



KINGDOM OF CAMBODIA  
Nation Religion King



**NATIONAL STRATEGIC PLAN  
FOR AQUACULTURE DEVELOPMENT IN  
CAMBODIA 2016 TO 2030**





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**Ministry of Agriculture, Forestry and Fisheries**



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## Foreword

It is my pleasure to introduce the Cambodia National Strategic Plan for Aquaculture Development which was fully adopted by the Royal Government of Cambodia, and subsequently integrated into the “Rectangular Strategy” for Growth Employment, Equity and Efficiency Phase III (RS III) and the National Strategic Development Plan 2014-2018 (NSDP). Further, the Cambodia National Strategic Plan for Aquaculture Development is closely linked to the Strategic Planning Framework for Fisheries 2015-2024 and the Agriculture Sector Strategic Development Plan (ASDP), of which the fisheries programme represents the National Fisheries Management Plan.

Cambodia is internationally famous for the variety and quality of its fish, and the highest consuming fish country throughout the region. We have a very long history of aquaculture production, a suitable climate, and abundant water resources. Yet we have struggled to keep up with the spectacular growth in aquaculture exhibited by our neighbours Thailand, Vietnam and Lao PDR, and other countries in the region. This is not necessarily a bad thing while our neighbours have achieved impressive production and export figures. They have suffered from both disease and periodic oversupply to markets. Rapid intensification and poor disease management has led to uncontrolled use of antibiotics and other chemicals with potentially serious long term consequences for animal and human health.

Cambodia now has a tremendous opportunity to learn from the achievements and mistakes of other countries and build a more sustainable and profitable aquaculture industry. This will imply steady, well managed growth, with strategic emphasis on species and products where Cambodia has comparative advantage. Cambodia can and should avoid the boom and bust cycle that has plagued aquaculture in so many countries.

This strategy sets out the broad guided principles to develop this sector including building on our own exceptional genetic resources and the great local variety of fish and aquatic invertebrate species native to Cambodia that can support dynamic young aquaculture entrepreneurs, using existing resources especially feed more efficiently; minimising the risks from disease and effective rapid responding when outbreaks do occur; promote best economic and environmental practices on farms; making sure that farmers understand markets and market opportunities; and promoting Cambodian aquaculture as the most sustainable in the region.

All this will require a high technical programme on financial, extension and marketing support to the emerging industry, as well as strong collaboration between government, donors and industry. Some of the key activities required to achieve success are outlined in the strategy, but these will need to be further elaborated in more detailed sub-sector strategies and action plans.

Over the coming years, I look forward to seeing a dynamic, diverse, profitable and sustainable aquaculture sector and producing a wide range of aquatic organisms for domestic, regional and ultimately international markets. Cambodia can and should be a leader in sustainable aquaculture production in the region, and in the coming years Royal Government of Cambodia will do all it can to realise this vision. សុខ សុខ

Phnom Penh, 22 Feb. 2017

**Minister of Ministry of Agriculture, Forestry and Fisheries**



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## ABBREVIATIONS AND ACRONYMS

AIDA	Ayuda, Intercambio y Desarrollo (Spanish NGO funded by Spanish Agency for International Development Cooperation (AECID))
AIT-AARM	Asian Institute of Technology-Aquaculture and Aquatic Resources Management Program
DAD	Department of Aquaculture Development (FiA/MAFF)
DANIDA	Danish Overseas Aid, Ministry of Foreign Affairs of Denmark
DFID	Department for International Development, United Kingdom
DP	Development Partner
EU	European Union
FAO	Food and Agriculture Organisation of the UN
FAIEX	Freshwater Aquaculture Improvement and Extension Project (JICA funded)
FiA	Fisheries Administration
FTE	Full time equivalent jobs
HARVEST	Five-year integrated food security and climate change program under the United States Feed the Future and Global Climate Change initiatives.
IFReDI	Inland Fisheries Research and Development Institute
JICA	Japan International Cooperation Agency
MARDeC	Marine Aquaculture Research and Development Center
MAFF	Ministry of Agriculture, Forestry and Fisheries
MoC	Ministry of Commerce
MoWRaM	Ministry of Water Resources and Meteorology
MRC	Mekong River Commission
NPBDMD	National program for broodstock development, management and distribution (proposed)
NAIEC	National Aquaculture Information and Extension Center (proposed)
NARI	National Aquaculture Resources Inventory (proposed)
PADEK	Partnership for Development in Kampuchea
SEAFDEC	Southeast Asia Fisheries Development Center
SME	Small-medium scale enterprise
SPF	Strategic Planning Framework for Fisheries
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organisation
USAID	United States Overseas Aid Programme
WHP	World Health Programme



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# EXECUTIVE SUMMARY

This document sets out a strategic framework in support of the development of a commercially viable and environmentally sustainable aquaculture sector in Cambodia through to 2030. The framework should serve to inform, guide and coordinate the activities of government and development partners in support of the sector.

