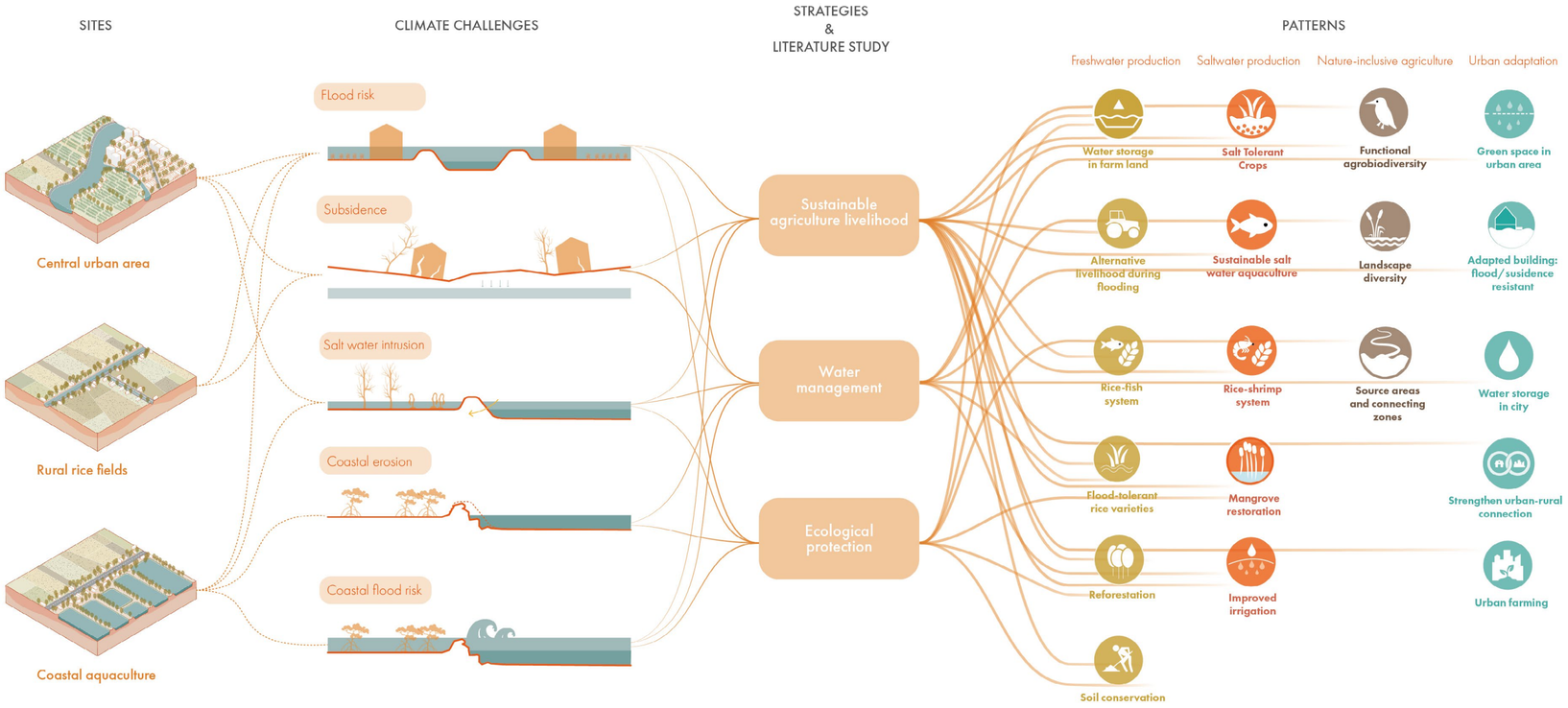
PATTERN FIELD



After the analysis, the challenges of climate change in different regions can be summarized as follows: firstly, flood risk, subsidence risk, and salt water intrusion in central urban areas and rural rice growing areas; secondly, coastal erosion and coastal flooding in coastal fishing areas.Strategies to address these threats include the development and support of sustainable agricultural livelihoods, water management, and ecological protection. Through the study of several relevant case and literature studies (Collentine, 2018; Tran, 2021; Frankic, 2003; Runhaar, 2016), the following pattern set can be proposed in combination with site-specific situations:

The first is freshwater production, i.e., when faced with flood risk and subsidence risk, the corresponding means of agricultural production are adopted to adapt to these challenges. The second is saltwater production, which focuses on saltwater intrusion. This involves the use of salt-resistant plant species, the adoption of salt-water irrigation techniques, and improved soil salt management to ensure proper crop growth and yield in a saline environment. nature-inclusive agriculture incorporates ecosystem services into agricultural production. Finally, urban adaptation focuses on the challenges of climate change in central urban areas.

Freshwater production: i.e., adapting agricultural production tools to these challenges in the face of flood risk and subsidence risk. This includes improving drainage systems, selecting flood-resistant crop species, and promoting flood-tolerant farming practices. Examples include Water storage in farmland, alternative livelihood during flooding, rice-fish system, flood tolerant rice varieties, etc((Van, 2015; Tran, 2021).

