Vanuatu Fisheries Department

VANUATU NATIONAL AQUACULTURE SECTOR DEVELOPMENT AND MANAGEMENT PLAN 2022–2030

Vanuatu Fisheries Department,
Ministry of Agriculture, Livestock, Forestry,
Fisheries and Biosecurity

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Contents

Foreword

Sustainable aquaculture growth is essential for Vanuatu

On behalf of the people and government of Vanuatu, I proudly present to you the *Vanuatu National Aquaculture Sector Development and Management Plan 2022–2030*.

Aquaculture in Vanuatu is part of Vanuatu government's 2030 vision of achieving a stable and prosperous Vanuatu within the next nine years, based on the three pillars of the *National Sustainable Development Plan 2016–2030*.

The important role played by the Ministry of Agriculture, Livestock, Forestry, Fisheries and Biosecurity (MALFFB) demonstrates the strength of the productive sector towards the economic development of Vanuatu. It is evident in such focused-based policies that properly managed development activities go towards achieving the overall 2030 vision. Development of such policies coincides with Vanuatu's graduation status to a 'developing country'.

This truly is the aquaculture development and management plan of Vanuatu. I ask that we make good use of this policy to ensure that it serves its purpose of supporting aquaculture management and development throughout Vanuatu.

Sincerely,

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REPUBLIC OF VANUATU
MINISTER OF AGRICULTURE, LIVESTOCK, FORESTRY, FISHERIES & BIO-SECURITY
REPUBLIQUE DE VANUATU

Honorable Nako Ianatom NATUMAN (MP)

Minister responsible for Agriculture, Livestock, Forestry, Fisheries, and Biosecurity

Approval

APPROVAL OF THE VANUATU NATIONAL AQUACULTURE SECTOR DEVELOPMENT AND MANAGEMENT PLAN 2022–2030

This Vanuatu National Aquaculture Sector Development and Management Plan 2022–2030 is made in accordance with Part 5 of the Fisheries (Amendment) Act No. 38 of 2019 and is hereby approved on this date.

COMMENCEMENT DATE

By virtue of the powers conferred on the Minister responsible for Fisheries, under Section 6(1) of the Fisheries Act, notice of approval and implementation of the Vanuatu National Aquaculture Sector Development and Management Plan 2022–2030 is hereby given on ..16th.... day of ..December..2022.

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REPUBLIC OF VANUATU
MINISTER OF AGRICULTURE, LIVESTOCK, FORESTRY, FISHERIES & BIO-SECURITY
REPUBLIQUE DE VANUATU

Honorable Nako Ianatom NATUMAN (MP)

Minister responsible for Agriculture, Livestock, Forestry, Fisheries, and Biosecurity

Abbreviations

BV	Biosecurity Vanuatu
DEPC	Department of Environmental Protection and Conservation
EIA	environmental impact assessment
EU-GIZ	European Union – *Deutsche Gesellschaft für Internationale Zusammenarbeit*
FAO	Food and Agriculture Organization of the United Nations
GIFT	genetically improved farmed tilapia
IRD	Research Institute for Development
JICA	Japan International Cooperation Agency
MALFFB	Ministry of Agriculture, Livestock, Forestry, Fisheries and Biosecurity
MTITNVB	Ministry of Tourism, Industry, Trade and Ni-Vanuatu Business
MOA	memorandum of agreement
MOU	memorandum of understanding
PL	post larvae
QUT	Queensland University of Technology
SOP	standard operating procedure
SPC	The Pacific Community
USP	University of the South Pacific
VAC	Vanuatu Agriculture College
VARTC	Vanuatu Agriculture Research Technical Centre
VFD	Vanuatu Fisheries Department

Executive summary

In Vanuatu, the national economy has been highly dependent on agriculture for decades, supporting 80% of its rural population with staple food and income.

Responding to the recent pandemic crisis of COVID-19 that mapped the downfall of the tourism sector through temporary lockdown, the government has injected for the first time 40% of its budget to the productive sector, with the aim of strengthening this sector and supporting the national economy.

Aquaculture is one of the agricultural activities designed to supplement current fisheries production and at the same time relieve the pressure on natural fisheries resources. The ultimate aim is to optimize fisheries sector production to improve food security and impact positively on the country's balance of trade.

With the assistance of development partners, CROP agencies (particularly SPC) and the Aquaculture Development Strategy 2008–2013, a lot of research and feasibility work was conducted that greatly assisted the Vanuatu Fisheries Department to produce tilapia (*Oreochromis niloticus*), marine shrimps (*Litopenaeus stylirostris*), native freshwater prawns (*Macrobrachium lar)*, giant clams (*Tridacna* spp.) and trochus (*Rochia nilotica*) as potential species that could support commercialisation.

The Vanuatu Aquaculture Development and Management Plan is a nine-year strategic plan that outlines the aquaculture road map for Vanuatu for the near future. It highlights the main components, including research and development, extension, infrastructure, credit and finance facilities, and environmental management. The plan will help the government to allocate scarce resources and assist investors in making informed decisions on what type of aquaculture development they should pursue. It will also assist communities to access the most appropriate resources required to set up smallholder operations.

The government recognises that, for the plan to work, it requires all stakeholders to put their hands and heads together, and work alongside the Fisheries Department to realise the country's potential for aquaculture.

Part 1: Preliminary

1.1 Context

Vanuatu was first exposed to aquaculture decades ago, when, in 1972, mangrove oysters were introduced from Japan and USA for trial. Between then and 2000, most aquaculture activities focused on research and trial. A key challenge during that period was that there was no clear policy to guide aquaculture development, as it was a new venture for Vanuatu. Real aquaculture development progress only started in the mid-2000s.

In 2008, Vanuatu adopted its first aquaculture policy document, the *Vanuatu Aquaculture Development Plan 2008–2013*. This plan provided clear guidance on aquaculture sector aspirations and development. The strategic focus of the plan was twofold. First, to assist Vanuatu identify and prioritise commodities that work well in the Vanuatu context and, second, to identify, develop and establish the necessary groundwork, such as infrastructure, institutional and human resources, and a legal and regulatory framework to support and assist the establishment and growth of the sector in Vanuatu.

The plan proved successful in its strategic focus; a lot has been achieved, and good lessons have been learnt to assist the development of aquaculture in the country. By the mid to late 2000s, genetically improved farmed tilapia (GIFT) (*Oreochromis niloticus*), marine shrimp (*Litopenaeus stylirostris*), red tilapia (*Oreochromis* sp.) and giant river prawn (*Macrobrachium rosenbergii)* were introduced and farmed successfully. Other commodities that were successfully farmed include the native freshwater prawn (*Macrobrachium lar*), trochus (*Rochia nilotica*), giant clams (*Tridacna* spp.) and green snail (*Turbo marmoratus*).

During that same period, infrastructure, such as hatcheries, were built, and a legal and regulatory framework was drawn up. Institutional, financial, and human resources to assist, support and guide aquaculture sector development were also put in place.

One of the key lessons learnt was that a few commodities, such as tilapia, shrimp, and prawn, were found to suit the farming context of Vanuatu. For example, in 2006–2007, the total production of these commodities in the subsistence and semi-commercial sector was about 48.8 mt. These commodities were well established, as more attention was placed on increasing production and less attention was paid to research and trial.

Like many Pacific Island countries and territories, Vanuatu's coastal resources face challenges, both man-made and natural. These include pressure due to increased population, cyclones, and the impact of climate change. The per capita fish consumption for Vanuatu is about 21 kg/person /year, which is just above the global average but below the Pacific average. This may be evidence of difficulty in accessing fish from coastal fisheries.

Aquaculture provides a real opportunity to supplement gaps in wild fishery for food security and livelihoods and to respond to post-disaster rehabilitation needs. Lessons have been learned from the aquaculture of tilapia, shrimp and prawn and strengths and opportunities have been identified. Strengths include the pristine and readily available marine, freshwater, brackish and terrestrial environment; experience of key commodities; a legal and policy framework in place; hatchery infrastructure; local feed ingredients available; the availability of markets and high demand; strong interest from communities and farmers; training institutions and facilities in place; good working collaboration between government and stakeholders; traditional skills and knowledge; a disease-free sector; the potential to improve and support food security and livelihoods; income generation and employment opportunities; and the potential to reduce fishing pressure from wild reef fishery.

While there is success and the potential to expand, challenges remain and need to be addressed in order to ensure progressive aquaculture sector development. Challenges include the need: (i) to improve inputs, such as new strains of tilapia and *M. rosenbergii* prawn; (ii) to acquire more feed equipment; (iii) to build and expand infrastructure, such as hatcheries and quarantine facilities; (iv) to build capacity; (v) to improve governance such as import, monitoring and disaster risk protocols; and (vi) to continue awareness programmes.

1.2 Purpose

The purpose of this plan is to build on the existing successes, strengths, and opportunities; pay special attention to the challenges and threats through strategic actions; and continue to build and expand the sector to ensure a secure, resilient, **and sustainable aquaculture sector,** contributing to increased production for food security and people's livelihoods.

1.3 Scope

This plan covers aquaculture as defined under Section 12 of the Fisheries (Amendment) Act No. 38 of 2019 and includes integrated aquaculture farming, semi-commercial and commercial aquaculture operations.

1.4 Vision and mission

Vision statement

A secure, sustainable aquaculture sector through strategic and effective financing to support best practices for development and management to ensure long-term economic, social and food security for the current and future generations of Ni-Vanuatu.

Mission statement

Provide an effective, efficient, and transparent aquaculture service delivery through a participatory approach to increase production and ensure a sustainable and prosperous aquaculture sector.

Part 2: Institutional, legislative and policy framework

2.1 Institutional context

The government institution tasked with the responsibility to conserve, manage, and develop aquaculture in Vanuatu is the Vanuatu Fisheries Department (VFD) under the Ministry of Agriculture, Livestock, Forestry, Fisheries and Biosecurity (MALFFB). Other institutions with some role in aquaculture conservation, management and development are the Department of Environmental Protection and Conservation, Biosecurity Vanuatu, and the Vanuatu Agriculture College.

2.2 Legislative context

The key legal instrument for the conservation, management, and development of aquaculture in Vanuatu is the Fisheries (Amendment) Act No. 38 of 2019. More specifically, Part 5 of the Act provides for the definition of aquaculture, the power to designate an area for aquaculture activities, requirements for aquaculture licenses, and powers to restrict or prohibit imports of aquaculture products.