The goal of the strategy is to ensure the development of “a commercially viable and environmentally sustainable aquaculture sector contributing to food security and nutrition, socioeconomic development, GDP and export earnings”.

The strategy takes into account four essential characteristics of aquaculture in Cambodia:

- That it has broadly favourable conditions for aquaculture development, though access to year round supplies of water is limited in many otherwise suitable areas of the country.
- That it has access to strong national and regional markets for a wide range of aquatic animal products.
- That its neighbours Thailand and Vietnam are highly developed and efficient producers of several “commodity” aquaculture products supplying relatively “mature” global markets – and that it will be very difficult to compete in these markets.
- That much current aquaculture practice is highly dependent on the use of low value fish as a feed input, that this resource is necessarily limited, and that the expansion of aquaculture based on current practice will represent significant pressure on the wild fishery resource with potential negative impacts on other resource users and the nutrition of the poor.

The strategy comprises a set of 7 strategic objectives and associated strategic activities designed to realise a vision for the future of aquaculture in Cambodia whose essential elements include diversity, value, and sustainability:

- Development of a wide range of high value aquaculture products for domestic and regional markets.
- Exploitation of seasonal and inter-annual price variation in domestic and regional markets through better market information, and more flexible and responsive timing of production.
- Reduced dependence on low value fish as feed input, and maximum value added generated from the wild fish that is used.

In order to realise the goal and vision, comprehensive and coordinated action will be required by government, development partners and the private sector. Following on from consultation with a wide range of stakeholders, a set of 28 strategic actions under 7 operational objectives have been developed. Taken together these actions will contribute to addressing the following key constraints and opportunities for aquaculture development in Cambodia.

**Availability of diverse, high quality broodstock:** Any aquaculture industry is primarily dependent on the quality of seed and the range of species and varieties available to its fish farmers. While the private sector can produce the seed, there remains a major role for government in the development and distribution of high quality broodstock of a range of species, at least in the medium term. Cambodia has historic R&D strength in this area, and the facilities in which to keep and develop broodstock, but an institutional overhaul, rationalisation and restructuring will be required.

**The capacity to maximise returns from highly seasonal markets:** Because many high value species are still sourced mainly from the wild, availability and price tends to be highly seasonal. Fish farmers need to time production to maximise their return. However they are frequently constrained in their ability to do so by limited and seasonal availability of seed, and/or by limited availability of high quality water at critical times of year. Action is required to address the seasonality of seed supply through general strengthening of the hatchery and nursing sector, and improved year round water supply to hatcheries

(together with appropriate siting). Improved water storage and supply on grow-out farms to address typical water shortage in the March-May period will also be needed. Much better market information (national, regional) on the one hand, and farmer business and production management skills on the other will be required in order to maximise income. There are particular opportunities to use electronic/phone based market information to connect suppliers, producers and buyers. Issues of product quality and safety will be addressed through appropriate standards and enforcement, and through both public and private sector mechanisms.

**The conservation of feed and fishery resources:** Cambodia benefits from a seasonal supply of low cost fish which is used as a major input to many aquaculture systems, and especially the more intensive and/or those based on carnivorous species. This resource is limited, has alternative uses and values, and it must be used more efficiently if aquaculture is to expand without undue pressure on the resource. A wide range of activities have been identified which will contribute to this, including research/guidance on better feed formulations, increasing the proportion of high value and/or feed efficient species, and shifting to scientifically formulated commercial pelleted feeds.

**Advisory and financial support to existing and new enterprise:** Existing extension support is primarily delivered through donor led projects, and is limited in space and time. There is an important opportunity to disseminate more and better guidance, experience and training through a wide range of development organisations, and especially through national rural development NGOs and those involved in agricultural extension. A small centralised extension coordination and dissemination will be developed to address this opportunity. Historically there has been limited support to small and medium sized enterprise (SME). A specific package of strategic activities in support of these enterprises will be developed – to address issues of site and water access, market analysis, business development, and finance.