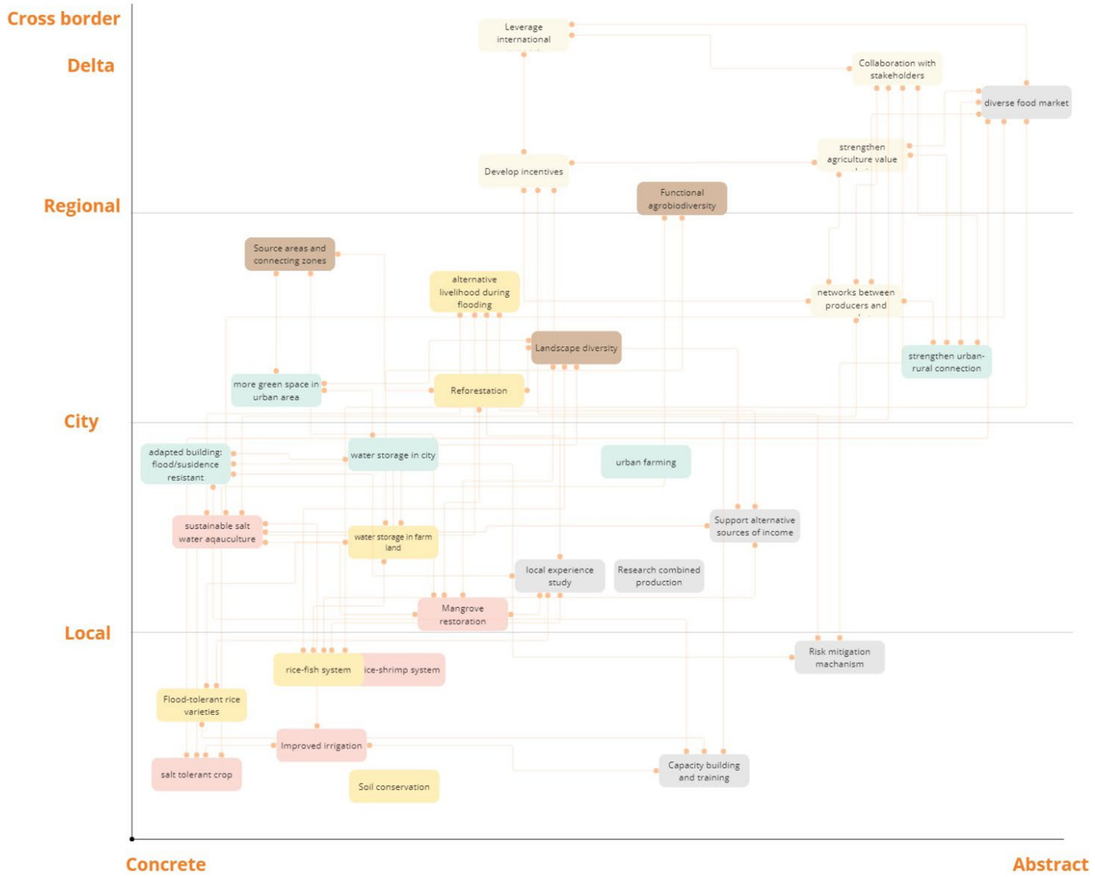
Saltwater production: It focuses on saltwater intrusion and coastal erosion. This involves the use of salt-resistant plant species and salt-water irrigation techniques to ensure crop growth and production in a saline environment; and the development of sustainable aquaculture, rice-shrimp systems and mangrove restoration to promote coastal ecological restoration and its stabilization to prevent coastal flooding(Frankic & Hershner, 2003).

Nature-inclusive agriculture: This model of agriculture incorporates ecosystem services into agricultural production, such as the use of wetlands and green infrastructure to regulate flood risk, increase the water retention capacity of farmland, and provide functions such as biodiversity conservation and natural resource restoration. Source areas and connecting zones are concerned with the use of ecological corridors such as rivers and forest belts in agricultural production areas to establish linkages between ecological sources to protect biodiversity. (Gies, 2019; Runhaar, 2016)

Urban adaptation: The main focus of urban adaptation is to address the challenges of climate change in urban areas by improving urban infrastructure, increasing flood resilience. It also promotes public awareness through urban farming and strengthening the linkages between urban and rural agricultural production and markets, strengthening urban-rural relationships.

Decision making and networks: In the area of decision making and networks, there is a need to address the shortcomes of spatial patterns, such as reduced production capacity and market changes. This can be achieved by working with stakeholders, strengthening agricultural value chains, building networks between producers and markets, developing incentives, and leveraging international support.

Social adaptation of communities: Social adaptation of communities can be facilitated by conducting research on local experiences, developing diversified food markets, establishing risk mitigation mechanisms, strengthening capacity building and training, supporting alternative sources of income, and conducting research on integrated production(Watson, 2021; Greenville, 2017).



Different patterns differ in scale and specificity in their internal linkages, and their spatial and temporal locations are indicative of their scale and continuity. Specific and small-scale patterns, such as salt tolerant crop, flood tolerant rice varieties, and rice-fish systems, can be implemented first in pilot projects. At the urban and regional scales, alternative livelihoods during flooding, sustainable saltwater aquaculture, and landscape diversity can be implemented.

At the abstract institutional level, patterns from the different perspectives of decision making and networks and social adaptation of communities dominate the upper and lower right corners of the pattern field. They can provide institutional support to promote spatial interventions for agricultural and urban adaptation. This includes building networks between producers and markets, strengthening agricultural value chains, and developing incentives. Through the coordinated operation of these interventions, a diverse food market can be created while protecting biodiversity and resisting the challenges of climate change to achieve the goal of sustainable agricultural livelihoods.

AF01

Water storage in farm land

Hypothesis

Water retension area in farmland increases ability to cope with flooding and drought

Theoretical backup

The utilization of agricultural land for flood drainage management serves as a means to regulate flood peaks and store water for the dry season. This approach allows plants to effectively capture nutrients, resulting in decreased environmental losses and improved water quality. During periods of high flow, the presence of obstructed drains can reduce downstream flood peaks by retaining water within the landscape for a longer duration (Collentine, 2018).

Links with other patterns

N01 Functional agrobiodiversity

N02 Landscape diversity

AF04 Flood-tolerant rice varieties

U03 Water storage in city

Practical implications

(i) Enhancing water resources management and implementing flood retention measures within agricultural areas. (ii) Providing support for the development of sustainable and adaptable agricultural and aquaculture systems that promote resilience.

Collentine, D., & Futter, M. N. (2018). Realising the potential of natural water retention measures in catchment flood management: Trade-offs and matching interests. Journal of Flood Risk Management, 11(1), 76-84.

source: www.wwno.org

AF02
Alternative livelihood during flooding

Hypothesis

Alternative livelihood increaces the agricultural resilience in coping with flooding.