2.3 Policy context

In terms of policy context, this plan is developed to align with other government policies. Most relevant are the *Vanuatu 2030: The People's Plan: National Sustainable Development Plan 2016 to 2030* and the National Fisheries Sector Policy 2016–2030. This aquaculture management plan will play a key role in operationalising the goals and objectives of these two policy documents, e.g. policy objectives ENV 1.1- ENV 1.5 under the Environment Pillar of *The People's Plan* and Strategic Action 12 of the *National Fisheries Sector Policy* (Figure 1).

In addition, the framework of cooperation between the Ministry of Tourism, Industry, Trade and Ni-Vanuatu Business (MTITNVB) and MALFFB clearly outlines the responsibilities of both ministries, ensuring that one focuses on marketing products and the other purely on production. In this regard, aquaculture production aligns with marketing standard policies and legislation under MTITNVB.

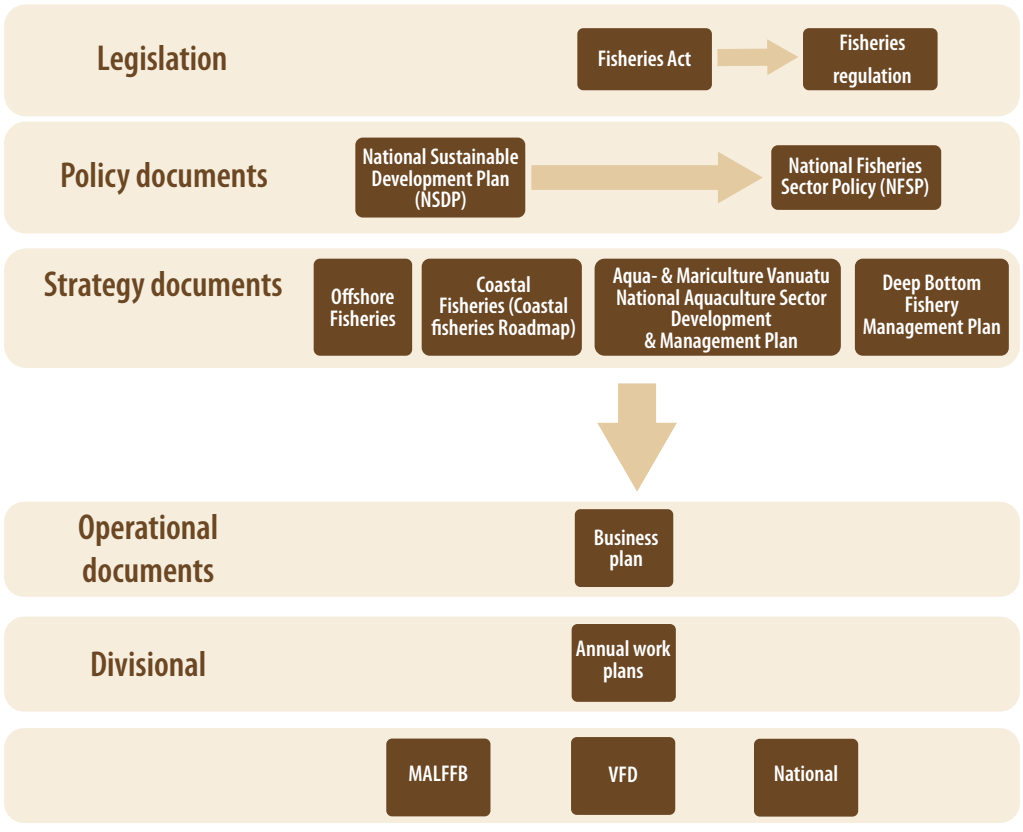


Figure 1. National Policy context of the Vanuatu Fisheries Department with specific focus on Aquaculture

2.4 Key guiding principles

The following key guiding principles provide the basis for the implementation of this plan.

- Increase production
- Food security and nutrition
- Best practices aquaculture
- Community-based aquaculture
- Inclusivity
- Decentralisation of aquaculture

Farmer with his harvest of *Macrobrachium rosenbergii* prawn

Part 3: Overview of aquaculture development and management in Vanuatu

3.1 Brief history

Vanuatu was first exposed to aquaculture over five decades ago, when mangrove oysters were introduced from Japan and USA for farming trials in 1972. Since then, aquaculture development has slowly but surely grown over the years, with good development progress achieved over the recent decade. Figure 2 shows a brief history of aquaculture development in the country.

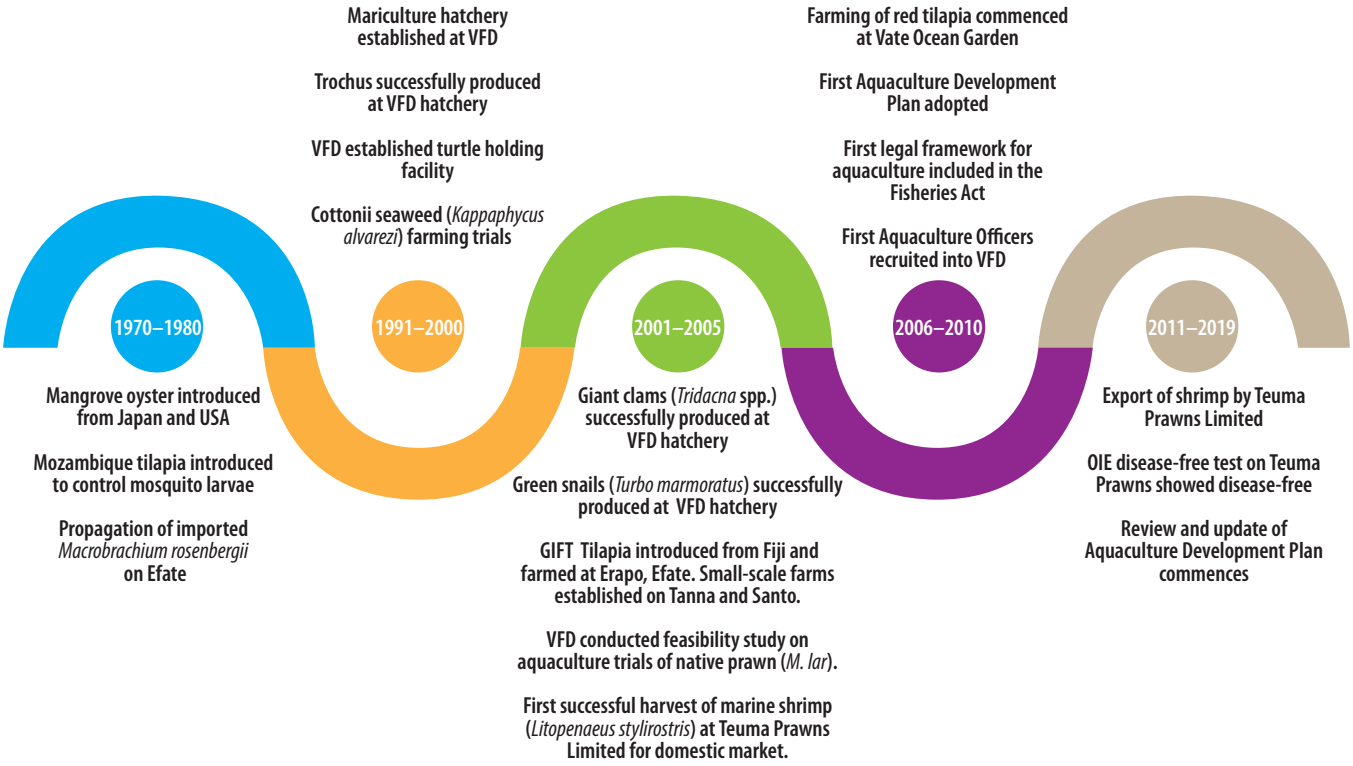


Figure 2. Brief history of aquaculture development in Vanuatu

3.2 Production trend

Aquaculture can be categorised into subsistence, semi-commercial and commercial, large-scale aquaculture operations. For subsistence and semi-commercial operations, production by weight peaked in 2017 with six tonnes of tilapia and one tonne of freshwater prawns produced (Figure 3). For commercial operations, production by weight of tilapia (red) peaked in 2013 with more than 100 tonnes produced and marine shrimp production peaked in 2013 with 17 tonnes produced (Figure 4). Production of ornamental species, mainly clams and corals, peaked in 2008 for clams with more than 26,000 pieces exported and in 2006 with an estimated 1200 pieces of coral exported (Figure 5).