**Planning and management:** Aquaculture development is as yet relatively little developed in Cambodia and the environmental and disease problems associated with concentrated aquaculture activity in neighbouring countries is not yet a major issue. However, rapid development is likely take place in favourable locations, and it is important that these areas are identified and precautionary planning and management measures (both on farm, and in the wider aquatic environment) put in place. An aquaculture resource inventory will be developed, and pilot zones for aquaculture development established which will facilitate environmental and disease management as well as serving as a focus for infrastructure development (water, power, roads, processing etc.). An investment prospectus for larger scale aquaculture development will be prepared based on the resource inventory and identified opportunities in pilot zones.

**Quality and disease status of imports:** Significant quantities of low quality and in some cases diseased seed, and poor quality or mislabelled feed is entering Cambodia from neighbouring countries. Options for approving overseas supplier hatcheries and improving quality/reliability of documentation will be explored; regulatory mechanisms, responsibilities, and protocols will be clarified and strengthened; and capacity to assess, analyse and respond increased.

This strategy is aligned with national policy and development objectives (Rectangular Strategy and National Strategic Development Plan, the Strategic Planning Framework for Fisheries), and also with international guidance including the FAO Code of Conduct for Responsible Fisheries.

**Implementation of the strategy:** will be the responsibility of the Technical Working Group (fisheries) and will require coordinated action by government, development partners and private sector.

# 1



## INTRODUCTION

Along with rice, fish lie at the heart of the Cambodian rural economy, and are a crucial element in nutrition, especially for the poor. Drawing on a survey of 1200 households, a recent study estimated per capita fish consumption in Cambodia at 63kg/person/yr., and found that fish and aquatic resources provide 76% of animal protein intake, 37% of iron and 28% of fats for the Cambodian population<sup>1</sup>. Aquatic resources comprise 18% of total food intake - second only to rice. Fish is therefore a crucial element in food security for the people of Cambodia, and especially for the rural poor. Fish is also an important source of income for individual fishers, fish farmers and for the country as a whole.

The primary source of this fish is from the wild capture fisheries of the Great Lake, and from the Mekong, Tonle Sap and Brassac rivers and their associated floodplains. These are estimated to yield 625,000 tonnes of fish and other aquatic organisms. While aquaculture only contributes around 143,141 tonnes of total supply in 2015, its relative contribution is increasing year by year. Demand for farmed fish is increasing, related to growing population and higher living standards on the one hand, and the probable decline in wild capture fisheries on the other. This probable decline is associated with habitat loss, increased use of chemicals in agriculture, and the disruption of natural aquatic systems and their seasonal cycles by dam, reservoir and irrigation projects. These pressures are likely to increase in the future, along with those associated with climate change.

Aquaculture has an ancient history in Cambodia, closely related to the abundant capture fisheries. Cage culture of higher value fish using lower value fish as feed has been undertaken for centuries, and has served both as a storage mechanism (utilisation of seasonally abundant fish) and as a means of “adding value” to a cheap and abundant resource. Low value “trash” fish from both freshwater and marine resources continues to be used as an important input to the rapidly growing aquaculture sector. The availability of this high quality but low cost feed resource is a significant strength and opportunity for aquaculture in Cambodia, but the resource is limited, needs to be used as efficiently as possible, and must be managed effectively if aquaculture is to be regarded as sustainable. This partial dependency of aquaculture on capture fisheries is a key issue for aquaculture development globally, and especially in Cambodia where the link is particularly close.

Aquaculture development in Cambodia is now showing signs of more rapid growth, and is at a critical stage in its development. It has the potential to meet the likely future shortfall in supply of both high value and lower cost species, to generate employment for both men and women, and to increase value added and export earnings for the country. There is a need and opportunity to facilitate the development of more profitable and sustainable aquaculture development, while at the same time conserving valuable fisheries resources, and maximising the contribution to nutrition and poverty alleviation. This has to be

<sup>1</sup> IFREDI 2013. *Food and nutrition security vulnerability to mainstream hydropower development in Cambodia. Synthesis report of the FiA/Danida/WWF/Oxfam project “Food and nutrition security vulnerability to mainstream hydropower dam development in Cambodia. Inland Fisheries Research and Development Institute, Fisheries Administration, Phnom Penh Cambodia*



done taking into account the opportunities and constraints associated with the wider economy in Cambodia, and the sector's ability to compete with the much more highly developed aquaculture sectors in neighbouring country.