Theoretical backup

In light of climate change, the increasing risk of flooding has rendered certain farming practices unsustainable. To mitigate the impact of floods on agricultural production and adapt to the changing conditions, it is crucial to diversify livelihood models. By embracing alternative approaches that accommodate living with water, the adverse effects of floods can be minimized.

Practical implications

To achieve sustainable livelihood outcomes, various activities such as agricultural production, fisheries and aquaculture, tourism, and livelihood diversification need to be implemented in accordance with the local institutions and policies of a particular area. By integrating these activities into the specific context, the desired outcomes can be realized. These outcomes include increased employment opportunities, higher income levels, reduced risk and vulnerability, improved food security, and the promotion of more sustainable resource utilization. (Tran, 2021)

Links with other patterns

AS01 Salt Tolerant Crops

AS02 Sustainable salt water aquaculture

S01 Local experience study

S02 A diverse food market

S05 Alternative sources of income

Tran, D. D., Huu, L. H., Hoang, L. P., Pham, T. D., & Nguyen, A. H. (2021). Sustainability of rice-based livelihoods in the upper floodplains of Vietnamese Mekong Delta: Prospects and challenges. Agricultural Water Management, 243, 106495.

source: www.aciar.gov.au

AF03

Rice-fish system

Hypothesis

The rice-fish system adapts to double rice cultivation and creates livelihoods in combination with flooding conditions.

Theoretical backup

Rice-fish/prawn farming is a traditional practice in freshwater areas of the Mekong Delta. It describes a system for raising prawn and rice together. Meantime rice-fish farming alos has a long history in Indonesia. (Capistrano-Doren, 1992)

Links with other patterns

AF01 Water storage in farm land

AS03 Rice-shrimp system

N02 Landscape diversity

S01 Local experience study

S02 A diverse food market

S05 Alternative sources of income

Practical implications

Farmers have developed several systems that fit diffrerent areas :
A. Fish culture (no rice) in wet season followed by dry season rice: appropriate in areas where flooding is deep.
B. Concurrent rice-fish (wet season) followed by dry season rice: done in areas where standing water is not so deep and water is sufficient to support dry season rice crop.
C. Fish culture throughout: done in areas where farmers prefer to raise fish instead of rice in the entire flooding season.
D. Concurrent rice-fish system during wet season: appropriate in areas where inundation and the risk against submergence of rice is low. On the other hand, water is not sufficient to support a dry season rice crop.

Capistrano-Doren, L., & Luna, N. (1992). Farmer-proven integrated agriculture-aquaculture: a technology information kit.

Source: www.agrifarming.in/rice-fish-farming

AF04

Flood-tolerant rice varieties

Hypothesis

Floating rice helps rice cultivation to adapt to more flooding and rising water levels and provides more ecological benefits.

Theoretical backup

In areas prone to increased flooding and climate extremes, floating rice offers a flexible adaptation strategy by being able to adjust to varying water levels and ensuring a consistent level of rice production. The soil in floating rice fields differs from the surrounding soils as it contains a higher amount of organic material, making it softer and lighter. This unique characteristic contributes to the richness of biodiversity in floating rice fields. (Van, 2015)

Links with other patterns

AF01 Water storage in farm land

AS03 Rice-shrimp system

N02 Landscape diversity

S01 Local experience study

S02 A diverse food market

S05 Alternative sources of income

Practical implications

The cultivation of floating rice necessitates deeper water and extended growing periods, requiring agricultural practices to identify suitable areas for cultivation and provide guidance to farmers on adapting to rice growing patterns. This can be achieved through investments in infrastructure, education, and other supportive measures.

Van Vo, O., & Huynh, D. N. (2015). Comparing the costs and benefits of floating rice-based and intensive rice-based farming systems in the Mekong Delta. Asian Journal of Agriculture and Rural Development, 5(9), 202-217.

Source: Le Hoang Vu. https://vietnamagriculture.nongnghiep.vn/floating-rice-the-unique-rice-variety-with-internodes-of-3--5m-long-d300152.html

AF05

Reforestation

Hypothesis

The reforestation in agricultural areas helps to mitigate flood peaks and retain flood water.

Links with other patterns

AF04 Mangrove restoration

N02 Landscape diversity

N03 Source areas and connecting zones

Theoretical backup

Trees possess a greater capacity to influence the water cycle compared to crops and pastures, thereby aiding in flood mitigation. Through reforestation efforts, a significant portion of water infiltrates into deeper soil layers and the water table, where tree roots absorb and facilitate its evaporation from the leaves. The remaining water contributes to baseflow, replenishing streams. Reforestation serves as a crucial approach to address biodiversity loss and mitigate climate change, making it an essential tool in environmental conservation (Cunningham, 2015).

Practical implications

Reforestation efforts in agricultural areas require careful consideration of the balance between local structural and functional components, recognizing that regional benefits will ultimately outweigh any local negative impacts. The approach taken in reforestation carries long-term implications and necessitates compromises between the structural and functional aspects of the forest. Key decisions include determining the appropriate number of trees, the selection of tree species and whether to include shrubs in the reforestation process.

Cunningham, S. C., Mac Nally, R., Baker, P. J., Cavagnaro, T. R., Beringer, J., Thomson, J. R., & Thompson, R. M. (2015). Balancing the environmental benefits of reforestation in agricultural regions. Perspectives in Plant Ecology, Evolution and Systematics, 17(4), 301-317.

source: https://news.mongabay.com/2015/11/reforestation-contributed-more-than-5-billion-to-brazils-economy/

AF06

Soil conservation

Hypothesis

Soil conservation measures such as soil cover, terracing, and reduced tillage reduce soil erosion and improve soil fertility.