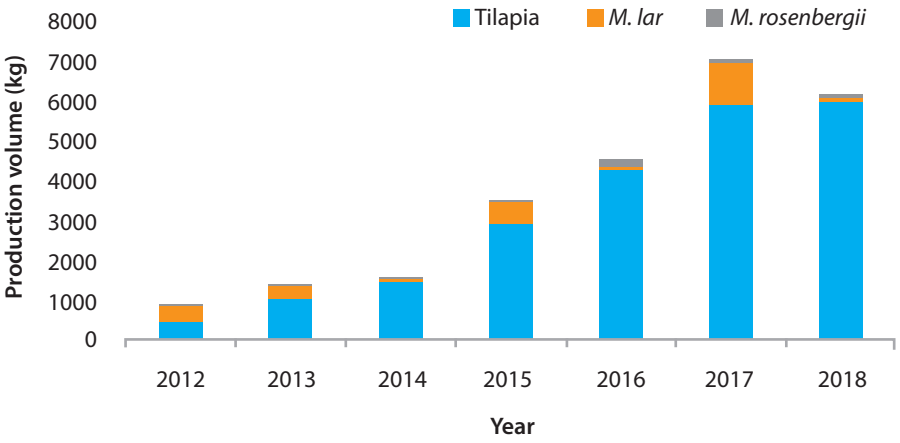


Figure 3. Production volume (kg) for commercial operations

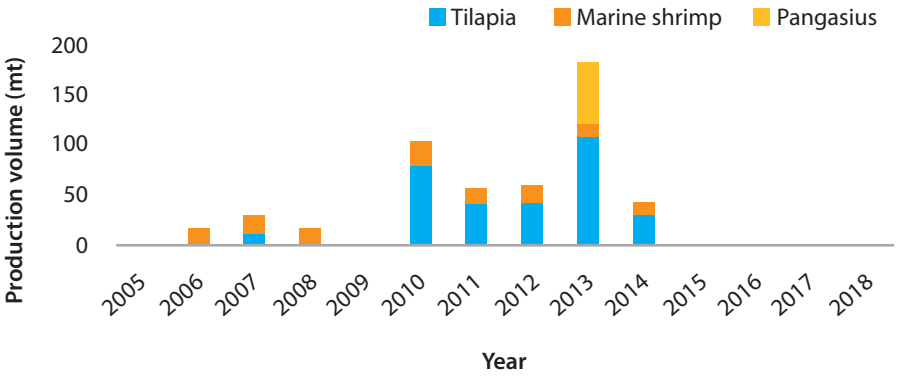


Figure 4. Production volume (mt) for large-scale commercial operations

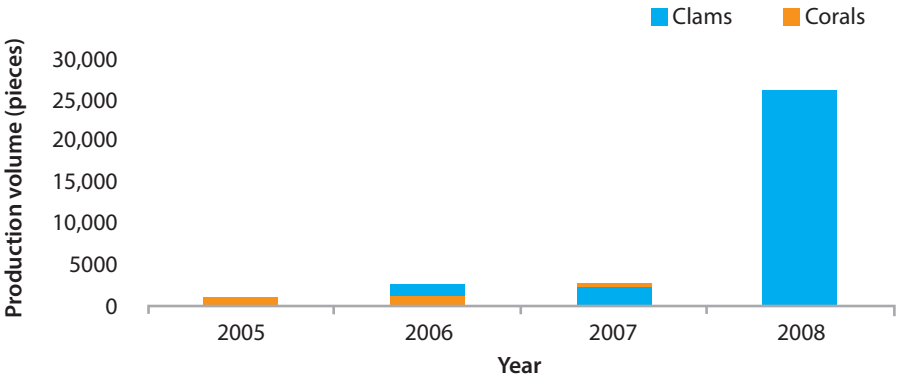


Figure 5. Production volume (pieces) for aquaculture giant clams and corals

3.3 Opportunities and constraints

Table 1 outlines the opportunities and constraints of the aquaculture sector in Vanuatu. Overall, these fall into eight broad categories: (i) infrastructure; (ii) inputs; (iii) institutional and human resource capacity; (iv) finance; (v) marketing collaboration, partnership and networking; (vi) participation and empowerment of local Ni-Vanuatu; (vii) environment; and (viii) governance and monitoring.

Table 1. Opportunities and constraints in various thematic areas in aquaculture development in Vanuatu

Opportunities	Constraints
Infrastructure	
• Infrastructure (government hatchery and private sector hatcheries for key species) • Existing market infrastructure	• Limited capacity of government hatchery • Lack of quarantine facility • Improper facility within an established existing fish market • Lack of local supplier for Pond Liner proper
Inputs	
• Feed and seed production capacity • Feed ingredients present locally	• Limited and inconsistent supply of feed and seed • Feed is expensive • Need to import new strain for Tilapia and *M. rosenbergii*
Human resource and capacity-building needs	
• Capacity/expertise exists in tilapia, prawn, giant clam, trochus and green snail • Human resource capacity with good gender balance • Traditional knowledge, skills and practices, esp. for *M. lar* • Training institution available, e.g. Vanuatu Agriculture College	• Lack of husbandry skills for farmers • Training needs assessment for government/ farmers
Finance	
• Committed recurrent budget from government to support personnel	• Insufficient budget (to assist government and farmers)
Marketing	
• Market for key species (local and international) • Disease free for shrimp, prawns and tilapia as tested twice (assisted by SPC)	• Lack of market strategy (Trades and Industry) • Lack of knowledge on access to market
Collaboration, partnerships and networking	
• Good collaboration and partnership with donors and institutions, e.g. SPC, QUT, JICA, EU-GIZ, IRD.	• Lack of MOU with other agencies • Promote private sector partnership (MOA/MOU) • Strengthen line agencies engagement (USP, SPC, national agencies) • Collaborate with regional /international agencies (e.g. SPC)
Participation and empowerment of Ni-Vanuatu	
	• Indigenous Ni-Vanuatu left out on participation if there is no legal framework to safeguard • Inadequate awareness provided to farmers • Identify reserve list of potential species/ commodities for indigenous Ni-Vanuatu
Environment, governance and monitoring	
• Suitable and available freshwater, marine and brackish water	• Lack of import protocol – SOP • Zoning of aquaculture potential sites not done yet • Lack of farm monitoring and upgrading/revival of non- operational farms
Governance	
• Legal framework in place • Policy framework in place	• Review and update legislation to include provision to promote and safeguard participation of Vanuatu local farmers in aquaculture

3.4 Key lessons learnt

Aquaculture is a new development area but a priority for Vanuatu to address food security and livelihoods. For this reason, it is important that its development is sustainable and done in a way that builds trust among the key stakeholders, such as community farmers and donors. Table 2 outlines some of the key lessons learnt from past development experiences, especially among local and community farms.

Table 2. Key lessons learnt from development experiences

Area	Issues identified	Key lessons learnt
Water seepage	• Use of inappropriate pond linings	• Must use proper pond lining
Low harvest rate compared to expected harvest	• Inconsistent supply of feed • Feed unavailability • Lack of husbandry skills • Inbreeding • Farms are not stocked in accordance with stocking capacity due to shortage of supply of fries	• Farmers need consistent supply of feed • Capacity-building in farm husbandry skills needed • It is believed that if sufficient and appropriate feed is provided, inbreeding should not be an issue • Need to increase fry production
Farm site selection and shortage of water	• Farmers construct ponds before engaging VFD • Bore holes do not have a generator, pumps not functioning, or pumps misplaced	• Important to engage VFD prior to construction of ponds to ensure compliance with farm site selection criteria • Generator and pump should be the responsibility of the farmer or, if provided by VFD, some sort of working arrangement governing the use of generator and pump should be put in place
General farm maintenance and sustainability	• Most farmers do not continue after their first harvest	• Need regular visits and a monitoring programme to identify challenges and assist farmers to address on-farm challenges

3.5 Current management measures

The legal framework and the regulatory framework for aquaculture are provided for under Part 5 of the Fisheries Act and Part 8 of the Fisheries Regulation Order No. 28 of 2009 respectively.

Current measures for aquaculture management and development in Vanuatu include the power of the Minister responsible for Fisheries to designate areas where aquaculture activities may occur; the requirement of a license for any person wishing to engage in aquaculture on a larger scale; assurance that the aquaculture activity complies with the Foreshore Development Act and the Environment Protection and Conservation Act (Cap 283); and restrictions relating to the importation of aquatic organisms for aquaculture, and the export of aquaculture products under the Animal Importation and Quarantine Act (Cap 201). While backyard farms will not be licensed, they must be registered in order to improve data collection.

3.6 Hatchery capacity

Currently, there are seven hatcheries that can support aquaculture development in Vanuatu, five of which are government-owned (three freshwater and two mariculture) and two are owned by the private sector. Apart from Tagabe hatchery in Efate and Northern Aquaculture hatchery in Santo, the government is embarking on establishing satellite hatcheries in all six provinces of the country. This will increase seed supply capacity.

3.7 Institutional and human resources capacity

Under the current VFD organisational structure, aquaculture is part of the Research and Aquaculture Division. Three positions under the structure were created and committed to aquaculture or aquaculture related activities. In addition, there is capacity in terms of experience, qualifications, and technical know-how within VFD on key aquaculture commodities.

3.8 Pond capacity

Over 200 freshwater aquaculture farms have been established, consisting of backyard, subsistence, semi-commercial and commercial scale farms. The combined estimated total pond area is about 13,262 square metres.

3.9 Farm category

There are four categories of pond aquaculture farming systems, ranging from commercial to backyard farming. These are defined by the pond size (Table 3).

Table 3. Farm categories and pond sizes

Abbreviation	Farm category	Meaning	Sizes (m^2)
C	Commercial	Large scale	2500 and above
SC	Semi-commercial	Medium scale	300–2499
S	Integrated	Small scale	51–299
B	Backyard	Backyard	<50

Commercial farming refers to farming to produce very high production with the aim of making a profit. Workers are used to sustain the farm, using high technology equipment.

1. Semi-commercial farming refers to farming to maximise profit from available resources.
2. Subsistence refers to farms producing for personal consumption and income generation.
3. Backyard farming refers to any space in a contained home that is utilised to set up a small pond system between 2 and 50 m^2.

Farmers smiling at their tilapia harvest

Part 4: Strategies for aquaculture sector development and management in Vanuatu 2022–2030

Aquaculture sector development in Vanuatu has shown real progress over the last decade with some key aquaculture commodities. For the sector to develop to another level, a few gaps need attention to ensure sustainability and meaningful impact. This section aims to address those gaps through strategies and actions. Overall, there are five thematic areas supported by 10 strategic objectives, 41 action activities and 60 measurable key result areas.

Table 4. Key thematic areas for aquaculture in Vanuatu

Strategic objectives	Action activities	Key Result Areas	Target species
Thematic area 1: Increase aquaculture production for food security, livelihoods and health nutrition			
Improve and expand aquaculture infrastructure and equipment	Construct national hatcheries	Build three freshwater aquaculture hatcheries	Tilapia, freshwater prawn, grass carp
		Build two mariculture hatcheries	Clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species
	Construct provincial hatcheries	Build six freshwater provincial hatcheries	Tilapia
		Build 24 mariculture holding facilities	Clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species
	Construct community hatcheries and holding facilities	Build 36 freshwater aquaculture holding facilities	Tilapia, Freshwater prawn, Grass carp, ornamental species
	Construct quarantine facility	Build two freshwater quarantine facilities	Tilapia, freshwater prawn, grass carp, ornamental species, freshwater species
	Construct aquaculture storage facilities	Build aquaculture storage facility in all provinces	Tilapia, freshwater prawn, grass carp, ornamental species, freshwater species
	Collaborate with Ministry of Trades in constructing a live and frozen aquaculture market facility	Build 60 live and frozen aquaculture produce market facilities	Tilapia, freshwater prawn, crab species, rabbit fish, etc
	Construct within existing fish market facilities to accommodate the sale of live aquaculture products	Renovate existing provincial fish markets to accommodate the sale of live aquaculture products	Tilapia, freshwater prawn, crab species, rabbit fish, etc
	Purchase farm mechanisation equipment	Purchase three JCB and three boats for ease of maintenance	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species
	Establish integrated aquaculture farming	Develop freshwater aquaculture integrated farming system in all provinces	Tilapia, ornamental fish species, grass carps, freshwater prawns, valuable plants and vegetables and root crops
		Establish mariculture integrated systems in all provinces	Clam, trochus, green snail, sea cucumber, rabbit fish