## 1. AIM AND CONTENT OF THE STRATEGY

The aim of this strategy is:

*To contribute to the sustainable development of fisheries resources in Cambodia with the aim of promoting food security and socioeconomic development in the country, and more specifically to support the development of a commercially viable and environmentally sustainable private-sector and/or smallholders based aquaculture sector in the country<sup>2</sup>.*

This National Strategic Plan for Aquaculture Development in Cambodia 2016 - 2030 sets out a vision and strategy for the sustainable development of aquaculture contributing to economic growth, food security and poverty alleviation. It should serve as a framework and prospectus for coordinated action by the Royal Government of Cambodia, Development Partners, private sector and NGOs.

This draft strategic plan sets down:

- A background and rationale for strategic action
- A goal and vision for the state of the aquaculture sector in 2030
- A set of objectives for the sector that will allow us to realise the vision<sup>3</sup>
- One or more performance indicators for each objective
- A set of strategic actions required to overcome constraints, realise potential and meet objectives<sup>4</sup>.

## 2. IMPLEMENTING MECHANISMS AND RESPONSIBILITIES

This is a strategic plan to 2030, and it is not appropriate to assign specific responsibilities for all of the actions. This will depend on resources, institutions, political change, Development Partner priorities, and so on. Nonetheless it has been possible to identify the kinds of mechanism and possible organisations that might take these forward, and these are set down in the log-frame (Annex 1).

In addition a set of small working groups or task forces are proposed to take forward the more demanding initiatives and activities. These are described in more detail at the end of section 9.

More specific allocation of responsibilities will emerge from the deliberations of these groups, and in periodic and annual work plans and other practical instruments.

<sup>2</sup>Terms of reference "Elaboration of a National Aquaculture Development Strategy for Cambodia FWC BENEFICIAR-IES 2009 - LOT 1: Rural Development EuropeAid/127054/C/SER/multi

<sup>3</sup>based on the findings of a preliminary situational analysis – Appendix 1

<sup>4</sup>These were developed from the situational analysis and the outputs of a series of technical consultation meetings culminating in a final validation workshop (Appendix 2)

# 2



## DEVELOPMENT CONTEXT

### 1. NATURAL RESOURCE BASE

Cambodia benefits from substantial and productive water resources and floodplains associated with the Mekong, Tonlé Sap and Brassac River systems. The Tonlé Sap Lake is highly productive, steadily filling and expanding from June to November, and emptying back into the Mekong and Brassac Rivers from December to May. During the wet season there is tremendous reproduction and growth of fish benefitting from the fertile floodplain and submerged forest waters, and a large part of this production can be efficiently harvested as the fish migrate out of the lake in December-February. This huge but highly seasonal production of fish is mainly exported to neighbouring country, fed to fish, pigs, and ducks, and converted to fish sauce and fish paste (prahok) for local year round consumption or export. The total yield of inland fisheries is highly variable dependent on the extent of flooding, and published figures are generally not reliable. However, it is likely that the average yield exceeds 500,000 tonnes, and if other aquatic animals are included, more than 600,000 tonnes .

There is substantial opportunity for aquaculture development within the central lake and floodplain areas, and also further to the Northwest in Pursat and Battambang - in cages in lakes and other water bodies, across the many floodplains in ponds and water courses (especially where irrigation infrastructure is in place), and close to the numerous tributaries.

Flooding, and variation in the water regime in many areas, while generally benefitting fisheries and maintaining soil fertility, is nonetheless a significant problem for both agriculture and aquaculture. Many fish farmers lost stock in the floods of 2011 and have been cautious to reinvest since. 2012 saw very limited demand for seed, and this is undermining efforts to develop reliable seed production within Cambodia. Water retention in ponds and reservoirs is also an issue in some regions with sandy soils, such as Kompong Speu.

The SW and NE of the country are comprised mainly of mountain and forest which serve to dampen and stabilize water run-off, contribute nutrients, fix carbon, and harbour tremendous biodiversity. Both fisheries and aquaculture potential is more limited here, but year round water supply from springs and smaller rivers may offer important local opportunities, especially for hatchery production.

The NE region is divided by the Mekong River itself. The upper stretches are braided and interspersed with rapids and deep pools which serve as dry season refuges for many fish species. Here there is significant opportunity for aquaculture development, and especially cage culture. To the south of Kratie the river meanders more gently towards the delta region of the south, and this is an area with abundant water resources and aquaculture potential which is already being developed. The river is home to more than 500 species of fish, of which more than 200 are regularly caught.