Theoretical backup

Land degradation poses a threat to the productivity of soils, undermining the stability of ecosystems and agricultural production. Recognizing this, traditional soil farming methods are being replaced by innovative models that prioritize soil protection and improvement. These new approaches aim to enhance productivity, profitability, and environmental benefits, acknowledging the crucial role of soil in sustaining stable production within healthy ecosystems (Dumanski, 2013).

Links with other patterns

AF05 Reforestation

S01 Local experience study

S06 Research combined production

Practical implications

Soil conservation agriculture is guided by principles that aim to sustain soil health and productivity. These principles include maintaining continuous soil cover and minimizing mechanical soil disturbance through practices like no-till systems. Promoting the vitality of "living soils" is achieved through strategies such as crop rotations, cover crops, and integrated pest management techniques. Additionally, the use of organic soil amendments like compost, manure, and other natural materials is encouraged

Dumanski, J., & Peiretti, R. (2013). Modern concepts of soil conservation. International soil and water conservation research, 1(1), 19-23.

source: www.treehugger.com/soil-conservation-methods-and-benefits-5190379

AS01

Salt Tolerant Crops

Hypothesis

Alternative crops that is more salt tolerant increases resilience to salt water intrusion and improves food safrty.

Links with other patterns

AF02 Alternative livelihood during flooding

N01 Functional agrobiodiversity

S02 Diverse food market

Theoretical backup

Soil salinity poses a significant challenge to agricultural productivity, as it negatively impacts plant growth and affects vast terrestrial areas globally. Addressing this issue is crucial for ensuring food security and meeting the needs of a growing population. Increasing crop yield, both in normal soils and less productive salinized lands, is an essential requirement in our efforts to feed the world (Yamaguchi, 2005).

Practical implications

Integrating salt-tolerant crops like potatoes and sugar beets into planting plans, along with the inclusion of perennials and trees in mixed cropping systems, can help mitigate the accumulation of salts, including sodium, in the upper soil layers. Additionally, the application of technology can contribute to the development of crop varieties with enhanced salt tolerance. These measures aim to address the challenges posed by soil salinity and promote sustainable agricultural practices.

Yamaguchi, T., & Blumwald, E. (2005). Developing salt-tolerant crop plants: challenges and opportunities. Trends in plant science, 10(12), 615-620.

source: FrameIn Productions/ICCO

AS02

Sustainable salt water aquaculture

Hypothesis

Adoption of diversified fisheries systems builds the capacity adaptation to the process of saline intrusion

Theoretical backup

The promotion of sustainable aquaculture development entails ensuring environmental sustainability and safeguarding the quality of the environment for both aquaculture operations and other users. It is essential for society to prioritize the protection of the environment to support the long-term viability of aquaculture while maintaining a healthy and balanced ecosystem (Frankic & Hershner, 2003).

Practical implications

To enhance the sustainability of fish farming and encourage diversification in farming systems, several measures can be taken. These include the adoption of new technologies in shrimp farming systems to improve efficiency and minimize environmental impacts. Support should also be provided for the diversification of aquaculture and agriculture by promoting non-shrimp high-value species or crops. Additionally, technical assistance should be offered to strengthen integrated planning across sectors, ensuring coordinated and sustainable development.

Links with other patterns

AF02 Alternative livelihood during flooding

AS03 Mangrove restoration

D03 Networks between producers and market

S02 Diverse food market

Frankic, A., & Hershner, C. (2003). Sustainable aquaculture: developing the promise of aquaculture. Aquaculture international, 11(6), 517-530.

source: www.marinemammalcenter.org/science-conservation/conservation/sustainable-seafood/aquaculture

AS03

Rice-shrimp system

Hypothesis

The rice-shrimp system adapts to rice and aquatic production in coastal saltwater areas.

Theoretical backup

Rice and shrimp farming in the coastal areas of the Mekong Delta have been carried out in rotation. Rice cultivation takes place during the rainy season when water salinity is low, while shrimp farming is extensive and semi-intensive during the dry season when water salinity is too high for rice production to continue (Capistrano-Doren, 1992).

Practical implications

Mudflats in coastal areas experience periodic flooding during high tides. During the dry season, salinity usually exceeds 5 ppt, resulting in a fallow period for most rice fields. During the rainy season, salinity decreases and rice can be grown. Combining freshwater shrimp farming with rice cultivation during the rainy season and practicing sea shrimp monoculture during the dry season has become a means of improving the economic situation.

Links with other patterns

AF01 Water storage in farm land

AF03 Rice-fish system

N02 Landscape diversity

S01 Local experience study

S02 A diverse food market

S05 Alternative sources of income

Capistrano-Doren, L., & Luna, N. (1992). Farmer-proven integrated agriculture-aquaculture: a technology information kit.

source: vietshrimp.net/ca-maus-organic-shrimp-solution-to-climate-change-adaptation/

AS04

Mangrove restoration

Hypothesis

Coastal landscapes should be restored to reduce vulnerability for the impacts of sea-level rise and coastal erosion.

Links with other patterns

AF05 Reforestation

N02 Landscape diversity

N03 Source areas and connecting zones

S01 Local experience study

Theoretical backup

Restored mangroves offer various benefits. They contribute to shoreline stabilization by trapping sediments and enhancing shoreline protection. These restored ecosystems also provide suitable habitats for a wide range of animals, while offering additional resources such as timber and firewood. The presence of restored mangroves enhances the aesthetic value of coastal areas, providing a appealing and valuable landscape (Bosire et al., 2008).

Practical implications

(i) Enhancing sediment deposition on the restoration site to elevate the sea floor and establish the appropriate hydrologic regime; and (ii) Restoring mangroves to establish a sustainable ecosystem that functions at a level comparable to the adjacent natural mangrove ecosystem.