Strategic objectives	Action activities	Key Result Areas	Target species
Improve aquaculture data collection mechanism	Expand the coverage of Aquanetix data collection	Collect freshwater aquaculture data in all provinces	Tilapia, freshwater prawn, grass carp
		Collect mariculture data in all provinces	Clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species
		Conduct training for Aquanetix	Tilapia, freshwater prawn, grass carp clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species
	Purchase software and data collection equipment	Purchase 120 tablets for Aquanetix data input	Tilapia, Freshwater prawn, Grass carp, Clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species
		Renew Aquanetix license	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species
Improve production and supply of feed and seeds	Establish public private partnerships (PPP) to improve access to freshwater aquaculture feed, whereby a company imports aquaculture feeds so that aquaculture farmers can access feed regularly	Produce consistent supply of aquaculture feed	Tilapia, prawn, rabbit fish
	Develop and Improve aquaculture feed production	Produce aquaculture feed using local ingredients	Tilapia, prawn, rabbit fish
		Conduct training on local feed production	Tilapia, prawn, rabbit fish
	Increase seed production	Import new seed and genetic strains for freshwater species	Tilapia, freshwater prawn, grass carp
		Import new seeds for mariculture species	Rabbit fish, mud crab,
		Collect and establish aquaculture brood stock locally	Clam, trochus, green snail, mullet
	Provide a list of service providers to farmers for easy access and convenience	Develop list of service providers accessible for freshwater aquaculture farmers	Tilapia, freshwater prawn
		Develop list of service providers accessible for mariculture farmers	Crab species, rabbit fish, clam, etc
	Develop an aquaculture feed strategy	Develop a feed strategy	Tilapia, freshwater prawn, grass carp, green snail, rabbitfish, milkfish, grouper, anemone
Strengthen capacity for government and farmers	Conduct training needs assessments for all stakeholders	Conduct aquaculture training for both government officials and farmers in all provinces	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, aquarium species, sea cucumber
		Conduct aquaculture husbandry skills training and other technical skills for farmers and government officials	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, aquarium species, sea cucumber
	Collaborate with VAC to develop an aquaculture training programme	Develop an aquaculture cadetship training plan	Tilapia, freshwater prawn, sea cucumber

Strategic objectives	Action activities	Key Result Areas	Target species
Develop an aquaculture extension programme	Establish and implement an effective aquaculture extension programme	Develop aquaculture extension strategy	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper
		Review and update the Fisheries Act to accommodate aquaculture extension programme	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper
		Create new aquaculture positions under revised fisheries structure	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper
	Develop an aquaculture species action plan for the extension programme	Develop an action plan for specific species	Tilapia, freshwater prawns, giant clams, trochus, green snails
	Standardise aquaculture hatcheries and farms	Develop standard freshwater hatcheries and farms	Tilapia, freshwater prawn, grass carp
		Develop standard mariculture hatcheries and farms	Clam, trochus, green snail, rabbitfish, milkfish, grouper, anemone
	Prepare and disseminate awareness materials on aquaculture husbandry and other technical or policy areas to farmers	Develop and publish awareness materials on aquaculture husbandry and other technical or policy areas to farmers with brochures, banners, etc.	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber
	Establish a framework to access funds for aquaculture development	Prepare and submit a budget increase for aquaculture operations	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber
		Work with partners to prepare concept papers for aquaculture project proposals	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber
		Develop an aquaculture financing strategy for extension development and support services	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber
		Develop SOPs to facilitate the process for farmers to access financial resources for aquaculture development	Tilapia, freshwater prawn, clam, trochus, green snail, sea cucumber
	Promote easy and clear marketing access	Work with the Ministry of Trade and Industry on a market strategy that covers aquaculture products	Tilapia, freshwater prawn, clam, trochus, green snail, sea cucumber
		Work with the relevant private sector to reduce the high transport cost to access markets	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber

Strategic objectives	Action activities	Key Result Areas	Target species
Thematic area 2: Collaboration, partnership and networking			
Promote and strengthen collaboration, partnership and networking with key stakeholders	Prepare and sign agreements: MOUs/ MOAs with key national stakeholders	Develop and sign with key stakeholders	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber
	Implement cooperation arrangements at national and regional levels	Strengthen and maintain cooperation arrangements with national and regional agencies: SPC, USP, VARTC, VAC, etc.	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber
Thematic area 3: Participation and empowerment of local farmers			
Promote, protect and empower local farmers' participation in aquaculture	Review and update the Fisheries Act	Review and update the Fisheries Act, fisheries regulations and other relevant laws to include provision to safeguard and empower local farmers' participation in aquaculture	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber
	Promote aquaculture shows and symposiums for community-based farmers	Conduct annual aquaculture shows by participating in agri-shows to promote aquaculture	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber
	Promote gender balance in aquaculture farming	Create opportunities for marginalised groups to participate in aquaculture activities	Tilapia, freshwater prawn, clam, trochus, green snail, sea cucumber
Thematic area 4: Environment and monitoring			
Ensure environmental safeguards through best management and farming practices	Work with the Department of Environmental Protection and Conservation (DEPC) to implement EIA procedures	Collaborate with DEPC to conduct EIA during site inspections prior to farm establishment	Tilapia, freshwater prawn, clam, trochus, green snail, sea cucumber
	Work with the Ministry of Lands and Natural Resources to conduct zoning of designated aquaculture areas and declare them in accordance with section 13 of the Fisheries Act	Conduct survey and zoning to determine suitable sites and zone out existing aquaculture faming sites	Tilapia, freshwater prawn, clam, trochus, green snail, sea cucumber
	Develop and implement a farm monitoring mechanism	Develop an aquaculture farmers' profile, e.g. Aquanetix app	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber
	Establish a code of practice in aquaculture farming and processing	Develop and implement a code of practice on aquaculture farms	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber

Strategic objectives	Action activities	Key Result Areas	Target species
Ensure biosecurity consideration in aquaculture development	Work with relevant government agencies such as Biosecurity Vanuatu and other partners to develop and improve aquatic import protocols	Develop and improve aquatic import protocols on aquaculture import species	Tilapia, freshwater prawn, grass carp, sea cucumber, rabbitfish
	Work with the Department of Biosecurity and other partners to develop and implement a national aquatic biosecurity strategy	Carry out import protocols according to the national aquatic biosecurity strategy	Tilapia, freshwater prawn, grass carp, sea cucumber, rabbitfish
Thematic area 5: Research and development			
Ensure that aquaculture information is made available for development and management purposes	VFD to establish a working relationship with VARTC on researching local feed ingredients available to improve feed quality for aquaculture	VFD and VARTC to develop feed with local ingredients; Dept of Industry for local feed formulation and other alternatives; VBS for use of micro-plastics in aquaculture	Tilapia, freshwater prawn, grass carp, rabbitfish, grouper and crab species.
	Undertake research to ensure that brood stock genetic quality is maintained for breeding purposes	Develop a brood stock management strategy and standards to maintain genetic quality	Tilapia, freshwater prawn, grass carp, rabbitfish, grouper and crab species.
		Develop a seed distribution plan	Tilapia, freshwater prawn, grass carp, rabbitfish, grouper and crab species.
	VFD to maintain collaboration with other research institutions on aquaculture developments	Maintain working collaborations with research institutes, VARTC, SPC, USP, IRD, QUT, JICA, etc.	Tilapia, freshwater prawn, grass carp, rabbitfish, sea cucumber, nemo, mountain mullet, grouper and crab species.
	Conduct research on environmental parameters on aquaculture farming	Undertake research in pond dimensions, pond size, water flow, stocking densities, water quality, micro-plastics use as environmental risk and climate change impact	Tilapia, freshwater prawn, grass carp, rabbitfish, sea cucumber, nemo, mountain mullet, grouper and crab species.
	Explore options to farm native species	Undertake research on native species for aquaculture purposes	Mountain mullet, grouper, crab species, sea cucumber, freshwater prawn, milk fish, rabbit fish
	Explore options of mono-sex culture in some aquaculture commodities	Conduct research on sex reversal on aquaculture farm species	Tilapia

Part 5: Aquaculture management, monitoring and control

This part outlines the management measures that will be applied to guide development and ensure a sustainable and secure aquaculture sector in Vanuatu.

5.1 Authorisations

The following authorisations are applicable.

5.1.1 Licenses

Aquaculture license

- This license applies to a person who wishes to carry out aquaculture.
- The license is issued by the Director of Vanuatu Fisheries Department.
- A prescribed license fee shall be charged for the license.
- License conditions shall apply for the license.

Aquaculture export processing establishment license

- This license applies to a person who wishes to operate an aquaculture export processing establishment.
- The license is issued by the Director of Vanuatu Fisheries Department.
- A prescribed license fee shall be charged for the license.
- License conditions shall apply for the license.

5.1.2 Permits

Environmental impact assessment (EIA)

- This permit applies to a person wishing to carry out aquaculture.
- The permit is issued by the Department of Environmental Protection and Conservation.
- A prescribed permit fee shall be charged for the permit.
- Permit conditions shall apply for the permit

Foreshore development permit

- This permit applies to a person wishing to carry out aquaculture along the foreshore.
- The permit is issued by the Ministry of Internal Affairs.
- A prescribed permit fee shall be charged for the permit.
- Permit conditions shall apply for the permit

Provincial government access permit

- This permit applies to a person wishing to carry out aquaculture within a provincial government jurisdiction.
- The permit is issued by the relevant provincial government administration.
- A prescribed permit fee shall be charged for the permit.
- Permit conditions shall apply for the permit.

5.2 Reporting requirements

VFD will ensure that reporting requirements under this plan and the Fisheries Act are complied with. Such reporting may include submission of production data, disease outbreaks, and impacts of aquaculture development on the environment or on other sectors, or vice versa.

5.3 Aquatic biosecurity

Aquaculture development can have negative impacts on the environment. The protection of both the marine and freshwater environments of Vanuatu is very important for the aquatic biodiversity of the country. Recently, the aquaculture sector in Vanuatu was tested and found free from diseases. To ensure protection of biodiversity and maintain the status of a disease-free aquaculture sector, Vanuatu may opt to develop and implement a policy on aquatic biosecurity.

5.4 Environmental impact assessment

Environmental impact assessments (EIAs) shall be promoted as a tool to ensure minimal impact on the environment due to aquaculture development. An EIA will be a key criterion for granting an aquaculture license.

Aquaculture Facility, Luganville Santo

Part 6: Stakeholders, roles and responsibilities

The following partners have an important role to play in the development and management of the aquaculture sector in Vanuatu.