The east of the country is comprised of undulating plateau, which has lesser importance for fisheries and aquaculture. To the SE Cambodia has a 443km coastline and an EEZ of 55,600km<sup>2</sup>, home to at least 520 species of marine fish. Marine fisheries production is estimated at 50 to 75,000 tonnes, but this does not take account of the substantial catch made by Thai and Vietnamese vessels which normally land elsewhere. The coast is characterized by large bays and offshore islands, offering significant potential for marine cage culture development. On land there are also significant areas with potential for brackish-water aquaculture.

In summary, Cambodia has abundant and high quality land and water resources, a substantial if seasonal resource of low value fish that can be used as feed for higher value species (if appropriately managed), and a favourable climate.

## 2. LABOUR AND SKILLS

Cambodia has relatively low wage rates by regional standards, although these are beginning to increase, especially in some rural areas, as labour migrates to Phnom Penh and other larger cities in the region.

The country has benefitted from substantial development partner and NGO inputs to aquaculture development since the mid 1990s – initially from UNPD, WHP, AIT-AARM, MRC, FAO, PADEK, and since 2005 from JICA, DFID/DANIDA, USAID- HARVEST, AIDA, and FAO/EU. This has resulted in a substantial pool of experience and expertise, though not all is currently available to the aquaculture sector. The proximity of Cambodia to Vietnam and Thailand, and the substantial trade in feed, seed and other aquaculture inputs also facilitates exchange of knowledge. Inward investment by Vietnamese fish farmers also leads to technology demonstration and transfer.

Skills development and dissemination continues in particular under two current aquaculture development programmes funded by JICA (FAIEX) and USAID (HARVEST).

## 3. INFRASTRUCTURE

The roads network is fair for a relatively poor country and access to most of the country is possible within less than 12 hours. The river system also allows for efficient transportation and connects directly with Vietnam. However container facilities, and general logistics connecting with regional markets remains relatively limited.

Air connections have increased rapidly in recent years, primarily to Phnom Penh, but also Siem Reap and Sihanoukville. This presents a particular opportunity for higher value seafood species and products.

There is a substantial irrigation network, but most parts of the country still suffer from limited water availability during the dry season.

Cambodia has a substantial infrastructure of 13 government hatcheries that have been periodically funded or supported by development partners since the 1990's, although many of these are now underperforming. There are also several hundreds of private sector operations, mostly small scale.





#### 4. NATIONAL MARKETS

The abundant capture fisheries of Cambodia has generated a strong tradition for consumption and processing of freshwater fish. Freshwater fish have comprised between 80% and 90% of total fisheries production in Cambodia over the last decade, and the importance of fish to national diet, health and nutrition has been outlined in section 2. Population growth and increasing prosperity means that demand for fish is likely to grow significantly. Capture fisheries is unlikely to yield more than current rates of production in the medium term, and in the longer term may decline in response to dam building and possibly chemical/pesticide use in agriculture, resulting in substantial demand for aquaculture products. Future demand of the aquaculture product will be 740,000 tonnes by 2024<sup>5</sup> if it is to fill the gap. Furthermore, aquaculture has the capacity to produce fish species in high demand, and can therefore effectively supplement capture fisheries in key market segments.

The rapid growth of the cities of Phnom Penh, Siem Reap and Battambang, and the increase in tourism and business activity are all contributing to increased demand for high value fishery products. Notwithstanding this overall positive picture, many fish farmers and cantonment authorities have noted the lack of demand for some species for which seed is readily available – notably carps and Tilapia. The people of Cambodia have strong preferences for many of the native species and the prices of these are significantly higher in the market place.

#### 5. REGIONAL AND INTERNATIONAL MARKETS AND COMPETITION

Cambodia lies at the heart of Southeast Asia, the most economically dynamic region in the world. It has good road connections with Thailand, Vietnam and Lao PDR – all of which have rapidly growing economies and growing domestic markets, providing significant regional trade opportunities.

Trade relations with Vietnam are particularly strong due to the close proximity of Ho Chi Minh City, and good river, road and air connections. Increasing tourist traffic to Siem Reap and the north of the country, especially from Bangkok, is also underpinning improved connections and trade potential.