Bosire, J. O., Dahdouh-Guebas, F., Walton, M., Crona, B. I., Lewis Iii, R. R., Field, C., ... & Koedam, N. (2008). Functionality of restored mangroves: a review. Aquatic botany, 89(2), 251-259.

source: www.worldbank.org/en/news/feature/2021/07/26/mangrove-conservation-and-restoration-protecting-indonesia-climate-guardians

AS05

Improved irrigation

Hypothesis

Achieving high water use efficiency is an important step towards sustainable adaptation of agriculture to saline environments.

Theoretical backup

The sustainability of irrigated agriculture is threatened by adverse climate change. Pressurized irrigation systems and proper irrigation schedules can increase water productivity and reduce water evaporation or system losses compared to traditional surface irrigation methods (Nikolaou, 2020).

Practical implications

The adoption of deficit irrigation and the use of non-conventional water resources (e.g., wastewater, brackish groundwater) as part of climate change mitigation measures to address water scarcity. Protected cultivation systems such as greenhouses or sheds equipped with artificial intelligence systems are another sustainable option to increase water productivity and help mitigate water scarcity.

Links with other patterns

AS01 Salt Tolerant Crops

AS02 Sustainable salt water aquaculture

S02 Capacity building and training

Nikolaou, G., Neocleous, D., Christou, A., Kitta, E., & Katsoulas, N. (2020). Implementing sustainable irrigation in water-scarce regions under the impact of climate change. Agronomy, 10(8), 1120.

source: www.agric.wa.gov.au/water-management/water-salinity-and-plant-irrigation

N00

Nature inclusive agriculture

Hypothesis

Nature inclusive agricluture helps build a more climate resilient food production system.

Theoretical backup

Nature-inclusive agriculture is a form of sustainable agriculture based on a resilient food and ecosystem. Food production through natural processes of ecosystem development can reduce the burden on ecosystems and improve the recovery of biodiversity (Runhaar, 2016)

Links with other patterns

AS01 Salt Tolerant Crops

AS03 Mangrove restoratio

AF01 Farmland become wetter

AF03 Floating rice

S01 Local experience study

Practical implications

To employ ecosystem services rather than external inputs; minimize environmental pressures and contribute maximally to 'non- functional' biodiversity and landscape quality, inclusing conserving, improving and exploiting the services of water and soil; closing and minimizing harmful emissions to water, soil and air; and constructing and conserving landscape elements

Runhaar, H. A. C. (2016). Towards' Nature-inclusive'agriculture. Wageningen University.

source: https://www.wur.nl/en/research-results/research-funded-by-the-ministry-of-lnv/expertisegebieden/kennisonline/nature-inclusive-agriculture-from-revenue-models-in-niches-to-upscaling.htm

N01

Functional agrobiodiversity

Hypothesis

A resilient agricultural is based on the biodiversity that makes essential contributions to agricultural management.

Theoretical backup

Agricultural systems that take advantage of nature's self-regulating ability can take a impacr and restore themselves. Nature-inclusive agriculture assumes more variation in crops and animals and land use adapted to natural conditions as functional agrobiodiversity. (Gies, 2019)

Links with other patterns

AS01 Salt Tolerant Crops

AF01 Farmland become wetter

Practical implications

Functional agrobiodiversity includes natural diseases and pest control, pollination, water supply and purification, natural soil fertility and a good soil structure; asl well as preserving, enhancing and making use of this biodiversity and the ecosystem services it offers, andminimizing the negative effects of operational management on the environment

Gies, E., van Doorn, A., & Bos, B. (2019). Mogelijke toekomstbeelden natuurinclusieve landbouw. Uitwerking van toekomstbeelden ten behoeve van de transitieopgave naar natuurinclusieve landbouw. Wageningen Environmental Research Rapport, 2957.

source: www.orchardtech.com.au

N02

Landscape diversity

Hypothesis

Protecting and maintaining diversity of landscape elements creates conditions for more biodiversity.

Theoretical backup

Landscape elements are important to many species in agricultural landscapes. They provide breeding and shelter for birds and mammals, habitat for a variety of plants, mosses and mushrooms, and serve as guiding structures for foraging and migrating bats.

Links with other patterns

AS03 Mangrove restoration

AF01 Farmland become wetter

AF03 Floating rice

U01 Green space in urban area

Practical implications

Protecting the landscape elements such as hedges, trees, ditches and ditch banks and emphasizing their natural quality brings diversity to the physical environment. This allows more habitats to different species in farmland which increases biodiversity. (Zanen, 2017)

Zanen, M. (2017). Ontwikkeling van KPI's voor landschappelijke diversiteit en specifieke soorten. Onderdeel van de.

source: https://www.inrae.fr/en/news/bocage-landscapes-promote-plant-diversity-arable-fields

N03

Source areas and connecting zones

Hypothesis

The protection of ecological source and connecting zones in agricultural areas is an important part of enhancing ecological diversity.

Theoretical backup

The source areas and connecting zones are particularly measures on a landscape scale, coordination between the nature network, management, and exchange between areas. (Erisman, 2017)

Links with other patterns

AS03 Mangrove restoration

AF05 Reforestation

U01 Green space in urban area

Practical implications

Identify patches of plant and animal habitat in the farm matrix as well as migratory and mobile corridors and enhance and protect their size, width, integrity, connectivity and species diversity according to the principles of landscape ecology.

Erisman, J. W., van Eekeren, N., van Doorn, A., Geertsema, W., & Polman, N. (2017). Maatregelen natuurinclusieve landbouw (No. 2821). Wageningen Environmental Research.

source: www.lifegate.com

U01

Green space in urban area

Hypothesis

Green space in urban area provides flood retention space and helps with infiltration.

Theoretical backup

Green spaces in urban areas can contribute to climate change adaptation by providing ecosystem services such as flood regulation, temperature regulation and air purification, protecting and enhancing natural systems to support human resilience in the face of climate change (Jansson, 2014).