Vanuatu Fisheries Department

The Vanuatu Fisheries Department is the primary agency for the sustainable development and management of aquaculture in Vanuatu. Its key roles include but are not limited to:

- overseeing the implementation of the relevant provision of the Fisheries Act and fisheries regulations in relation to aquaculture;
- overseeing and coordinating the implementation of this plan and other policies in relation to aquaculture development and management in Vanuatu; and
- receiving, appraising and issuing aquaculture licenses.

Department of Environmental Protection and Conservation

The key role of the DEPC in the sustainable management and development of the aquaculture sector in Vanuatu is to oversee environmental impact assessments on current and potential aquaculture activities.

Biosecurity Vanuatu

The Vanuatu Department of Biosecurity's role in the sustainable aquaculture management and development is critical. Its key role is to implement legislative and policy frameworks in relation to ensuring a disease-free aquaculture sector.

Ministry of Lands and Natural Resources

The key role of the Ministry of Lands and Natural Resources is to assist with the survey, demarcation, and designation of aquaculture areas as per section 13 of the Fisheries Act.

Vanuatu Investment Promotion Authority

VIPA's key role in aquaculture management and development includes promoting aquaculture sector development as a direct foreign investment opportunity for foreigners and working with VFD to appraise and issue VIPA certificates to foreigner investors.

Vanuatu Agriculture College

The role of a training institution such as the Vanuatu Agriculture College (VAC) is critical in the development, management and expansion of aquaculture farming in Vanuatu. VAC's key role is to work with VFD to provide relevant, high quality training to equip potential aquaculture farmers.

Vanuatu Agriculture Research and Technical Centre

Vanuatu Agricultural Research and Technical Centre (VARTC) is the national research centre for coconut, coffee, cocoa and livestock in Vanuatu. More recently root/tuber crops, nuts and breadfruit have been added to the research programme. VARTC contributes to the economic development of Vanuatu by selling improved plant materials and cattle, providing training in agriculture and breeding, and providing scientific and technical information. Since this institution comes under MALFFB, it can be utilised for aquaculture research on request.

Provincial governments

The Decentralisation and Local Government Act 1994 empowers provincial governments to pass bylaws and issue fishing licenses to regulate fishing activities within the six-mile boundary of provincial waters. The role of provincial governments in the sustainable development and management of aquaculture is to develop and promulgate bylaws on aquaculture management and development in their respective areas of jurisdiction.

Farmers

Farmers play a crucial role in ensuring that food security and livelihood needs are being met, first at the rural community level and then internationally. The ultimate goal of the plan is to ensure that local farmers' aspirations in the aquaculture sector are met by adhering to a well-developed strategic plan.

Sustainable farms in terms of sustainable feed and infrastructure are crucial to ensuring the sustainability and development of the aquaculture sector into the future; to assisting in alleviating poverty, particularly in terms of supplementing protein food security; and to boosting the economic aspects of peoples' livelihoods.

Part 7: Micellaneous

7.1 Review and amendment

This plan is a ten-year plan, from 2020 to 2030. There will be a mid-term review and amendment towards the end life of the plan. If there are major changes in the operating environment of VFD or MALFFB, the plan can be reviewed and amended to reflect those changes.

7.2 Implementation

Table 4 is the action activity plan and a more detailed implementation plan is attached as Appendix A. This is to ensure effective and efficient implementation of this plan.

7.3 Monitoring, evaluation and learning

To ensure that this plan is achieving what it intends to achieve within a specific target timeframe, there needs to be a monitoring regime. VFD will develop and implement a monitoring, evaluation and learning regime for this purpose.

7.4. Risk monitoring strategy assessment

There are multiple methodologies described in the literature for evaluating risk within an environmental risk analysis context (Burgman 2005; Kapuscinski et al. 2007; Vose 2008). These methodologies can range from highly statistical quantitative approaches to more subjective opinion-based judgments to inform qualitative and semi-quantitative approaches to risk analysis.

The qualitative approach to risk assessment is amongst the most simple and flexible approaches for estimating risk, but it is highly prone to several types of bias and suffers several flaws (Burgman 2001). These shortcomings must be well understood and addressed as thoroughly as possible when taking this approach. Hayes et al. (2007) outline several ways to help maintain the scientific credibility of qualitative and semi-quantitative risk assessment. It is beyond the scope of this document to discuss in detail the various additional approaches to risk assessment.

Exposure and effects

Qualitative and semi-quantitative risk assessments attempt to estimate the risk of a particular hazard by multiplying qualitative rankings of the likelihood with consequence/impact scores based on clearly defined categories that increase on nominal scales (e.g. from least to most likely, ranging from 1 to 5). The combination of the likelihood and consequence/impact scores is the risk (risk = likelihood x consequence). There are many examples of likelihood and consequence/impact categories in the literature, for example, those outlined by Hewitt et al. (2006). A risk evaluation matrix may look like the one in Table 5.

Table 5. Risk assessment matrix

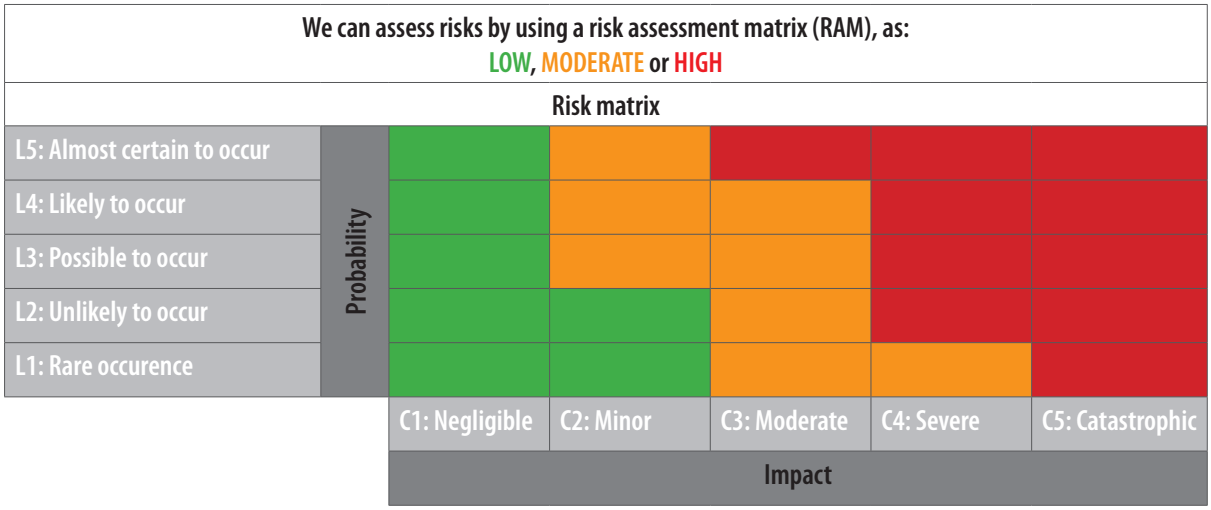


Table 6. Risk management for hatcheries and ponds, and possible risk management measures

System	Escape route	Potential risk management measures
HP	Floods//TC	Official demarcation of elevation at which hatchery can be placed, using high water beacons
		Coordinated dam management to regulate water levels below reservoirs
		Inspections and enforcement of zoning
P	Theft	Provide adequate pay and compensation to workers
		Ensure safe working conditions
		Maintain adequate fencing
		Institute a tracking system for persons entering and leaving the facility
		Conduct fish population checks
		Provide incentives for productivity or safety
		Track movement of fingerlings between facilities
HP	Birds	Netting
		Scarecrows
		Drummers or noisemakers
		Persons keeping watch and scaring away birds
HP	Effluent	Install screens that are micrometer mesh
		Sedimentation ponds (at least three)
		Dry and aerate sedimentation pond and sand before disposal
		Dispose of effluent on land or agricultural lands
HP= Hatcheries and ponds		

Table 7. Risk communication and monitoring strategy

Risk communication//monitoring strategy (approach)			
What	**Who**	**When**	**How**
Informing proposal initiator of the conduct of a risk analysis	DARD Dept. of Fisheries Competent authorities	Initial proposal for introduction	Government policy briefs or fact sheets
Obtaining initial stakeholder input on valued components of the system and acceptable level of risk	All affected stakeholders	After boundaries and objectives have been defined but before the risk assessment has been conducted	Targeted letters to major stakeholders; stakeholders register as an interested or affected party, followed by workshop or meeting
Specialist scientific input from outside risk assessment team	Scientific experts and scientific community	During and after completion of risk assessment stage, before final decision or recommendation is made	Peer review; symposia or workshop meeting
Community education of environmental impacts of introduced species	Dept of Education, Dept of Fisheries, conservation groups	Ongoing	Community events, agriculture field days, school excursions, aquaculture extension officers

For details of hazards and risks, refer to Appendix F.

Appendices

Appendix A: Implementation plan

Strategic objectives	Action activities	Key result areas	Target species	Responsibility	Timeframe (years) Short term-S (1–2) Medium term-M (3–6) Long term-L (7–10)	KPI
Thematic area 1: Increase aquaculture production for food security, livelihoods and health nutrition						
Improve and expand aquaculture infrastructure and equipment	Construct national hatcheries	Build three freshwater aquaculture hatcheries	Tilapia, freshwater prawn, grass carp	VFD	Short term	Three freshwater hatcheries built to complete and operational
		Build two mariculture hatcheries	Clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species	VFD	Short term	Two mariculture hatcheries built and operational
	Construct provincial hatcheries	Build six freshwater provincial hatcheries	Tilapia	VFD, provincial government	Short term	Six provincial freshwater hatcheries built and operational
		Build 24 mariculture holding facilities	Clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species	VFD, provincial governments	Medium to long term	24 mariculture holding facilities built and operational
	Construct community hatcheries and holding facilities	Build 36 freshwater aquaculture holding facilities	Tilapia, Freshwater prawn, Grass carp, ornamental species	VFD, communities	Short term-medium - long term	36 freshwater holding facilities built to complete and operational
	Construct quarantine facility	Build three freshwater quarantine facilities	Tilapia, freshwater prawn, grass carp, ornamental species, freshwater species	VFD, Biosecurity	Short term	Three freshwater quarantine facilities built and operational
	Construct aquaculture storage facilities	Build aquaculture storage facility in all provinces	Tilapia, freshwater prawn, grass carp, ornamental species, freshwater species	VFD	Short to Long term	Storage facility built in all provinces
	Construct live and frozen aquaculture market facility	Build 60 live and frozen aquaculture produce market facilities	Tilapia, freshwater prawn, crab species, rabbit fish.	VFD, MTTCNVB	Medium to long term	60 live and frozen aquaculture produce market facilities built
	Construct facilities to accommodate the sale of live fish within existing fish markets	Renovate existing provincial fish markets to accommodate sale of live aquaculture fish produce	Tilapia, freshwater prawn, crab species, rabbit fish.	DOC, VFD	Medium to long term	Existing provincial fish markets modified
	Purchase farm mechanisation equipment	Purchase three excavators and three boats	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species	VFD, partners	Short to long term	Three excavators and three boats purchased
	Establish integrated aquaculture farming	Develop a standard freshwater aquaculture integrated farming system in all provinces	Tilapia, ornamental fish species, grass carps, freshwater prawns, valuable plants and vegetables, root crops	VFD, farmers, DARD, Livestock, Forestry	Medium to long term	Freshwater aquaculture Integrated system established in all provinces
		Establish a standard mariculture integrated system in all provinces	Clam, trochus, green snail, sea cucumber, rabbit fish	VFD, farmers, partners	Medium to long term	Mariculture Integrated system established in all provinces