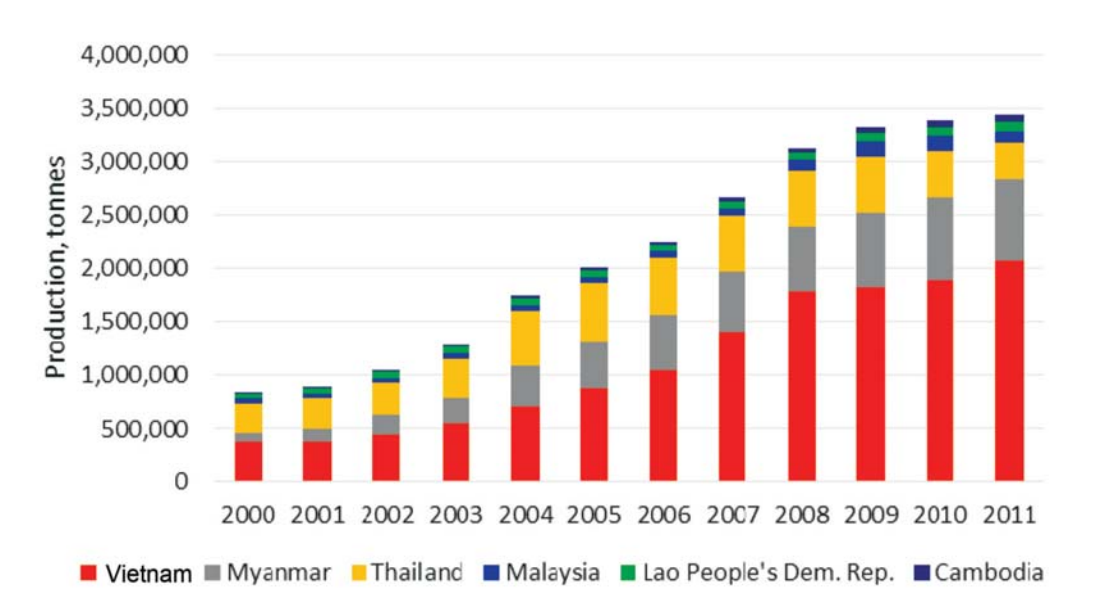
This strategic position represents both a strength and a weakness. These are large accessible markets with growing demand. The combined population of Vietnam, Thailand and Lao PDR is 162 million compared with a mere 14 million in Cambodia. Cambodia can import relatively cheap feed and seed which will tide it over that common development bottleneck when input supplies are costly or inadequate, but demand cannot yet justify significant investment in large scale production of these inputs. Significant exchange of skill and experience is taking place. Vietnamese entrepreneurs are now investing in aquaculture in Cambodia, especially in the South of the country, and their skills, and the trading networks they create, will undoubtedly facilitate further development of the industry.

<sup>5</sup> *The strategic planning framework for fisheries: update for 2015-2024*