Links with other patterns

N02 Landscape diversity

N03 Source areas and connecting zones

U03 Water storage in city

Practical implications

Identify potential areas for green space development, such as vacant lots, rooftops or underutilized spaces. Engage the community to ensure that the green space meets the needs and preferences of local residents. This can be done through public consultation, workshops or a collaborative design process. Incorporate green space into urban planning and development policies to ensure its inclusion in future projects.

Jansson, M. (2014). Green space in compact cities: the benefits and values of urban ecosystem services in planning. NA, 26(2).

source: ensia.com/notable/how-big-should-urban-green-spaces-be/

U02

Adapted building

Hypothesis

The adapted building helps residents adapt to flooding and subsidence.

Theoretical backup

As the global and local climate changes, the built environment will be exposed to a different climate than in the past. Adaptation measures will be required to ensure the long-term integrity and successful operation of the built environment (Stagrum, 2020).

Practical implications

Adaptive housing adapts housing in situ to accommodate the threat of inundation from flood risk with minimal disruption to the lives of Aboriginal people and without the need to relocate housing. Based on the aboriginal culture, traditional waterfront housing structures in some delta areas, and incorporating new materials and technologies, a number of housing types have been developed to suit different conditions.

Links with other patterns

U03 Water storage in city

S01 Local experience study

S03 Risk mitigation machanism

S04 Capacity building and training

Stagrum, A. E., Andenæs, E., Kvande, T., & Lohne, J. (2020). Climate change adaptation measures for buildings—A scoping review. Sustainability, 12(5), 1721.

source: chinadialogue.net/zh/4/44143/

U03

Water storage in city

Hypothesis

Storing water in the city helps to store flood water to relieve flood peaks and adjust urban heat islands.

Theoretical backup

Sustainable land use and design are important in flood mitigation. Implementing water storage strategies, such as green infrastructure, cisterns or underground reservoirs, plays a role in reducing flood risk and increasing urban resilience by integrating flood management into urban planning, using spatial planning, landscape design and stormwater management techniques (Zeleňáková, 2017).

Links with other patterns

U01 Green space in urban area

U02 Adapted building

Practical implications

Identify suitable locations for water storage infrastructure such as underground reservoirs, rooftop water harvesting systems, or green infrastructure solutions such as rain gardens and bioswales. Develop and implement policies and regulations that promote water storage practices, including incentives for property owners to install rainwater harvesting systems or require the inclusion of water storage in new construction projects.

Zeleňáková, M., Diaconu, D. C., & Haarstad, K. (2017). Urban water retention measures. Procedia engineering, 190, 419-426.

source: land8.com/europes-longest-sustainable-water-retention-boulevard-completed-in-luxembourg/

U04

Strengthen urban-rural connection

Hypothesis

The strengthening of urban-rural relations consolidates regional connections and develops agricultural markets.

Theoretical backup

Urban-rural connections can be strengthened by promoting balanced regional development and by leveraging the strengths and resources of both environments. The interdependence between urban and rural areas emphasizes the need for cooperation to address common challenges such as food security, environmental sustainability, and socioeconomic disparities (Nilsson, 2014).

Practical implications

In order to strengthen urban-rural linkages, it is important to promote cooperation and mutual understanding between urban and rural areas. This can be done by facilitating knowledge exchange and learning opportunities, promoting joint projects and initiatives, and building networks and partnerships to bridge the geographic divide. Policies that encourage cultural exchange, support local economies, and share resources can further strengthen the connections between urban and rural communities.

Links with other patterns

D02 Strengthen agriculture value chain

D03 Networks between producers and market

S02 A diverse food market

Nilsson, K., Nielsen, T. S., Aalbers, C., Bell, S., Boitier, B., Chery, J. P., ... & Zasada, I. (2014). Strategies for sustainable urban development and urban-rural linkages. European Journal of Spatial Development, 25-p.

source: www.japan.go.jp/kizuna/2022/01/vision_for_a_digital_garden_city_nation.html

U05

Urban farming

Hypothesis

Urban farming strengthens urban-rural connections and raises social awareness.

Theoretical backup

By promoting local food production, urban farming contributes to sustainable agriculture, reduces transportation-related carbon emissions, improves food security, and strengthens community resilience, emphasizing the importance of balancing economic growth, social welfare, and environmental stewardship in an urban context (Goldstein, 2017).

Practical implications

Identify available urban spaces, such as rooftops, balconies, open spaces, or community gardens, that can be converted into productive agricultural areas. Provide education and training to urban residents on urban farming techniques, sustainable practices, and food production to promote awareness of the benefits of local food production. Establish support mechanisms, such as community cooperatives, farmer networks, or public-private partnerships, to facilitate access to resources, land, seeds, and equipment.

Links with other patterns

D02 Strengthen agriculture value chain

D03 Networks between producers and market

S02 A diverse food market

Goldstein, B. P., Hauschild, M. Z., Fernández, J. E., & Birkved, M. (2017). Contributions of local farming to urban sustainability in the Northeast United States. Environmental science & technology, 51(13), 7340-7349.

source: www.thespruceeats.com/what-is-urban-farming-5188341

D01

Collaboration with stakeholders

Hypothesis

Achieving each of the climate adaptation interventions requires collaboration with stakeholders.

Theoretical backup

Developing collaboration with stakeholders by promoting multiple levels of governance and involving different actors in the decision-making process is consistent with this theory. Effective governance involves the participation of different stakeholders, including government, civil society, and the private sector, to address complex issues like climate change adaptation (Maher, 2019).

Links with other patterns

D02 Strengthen agriculture value chain

D03 Networks between producers and market

D05 Leverage international support

S03 Risk mitigation machanism

S04 Capacity building and training

Practical implications

This strategy Ipattern language as a means to promote stakeholder survey and participation, foster partnerships and networks, information sharing and capacity building, and coordinated planning and policy integration. By engaging different stakeholders, sharing knowledge and resources, aligning policies and plans, and providing support for collaboration, the Mekong Delta can improve its agricultural capacity for climate adaptation.