Strategic objectives	Action activities	Key result areas	Target species	Responsibility	Timeframe (years) Short term-S (1–2) Medium term-M (3–6) Long term-L (7–10)	KPI
Improve aquaculture data collection mechanism	Expand the coverage of Aquanetix data collection	Collect freshwater aquaculture data in all provinces	Tilapia, freshwater prawn, grass carp	VFD, farmers	Short to long term	Freshwater aquaculture data collected in six provinces
		Collect mariculture data in all provinces	Clam, trochus, green snail, rabbitfish, milkfish, grouper, anemone	VFD, farmers	Short to long term	Mariculture data collected in six provinces
		Conduct training for Aquanetix	Tilapia, freshwater prawn, grass carp clam, trochus, green snail, rabbitfish, milkfish, grouper, anemone	VFD, partners, farmers	Short to long term	Aquanetix training conducted and farm support equipment disseminated to farms in all six provinces
	Purchase software and data collection equipment	Purchase 120 tablets for Aquanetix data input	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species	VFD, partners	Short to long term	Software and equipment purchased; 18,000 kg recorded/year; 120 tablets purchased
		Renew Aquanetix license	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species	VFD	Short to long term	Aquanetix license renewed annually
Improve production and supply of feed and seeds	Establish PPP to improve access to freshwater aquaculture feed	Produce consistent supply of aquaculture feed	Tilapia, prawn, rabbit fish	VFD, private hatcheries, Customs, Biosecurity	Short term	Aquaculture feed produced and supplied
	Develop and Improve aquaculture feed production	Produce aquaculture feed using local ingredients	Tilapia, Prawn, Rabbit fish	VFD, VAC, VARTC, USP, QUT	Medium term	Aquaculture feed produced
		Conduct training on local feed production	Tilapia, Prawn, Rabbit fish	VFD, farmers, VARTC, VAC, QUT, SPC	Medium to long term	Feed production training conducted
	Increase seed production	Import new seed and genetic strains for freshwater species	Tilapia, freshwater prawn, Grass carp	VFD, Customs, Biosecurity, SPC	Short to long term	New genetic strain imported
		Import new seeds for mariculture species	Rabbit fish, Mud crab,	VFD, Customs, Biosecurity, SPC, JICA	Short to long term	New seeds imported
		Collect and establish aquaculture brood stock locally	Clam, trochus, green snail, mullet	VFD, JICA, SPC, farmers	Short to long term	Aquaculture brood stock established
	Provide a list of service providers to farmers for easy access and convenience	Develop a list of accessible service providers for freshwater aquaculture farmers	Tilapia, freshwater prawn	VFD	Short to long term	List of freshwater services developed and provided for public use
		Develop a list of accessible service providers for mariculture farmers	crab species, rabbit fish, clam, etc.	VFD	Short to long term	List of mariculture services developed and provided for public use
	Develop an aquaculture feed strategy	Develop a feed strategy	Tilapia, freshwater prawn, grass carp, green snail, rabbitfish, milkfish, grouper, anemone	VFD, SPC, other partners, FAO, JICA	Short to medium term	Feed strategy developed and approved by 2022

Strategic objectives	Action activities	Key result areas	Target species	Responsibility	Timeframe (years) Short term-S (1–2) Medium term-M (3–6) Long term-L (7–10)	KPI
Strengthen capacity-building for government and farmers – a top priority	Conduct training needs assessments for all stakeholders	Conduct aquaculture training for both government and farmers in all provinces	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, aquarium species, sea cucumber	VFD, SPC, partners	Short to long term	Aquaculture training needs assessment conducted
		Conduct aquaculture husbandry skills training and other technical skills for farmers and government officials	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, aquarium species, sea cucumber	VFD, SPC, partners, QUT, VAC	Short to long term	Husbandry and other technical skills training conducted in six provinces
	Develop an aquaculture training programme	Develop an aquaculture cadetship training plan	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, aquarium species, sea cucumber	VFD, SPC, QUT, VAC, VARTC, USP, VIPAM	Short to long term	Training plan developed

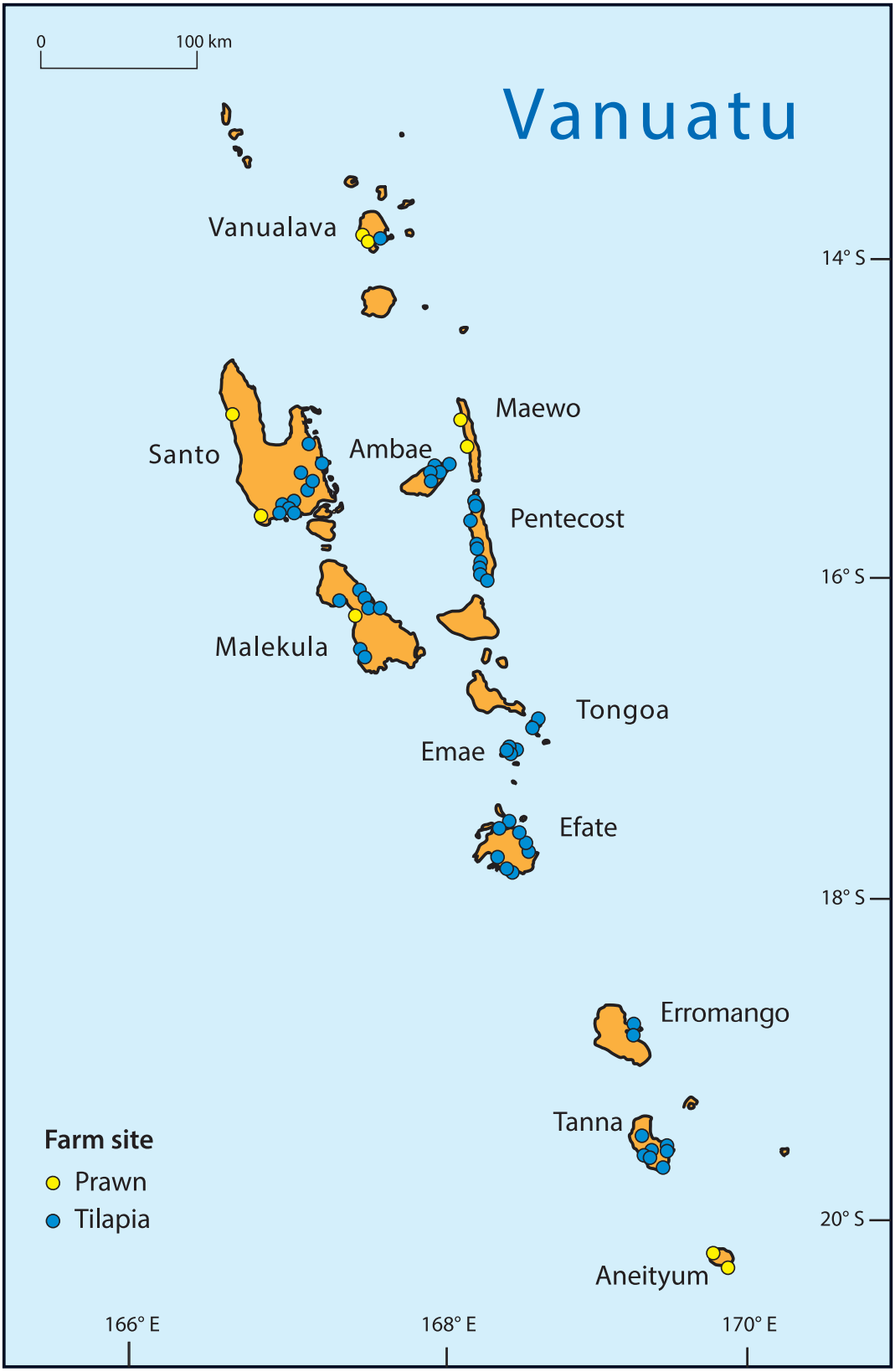
Strategic objectives	Action activities	Key result areas	Target species	Responsibility	Timeframe (years) Short term-S (1–2) Medium term-M (3–6) Long term-L (7–10)	KPI
Develop an aquaculture extension programme	Establish and implement an effective aquaculture extension programme	Develop an aquaculture extension strategy	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper	VFD, SPC	Medium to long term	Aquaculture extension strategy developed
		Review and update the Fisheries Act to accommodate the aquaculture extension programme	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper	VFD, SLO, stakeholders	Medium to long term	Fisheries Act updated
		Create new aquaculture positions under revised Fisheries Department structure	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper	VFD	Medium to long term	New aquaculture positions created
	Develop an aquaculture species action plan for the extension programme	Develop an action plan for specific species	Tilapia, freshwater prawns, giant clams, trochus, green snails	VFD, SPC, stakeholders	Short to long term	Action plan developed
	Standardise aquaculture hatcheries and farms	Develop standard freshwater hatcheries and farms	Tilapia, freshwater prawn, grass carp	VFD, partners	Short term	Freshwater aquaculture hatcheries and farms standardised
		Develop standard mariculture hatcheries and farms	Clam, trochus, green snail, rabbitfish, milkfish, grouper, anemone	VFD, partners	Short to medium term	Mariculture hatcheries and farms standardised
	Prepare and disseminate awareness materials on aquaculture husbandry and other technical or policy areas for farmers	Develop and publish awareness materials on aquaculture husbandry and other technical or policy areas for farmers with brochures, banners, etc.	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber	VFD, SPC, other partners	Short to long term	Awareness materials developed
	Establish framework to access funds for aquaculture development	Prepare and submit a budget increase for aquaculture operations	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber	VFD, DOFT	Short to long term	Aquaculture operation budget prepared and submitted
		Work with partners to prepare concept papers for aquaculture project proposals	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber	VFD, partners	Short to long term	Concept papers for aquaculture project proposal prepared and submitted
		Develop aquaculture financing strategy for extension development and support services	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber	VFD, SPC, other partners	Short to long term	Financing strategy developed
		Develop SOP to facilitate process for farmers to access financial resources for aquaculture development	Tilapia, Freshwater prawn, Grass carp, Clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber	VFD, SPC, other partners	Short to long term	Number of farmers receiving financial assistance
	Promote easy and clear marketing access	Work with the Ministry of Trade and Industry on a market strategy that covers aquaculture products	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber	VFD, MTTCNVB	Short to long term	Market strategy for aquaculture products is in place and implemented
		Work with relevant private sector on high transport costs to access markets	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber	VFD, private sector, LTA	Short to long term	High transport cost reduced