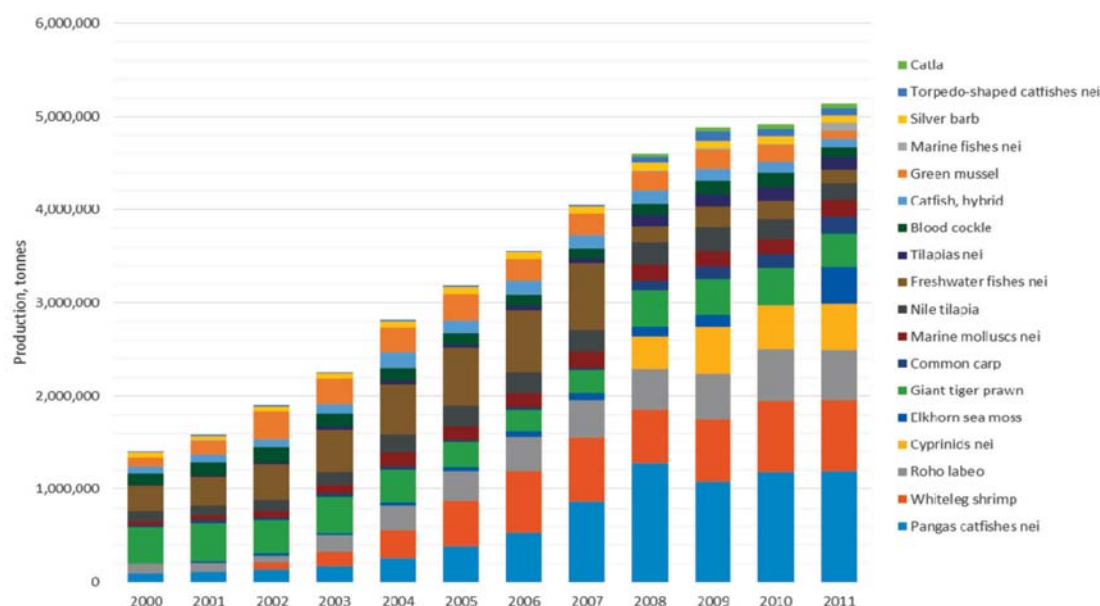


On the other hand this is a significant threat – Vietnam and Thailand (and increasingly Myanmar) are highly efficient and successful seafood producers and exporters, with exceptional skills and experience in aquaculture, benefitting from economies of scale at both enterprise and sector levels, and with a well-developed processing sector operating to international standards. Vietnam and Thailand can produce cheaply, and indeed already export low cost fishery products to Cambodia. FAO data on fishery commodity imports and exports suggests that net fishery exports from Cambodia declined in the period 2000 to 2009 (from 36,000 tonnes in 2000 to 24,000 tonnes in 2009), and imports of freshwater fish in particular are rising. This probably reflects increased imports of low cost pangas from Vietnam.

**Figure 1: Regional aquaculture production trends**



**Figure 2: Aquaculture species production trends (Vietnam, Thailand, Malaysia, Laos, Cambodia, Myanmar)**





Regionally aquaculture production is dominated by Vietnam, producing mainly Pangas (>1m tonnes), whiteleg and giant tiger prawn (0.5m tonnes) and various cyprinids. Myanmar has shown rapid growth in recent years and now produces more than 0.5m tonnes of shrimp (mainly tiger prawn) along with substantial quantities (>1m tonnes) of freshwater fish, mainly carps and tilapia. Thailand produces over 0.5m tonnes of shrimp, now mainly whiteleg shrimp, Tilapia and hybrid catfish (each >100,000t), green mussel (highly variable but usually >100,000t) and a very wide range of other species. Malaysia, Thailand, Indonesia and the Philippines produce substantial quantities of seaweed.

Prices for pangas are hard to gauge, and FAO data is unreliable. However, there has been substantial downward price pressure in recent years with prices below \$1.5/kg and often closer to \$1/kg. This corresponds to very slim profit margins or losses for less efficient farms, and Vietnam is currently seeking to reduce production with a view to restoring profitability.

It is clear therefore that although Cambodia has many natural advantages, it will be difficult to compete head on with the dominant aquaculture producers in the region, and a thorough understanding of national and regional markets will be essential if Cambodia is to compete successfully in future.

## **6. SOCIAL, ENVIRONMENTAL AND SUSTAINABILITY ISSUES**

Aquaculture is still relatively undeveloped in Cambodia, and the serious environmental and disease problems associated with highly concentrated and intensive aquaculture in other countries in the region are not yet evident here. Indeed, one of the reasons for increased activity of Vietnamese farmers in Cambodia relates to the good water quality and lack of chronic disease.

Should aquaculture development increase rapidly as has happened elsewhere however, these problems are likely to arise. Cambodia has a unique opportunity to put in place measures to prevent the negative effects often associated with over-rapid aquaculture development.

A significant part of aquaculture activity in Cambodia is dependent on the use of low value (“trash”) fish as a major component of food input. This represents an economic strength at the present time, since Cambodia has an abundance of low value fish that can be upgraded to high value fish through aquaculture, but as the industry grows the pressure on capture fishery resources, and possibility of reduced availability of low cost fish for the poor will have to be addressed. This issue is considered in more detail in section 4.4.

# 3

## POLICY CONTEXT



### 1. MILLENIUM DEVELOPMENT GOALS

Based on the UN Millennium Development Goals agreed in 2000, to which Cambodia was signatory, the country developed its own set of Cambodian Millennium Development Goals (CMDGs) supported by a large number of targets. Of particular relevance to aquaculture are CMDG1 (poverty and hunger); 4 (child mortality); and 5 (maternal health). The importance of fish in Cambodia in support of both child and maternal nutrition has been highlighted in the introduction to this strategy, and is particularly important with respect to iron, for which there are specific CMDG targets.