Maher, R., & Buhmann, K. (2019). Meaningful stakeholder engagement: Bottom-up initiatives within global governance frameworks. Geoforum, 107, 231-234.

source: www.mrcmekong.org/our-work/functions/stakeholder-engagement-and-communication/

D02

Strengthen agriculture value chain

Hypothesis

Strengthening agriculture value chain helps develop sustainable costal and inland livelihood.

Theoretical backup

Value chains act as an important catalyst in improving farmers' income by strengthening the backward and forward linkages of agriculture. Accordingly, policy interventions should be made to organize farmers and facilitate their access to markets, finances, inputs and technologies. (Greenville, 2017)

Links with other patterns

D04 Develop incentives

S02 Diverse food market

AF02 Alternative livelihood during flooding

AF03 Rice-fish system

AS03 Rice-shrimp system

Practical implications

Agricultural processing, planning and development of logistics networks and marketing of agricultural products can strengthen the value chain of agricultural products and reduce impact by improving farmers' livelihoods during agriculture transition.

Greenville, J., Kawasaki, K., & Beaujeu, R. (2017). How policies shape global food and agriculture value chains.

source: farmsquare.ng/profitable-value-chains-in-agribusiness/

D03

Networks between producers and market

Hypothesis

Developing networks between producers and markets helps expand market-oriented livelihoods of farmers and market climate-friendly agricultural products.

Theoretical backup

The development of networks between producers and markets can help reduce transaction costs by facilitating direct communication, coordination, and information exchange. By minimizing the costs associated with finding buyers, negotiating contracts, and overseeing transactions, networks can enable more efficient and mutually beneficial exchanges (Macher, 2008).

Links with other patterns

D01 Collaboration with stakeholders

D02 Strengthen agriculture value chain

D04 Develop incentives

S02 Diverse food market

U04 Strengthen urban-rural connection

AS02 Sustainable salt water aquaculture

Practical implications

Establishing direct communication and information exchange platforms between producers and potential buyers or market intermediaries, and promoting partnerships and cooperation between producers, cooperatives and local enterprises can strengthen market linkages. Strengthening value and supply chains through cooperative marketing initiatives can facilitate access to larger markets. Provide training and support to producers on market intelligence, product quality standards, and market trends.

Macher, J. T., & Richman, B. D. (2008). Transaction cost economics: An assessment of empirical research in the social sciences. Business and politics, 10(1), 1-63.

Source: commons.wikimedia.org/wiki/File:Saigon_Rice_shop.jpg

D04

Develop incentives

Hypothesis

The implementation of agricultural transformation is inseparable from the government's incentives financial support.

Theoretical backup

Individuals will respond to incentives by taking certain actions based on the perceived benefits and costs associated with those actions. By providing financial incentives, insurance mechanisms, and market incentives, farmers are encouraged to adopt climate-adapted agricultural practices because the benefits outweigh the costs. Incentives have a positive role in influencing behavior and decision making (Baker, 1988).

Links with other patterns

D02 Strengthen agriculture value chain

D03 Networks between producers and market

D05 Leverage international support

S03 Risk mitigation machanism

S05 Support alternative sources of income

Practical implications

Provide financial support, insurance mechanisms, market incentives, policy support, and community engagement and recognition. These incentives are designed to motivate farmers to adopt climate-resilient practices by offsetting costs, mitigating risks, creating market demand for sustainable products, providing information and training opportunities, implementing supportive policies, and fostering a sense of community engagement.

Baker, G. P., Jensen, M. C., & Murphy, K. J. (1988). Compensation and incentives: Practice vs. theory. The journal of Finance, 43(3), 593-616.

source: www.timeshighereducation.com/cn/opinion/indias-branch-campus-plans-may-not-germinate-without-seed-funding

D05

Leverage international support

Hypothesis

International support helps develop and promote climate-resilient agricultural adaptation in terms of finance, technology, and awareness.

Theoretical backup

Transnational governance theory examines how global challenges can be addressed through non-state actors and cross-border cooperation. Leveraging international support includes engaging with NGOs, research institutions, and international agencies, thereby drawing on transnational networks and governance structures. The importance of multi-level and multi-actor cooperation in solving complex global problems is recognized (Hale, 2011).

Links with other patterns

D01 Collaboration with stakeholders

D04 Develop incentives

S02 A diverse food market

Practical implications

Partner with international organizations to leverage climate finance mechanisms, conduct capacity building programs, promote knowledge sharing, advocate for supportive policies, and facilitate technology transfer. Access finance, acquire expertise, and exchange knowledge and best practices by engaging international stakeholders.

Hale, T. N., Hale, T., & Held, D. (Eds.). (2011). Handbook of transnational governance. Polity.

source: en.vietnamplus.vn/vietnam-calls-for-un-international-communitys-support-for-ethiopia/207068.vnp

S01

Local experience study

Hypothesis

Study of local experience in agriculture climate adaptation tradition enhances the agriclutural transition from bottom up.

Links with other patterns

AS03 Rice-shrimp system

AS04 Mangrove restoration

AF02 Alternative livelihood during flooding

AF03 Rice-fish system

AF04 Flood-tolerant rice varieties

N00 Nature inclusive agriculture

U02 Adapted building

Theoretical backup

Local people have been using and developing water-responsive infrastructure that engages and supports the complex ecosystems they inhabit. These technologies are rooted in traditional ecological knowledge or techniques that work in symbiosis with nature rather than against it, bringing a more holistic approach to climate adaptation design. (Watson, 2021)

Practical implications

Local peoples' responses to coastal resilience need to be explored in the search for design solutions. Studies at the material, module, structural, and system scale that reframed through an architectural rather than anthropological lens will inform the future of design for climate resilience.