Strategic objectives	Action activities	Key result areas	Target species	Responsibility	Timeframe (years) Short term-S (1–2) Medium term-M (3–6) Long term-L (7–10)	KPI
Thematic area 2: Collaboration, partnership and networking						
Promote and strengthen collaboration, partnership and networking with key stakeholders	Prepare and sign agreements, MOUs/MOAs with key stakeholders	Develop and sign with key stakeholders	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber	VFD, SPC, key stakeholders	Short to long term	Number of agreements, MOUs/MOAs signed with key stakeholders
	Implement cooperation arrangements at national and regional levels	Strengthen and maintain cooperation arrangements with national and regional agencies: SPC, USP, VARTC, VAC, etc.	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber	VFD, SPC, JICA, QUT, EU-GIZ, VARTC, VAC, USP	Short to long term	National and regional arrangements strengthened
Thematic area 3: Participation and empowerment of local farmers						
Promote, protect and empower local farmers' participation in aquaculture	Review and update the Fisheries Act	Review and update the Fisheries Act, fisheries regulations and other relevant laws to include provision to safeguard and empower local farmers' participation in aquaculture	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber	VFD, SLO, stakeholders	Short to long term	Fisheries Act updated
	Promote aquaculture shows and symposiums for community-based farmers	Conduct annual aquaculture shows	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber	VFD, MALLFB, VBTC, other partners	Short to long term	Number of aquaculture shows conducted
	Promote gender balance in aquaculture farming	Create opportunities for marginalised groups to participate in aquaculture activities	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber	VFD, SPC, other partners	Short to long term	Number of communities participating in aquaculture activities

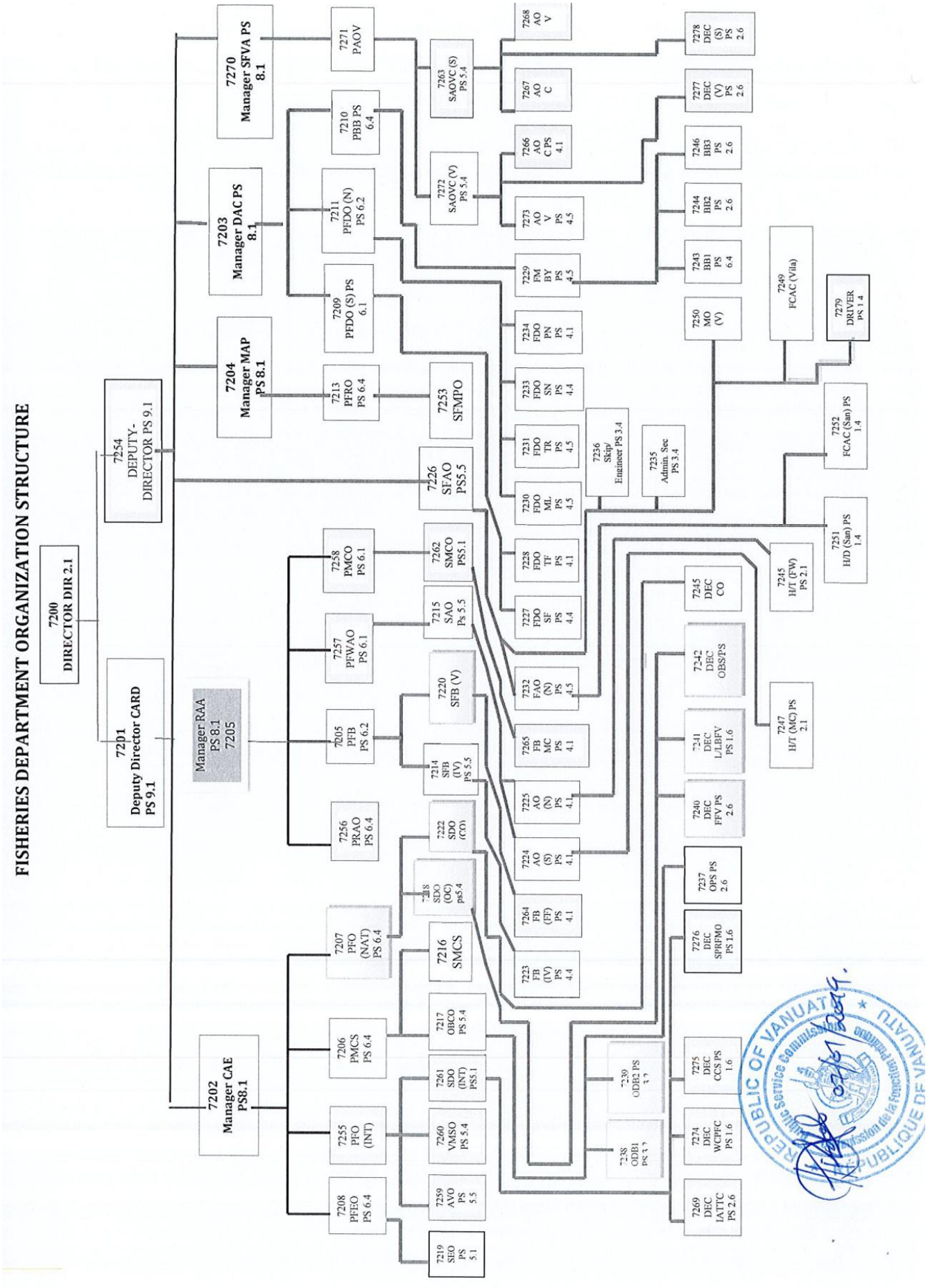
Strategic objectives	Action activities	Key result areas	Target species	Responsibility	Timeframe (years) Short term-S (1–2) Medium term-M (3–6) Long term-L (7–10)	KPI
Thematic area 4: Environment and monitoring						
Ensure environmental safeguards through best management and farming practices	Work with the Department of Environmental Protection and Conservation (DEPC) to implement EIA procedures	Conduct EIAs during site inspections prior to farm establishment	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber	VFD, DEPC, Lands	Short to long term	Numbers of EIAs conducted
	Work with the Ministry of Lands and Natural Resources to conduct zoning of designated aquaculture areas and declare them in accordance with section 13 of the Fisheries Act	Conduct survey and zoning to determine suitable sites and zone out existing aquaculture faming sites	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, ornamental species, sea cucumber	VFD, Lands, partners	Medium to long term	Aquaculture areas zoned and designated
	Develop and implement a farm monitoring mechanism	Develop an aquaculture farmers profile, e.g. Aquanetix app	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, anemone	VFD, SPC, partners	Short to long term	Aquaculture farms monitoring mechanism developed
	Establish a code of practice for aquaculture farming and processing	Develop and implement a code of practice for aquaculture farms	Tilapia, freshwater prawn, grass carp, clam, trochus, green snail, rabbitfish, milkfish, grouper, anemone	VFD, SPC, FAO, other partners	Short to long term	Code of practice developed
Ensure biosecurity consideration in aquaculture development	Develop and improve aquatic import protocols. Ensure biosecurity measures are in place to monitor high metallic content breeding facilities	Develop and improve aquatic import protocols on aquaculture import species	Tilapia, freshwater prawn, grass carp, sea cucumber, rabbitfish	VFD, Biosecurity, SPC, FAO, other partners	Short to long term	Import protocols developed
	Develop and implement a national aquatic biosecurity strategy	Carry out import protocols according to national aquatic biosecurity strategy	Tilapia, freshwater prawn, grass carp, sea cucumber, rabbitfish	VFD, Biosecurity, SPC, FAO, other partners	Short to long term	National aquatic biosecurity strategy developed and implemented
Thematic area 5: Research and development						

Strategic objectives	Action activities	Key result areas	Target species	Responsibility	Timeframe (years) Short term-S (1–2) Medium term-M (3–6) Long term-L (7–10)	KPI
Ensure that aquaculture information is made available for development and management purposes	VFD to establish a working relationship with VARTC on researching local feed ingredients available for aquaculture to improve feed quality	VFD and VARTC to develop feed with local ingredients	Tilapia, freshwater prawn, grass carp, rabbitfish, grouper and crab species.	VFD, VARTC, VAC, farmers, partners	Short to long term	Aquaculture feed developed and reported
	Undertake research to ensure that brood stock genetic quality is maintained for breeding purposes	Develop a brood stock management strategy and standards to maintain genetic quality	Tilapia, freshwater prawn, grass carp, rabbitfish, grouper and crab species.	VFD, SPC, QUT	Short to long term	Brood stock management strategy standards developed
		Develop a seed distribution plan	Tilapia, freshwater prawn, grass carp, rabbitfish, grouper and crab species.	VFD, SPC, farmers	Short to long term	Seed distribution plan developed
	VFD to maintain collaboration with other research institutions on aquaculture developments	Maintain working collaborations with research institutes, VARTC, SPC, USP, IRD, QUT, JICA, etc.	Tilapia, freshwater prawn, grass carp, rabbitfish, sea cucumber, nemo, mountain mullet, grouper and crab species.	VFD, VARTC, SPC, USP, VAC, QUT, JICA, FAO, IRD	Short to long term	Number of collaborative undertakings and reports produced
	Conduct research on environmental parameters on aquaculture farming	Undertake research in pond dimensions, pond size, water flow, stocking densities, water quality and climate change	Tilapia, freshwater prawn, grass carp, rabbitfish, sea cucumber, nemo, mountain mullet, grouper and crab species.	VFD, IRD, SPC, partners	Short to long term	Reports produced
	Explore options to farm native species and conduct more research on new commodities	Undertake research on native species for aquaculture purposes	Mountain mullet, grouper, crab species, sea cucumber, freshwater prawn, milk fish, rabbit fish	VFD, SPC, QUT, Partners	Short to long term	Reports produced
	Explore options of mono-sex culture in some aquaculture commodities	Conduct research on sex reversal on aquaculture farm species	Tilapia	VFD, SPC, USP, QUT, partners	Short to long term	Reports produced