Watson, J., Linaraki, D., & Robertson, A. (2021). Lo-TEK: Underwater and Intertidal Nature-Based Technologies. In SeaCities (pp. 59-105). Springer, Singapore.

source: civileats.com

S02

A diverse food market

Hypothesis

Food market and social diet need to be more diverse for the social adaptation to climate risk.

Theoretical backup

Diversified food markets will respond to the agriculture transition to provide a greater variety of food product and a healthy diet for everyone.

Links with other patterns

AS01 Salt Tolerant Crops

AS02 Sustainable salt water aquaculture

AS03 Rice-shrimp system

AF02 Alternative livelihood during flooding

AF03 Rice-fish system

U04 Strengthen urban-rural connection

D05 Leverage international support
S05 Support alternative sources of income

Practical implications

Growing appropriate agricultural products in the right areas rather than just rice production, and developing complementary marketing in response to a more diverse range of agricultural products. Well-functioning markets are also essential for food security and agricultural development, which cannot be achieved without the proper intervention of local institutions and domestic markets. (Ziervogel, 2010)

Ziervogel, G., & Ericksen, P. J. (2010). Adapting to climate change to sustain food security. Wiley Interdisciplinary Reviews: Climate Change, 1(4), 525-540.

source: www.archdaily.com

S03

Risk mitigation machanism

Hypothesis

Faced with the threat of climate extremes, farmers need risk mitigation macahnism to reduce their livelihoods and economic vulnerability.

Theoretical backup

Risk management theory states that individuals and organizations should identify, assess and manage risks to minimize potential negative impacts. Establishing risk mitigation mechanisms for farmers involves implementing strategies and tools to reduce vulnerability to various risks, such as climate variability, market fluctuations, pests and diseases, emphasizing the importance of proactive measures to anticipate, prevent and manage risks (Duong, 2019).

Links with other patterns

U02 Adapted building

D01 Collaboration with stakeholders

D04 Develop incentives

Practical implications

Develop risk mitigation mechanisms that promote social safety nets and enable farmers to manage climate-related risks, such as crop insurance, savings groups, and other financial instruments.

Duong, T. T., Brewer, T., Luck, J., & Zander, K. (2019). A global review of farmers' perceptions of agricultural risks and risk management strategies. Agriculture, 9(1), 10.

source: wikifarmer.com/risk-management-approaches-in-agriculture/

S04

Capacity building and training

Hypothesis

Education and training help increase the resilience of farmers and markets to climate change.

Theoretical backup

Agricultural extension services play an important role in disseminating research-based knowledge and technical assistance to farmers. Capacity building and training programs are usually conducted through the agricultural extension system, which serves as a bridge between research institutions and farmers. This theoretical framework emphasizes the importance of providing ongoing support, advice, and training to farmers to improve their skills and knowledge (Birkhaeuser, 19999).

Practical implications

i) Conduct farmer training programs, including providing training in agricultural technology, agricultural product management, marketing, etc., to improve farmers' professional knowledge and skill levels. ii) Organize demonstration farms and field trips to allow farmers to participate in and observe advanced agricultural practices firsthand. iii) Establish farmer cooperatives or farmer learning groups to facilitate experience sharing and mutual learning among farmers.

Links with other patterns

AF04 Flood-tolerant rice varieties

U02 Adapted building

D01 Collaboration with stakeholders

D04 Develop incentives

Birkhaeuser, D., Evenson, R. E., & Feder, G. (1991). The economic impact of agricultural extension: A review. Economic development and cultural change, 39(3), 607-650.

Source: vietnamnet.vn/en/ministry-urges-green-waterway-passage-for-rice-from-mekong-delta-766768.html

S05

Support alternative sources of income

Hypothesis

Implementing more climate-resilient farming practices requires government support for farmers to develop multiple sources of income.

Theoretical backup

Diversifying farmers' economic activities can reduce dependence on farm income and provide additional sources of income. This concept has been widely studied and accepted in economics as a way to reduce economic risk and increase income stability through diversified economic activities (Suryanata, 2021).

Links with other patterns

D04 Develop incentives

S02 Diverse food market

AF02 Alternative livelihood during flooding

AF03 Rice-fish system

AS03 Rice-shrimp system

Practical implications

Provide training and education opportunities to help farmers acquire skills and knowledge to develop employment opportunities in other areas such as farming, handicraft production, or tourism services. Promote farmers' participation in different parts of the value chain of agricultural products, such as processing, packaging, and marketing, to increase their added value and income. Develop emerging areas such as rural tourism to promote sustainable development in rural areas.

Suryanata, K., Mostafanezhad, M., & Milne, N. (2021). Becoming a new farmer: Agrarianism and the contradictions of diverse economies. Rural Sociology, 86(1), 139-164.

source: www.fao.org/sustainability/news/detail/es/c/1275817/

S06

Research combined production

Hypothesis

Combining research and development and producers helps technologies to reach production and markets faster and develop efficiency in climate adapted agricultural production.

Theoretical backup

The world as a whole and individual countries have reaped enormous benefits from increased agricultural productivity, a significant portion of which has been enabled by technological changes brought about by public and private investment in agricultural R&D. The evidence suggests that these benefits are worth many times more than the costs. It is profitable to invest more in agricultural R&D (Alston, 2010).

Links with other patterns

D04 Develop incentives

S02 Diverse food market

AF02 Alternative livelihood during flooding

AF03 Rice-fish system

AS03 Rice-shrimp system

Practical implications

Integrate research and production in the rice production sector in the Mekong Delta, conduct scientific research, and adapt the results to local conditions. Train farmers in improved technologies and establish demonstration farms to showcase benefits. Share knowledge through workshops and digital platforms, and collaborate with research institutions, government agencies, and farmer associations. Monitor and evaluate implementation, refining and optimizing these methods over time.

Alston, J. M. (2010). The benefits from agricultural research and development, innovation, and productivity growth.

Source: File: Kham/Reuters