Appendix B:
Map showing aquaculture hatcheries and farms in Vanuatu



Appendix C: VFD/R&A structure



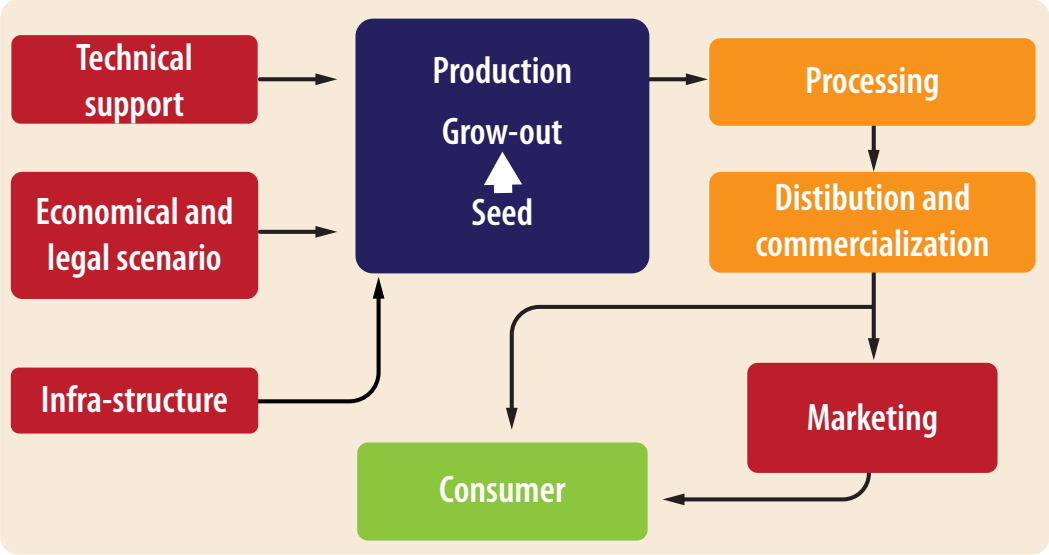
Appendix D: Fees

Abbreviation	Farm category	Meaning	Fees (VT)
C	Commercial	Large scale	100,000
SC	Semi-commercial	Medium scale	10,000
S	Integrated	Small scale	2,000
B	Backyard	Backyard	Free

Appendix E. Aquaculture production chain, schema and tilapia modelling

Aquaculture production chain

Target	Consumers & and farmers	**PRODUCTION** **Grow - Out** ▲ **Seed**
Input	Technical support	
	Economical and legal scenario	
	Infrastructure	
Output	Processing	
	Distribution and commercialisation	
	Marketing	
Details of major production elements		
Technical Support	Research and development	
	Importation of technology	
	Training or capacity building of personals	
	Transfer of technology	
	Rural extension support	
	Specialised services	
Economical and legal scenario	Environmental legislation	**PRODUCTION**
	Funding support	
	Cooperatives	
	Producer association?	
Infrastructure	Production of equipment and supplies	
	Importation of equipment and supplies	
	transportation	
Production ➡ Processing		
	Distribution and commercialisation (Note: distribution can be direct to either market or consumer)	
	Market (Develop marketing strategies)	
	Consumer	



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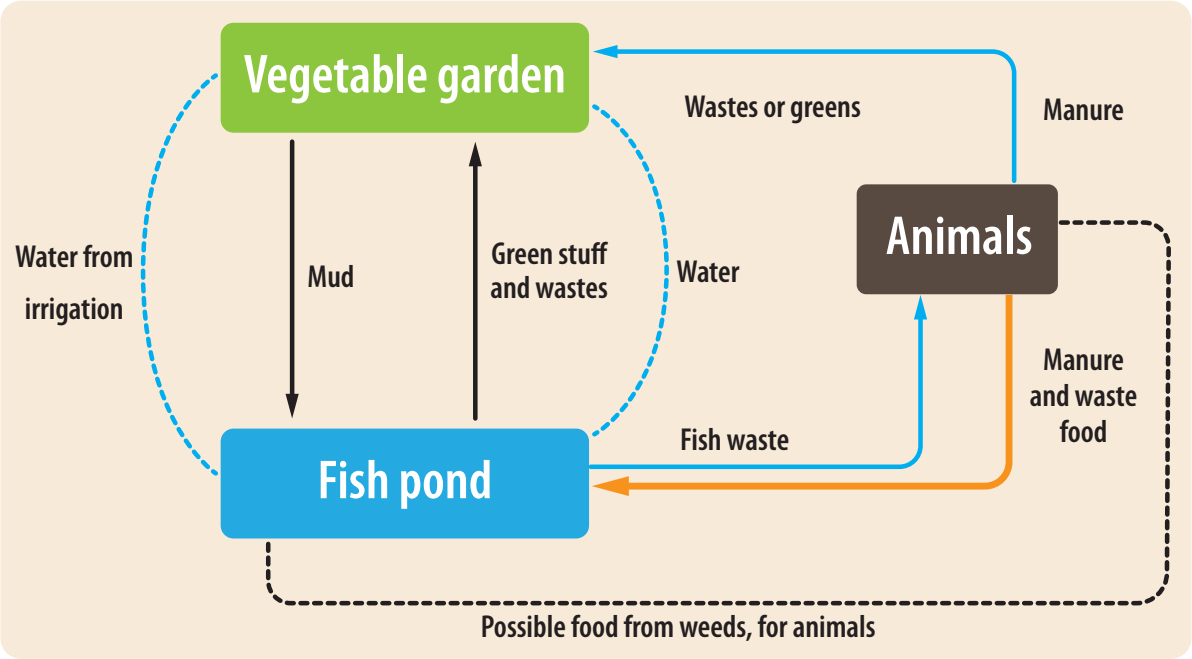
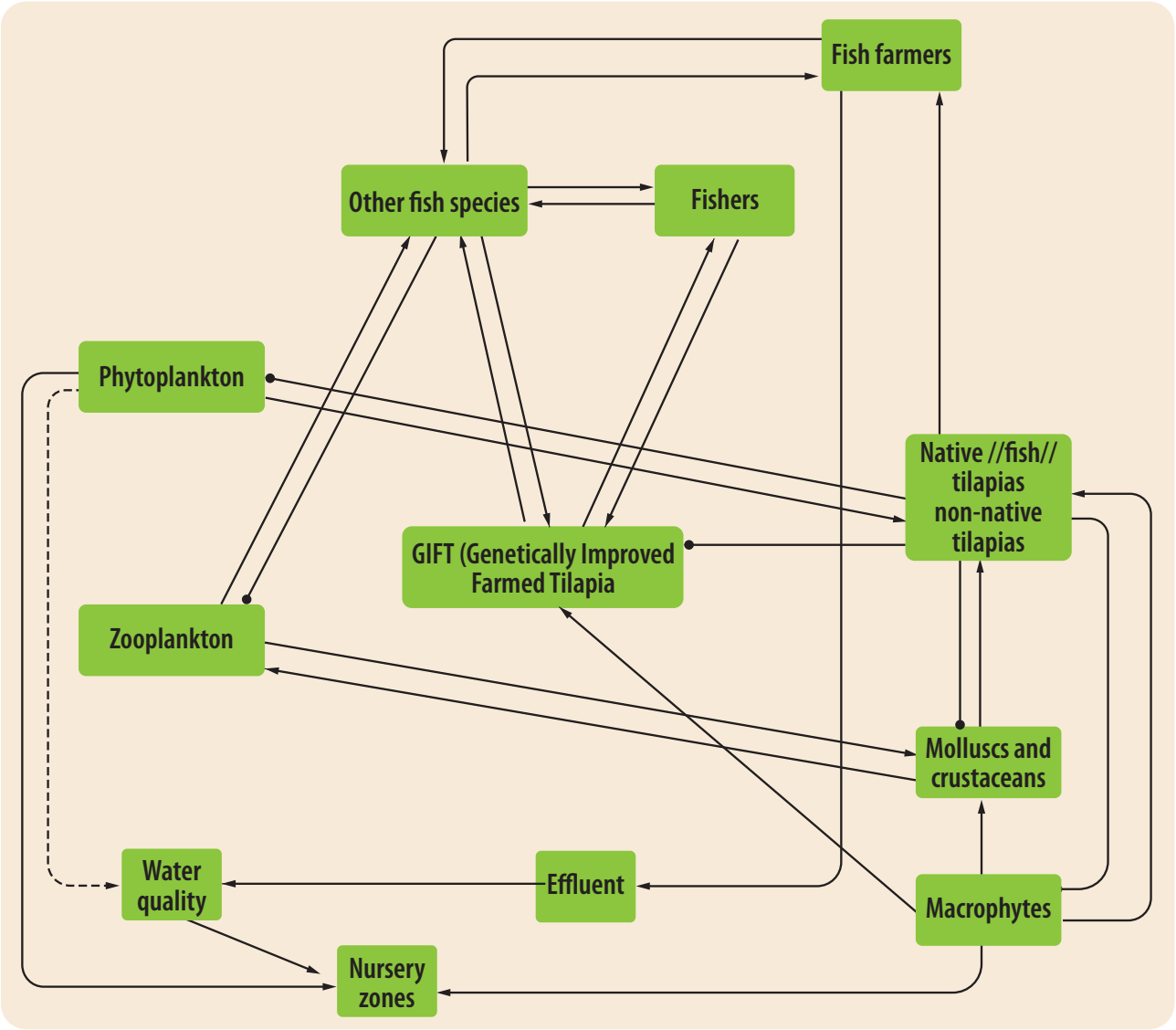
Aquaculture production chain schema




Fish farmers
Other fish species
Fishers
Phytoplankton
Native //fish// tilapias non-native tilapias
GIFT (Genetically Improved Farmed Tilapia
Zooplankton
Molluscs and crustaceans
Water quality
Effluent
Macrophytes
Nursery zones

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