### 2. RETANGULAR STRATEGY

The retangular strategy has recently been revised, and in the latest draft (October 2013) statements relevant to aquaculture include:

Rectangle 1 (Promotion of Agriculture Sector);

Side 4: Sustainable management of natural resources

2. Management and conservation of fishery resources

- Implementing the strategic planning framework for fisheries sector 2010-2019

3. Environmental protection and sustainability

- Preparation of policies and regulations
- Implementation of the law (Environmental protection and the management of natural resources; Law on protected natural areas; and the Guideline on the Development of Coastal Areas)

### 3. NATIONAL STRATEGIC DEVELOPMENT PLAN (NSDP)

In the updated NSDP, promotion of aquaculture is one of policy priorities in fisheries reform. Key statements include:

The promotion of aquaculture is considered necessary to preserve fish resources for which the Royal Government will provide a package of assistance to fish farmers, including technology, seed, credit and market. To accomplish this, the appropriate actions have been set:

- encouraging the development of different kinds and scales of aquaculture, both inland and coastal to be a broad national movement, by implementing the Regional Code of Conduct for Responsible Aquaculture; and
- developing fish processing and packaging by encouraging large-scale investments and improving the fisheries infrastructure to increase competitiveness and market access.

Great care will be required implementing the second bullet point, since rapid development of most forms of commercial aquaculture is likely to undermine the rationale for aquaculture (considered necessary to preserve fish resources) as set down in the introductory paragraph.



#### 4. STRATEGIC PLANNING FRAMEWORK FOR FISHERIES (SPF)

The aquaculture strategy must nest within or at minimum be comparable and compatible with the Strategic Planning Framework for Fisheries – the key instrument designed to implement national policy in the fisheries sector, and now explicitly recognised in the new draft Rectangular Strategy. Under this strategy the vision for the fisheries sector is:

*Management, conservation, and development of sustainable fisheries resources to contribute to ensuring people's food security and to socioeconomic development in order to enhance people's livelihoods and the nation's prosperity.*

The strategy highlights an important role for aquaculture, and suggests it has “enormous long-term potential for Cambodia”.

*Aquaculture, at small, medium and large-scales, has the potential to very significantly increase production to maintain food security levels, increase employment opportunities and fuel an export drive. Likewise rice field fisheries have great potential for growth and for benefiting the rural economy.*

It commits FiA to a series of supporting activities (Annex 2) including in particular:

*Take immediate action to reduce the relative reliance on natural water bodies that are vulnerable to external threats (including climate change) by increasing the use of human-managed resources such as rice field fisheries and aquaculture.*

With regard to implementing the strategy in relation to aquaculture (section 4.3) “the main interventions will be to support small and family scale development, primarily through training, provision of fingerlings, and establishing risk management systems”. Four targets are highlighted in section 4.3:

1. At least 85,000 trained fish farmers actively engaged in aquaculture by the end of 2019;
2. Fish seed production is increased to 250 million per year by the end of 2019;
3. A surveillance, control and monitoring system for disease outbreaks is developed and implemented by the end of 2016
4. Research and development to identify commercially viable production of indigenous species in cooperation with regional interventions i.e. MRC

A large number of additional indicators and targets are presented in Annex 1 of the SPF, and these are cross referenced in the log frame annexed to this strategy.



## **5. THE REGIONAL GUIDELINES FOR RESPONSIBLE FISHERIES IN SOUTHEAST ASIA: RESPONSIBLE AQUACULTURE, AND CAMCODE**

Drawing on the higher level guidance in the FAO Code of Conduct for Responsible Fisheries, these documents prepared by SEAFDEC present a range of principles and guidelines for aquaculture development in the region and in Cambodia, covering issues including equity, poverty and gender, impacts on capture fisheries, disease monitoring and management, environmental protection and management, feed development and alien species.

## **6. IMPLICATIONS FOR THE AQUACULTURE STRATEGY**

The international and national policy context is complex, although the main themes are consistent. They include in particular:

1. Poverty alleviation and improved nutrition
2. Food security
3. Economic growth
4. Environmental sustainability
5. Participatory, enabling and effective governance systems

This aquaculture strategy seeks to strengthen an aquaculture sector that will contribute to all these higher level policy goals.

The SPF itself offers a set of sector specific goals, principles indicators and targets. This aquaculture strategy is consistent with the principles, and provides a roadmap for delivering SPF targets through strengthening of the sector at all levels.

More detailed guidance on how aquaculture might be developed and managed to ensure a sustainable, equitable and dynamic future is provided in the FAO Code of Conduct for Responsible Fisheries, the regional guidance on responsible aquaculture, and in Camcode. Many of the strategic actions in this strategy should contribute to implementation of these various codes and guidelines, and FiA and its partners will seek to abide by these principles in all its activities relating to aquaculture development.



# 4

## CURRENT STATUS OF AQUACULTURE IN CAMBODIA

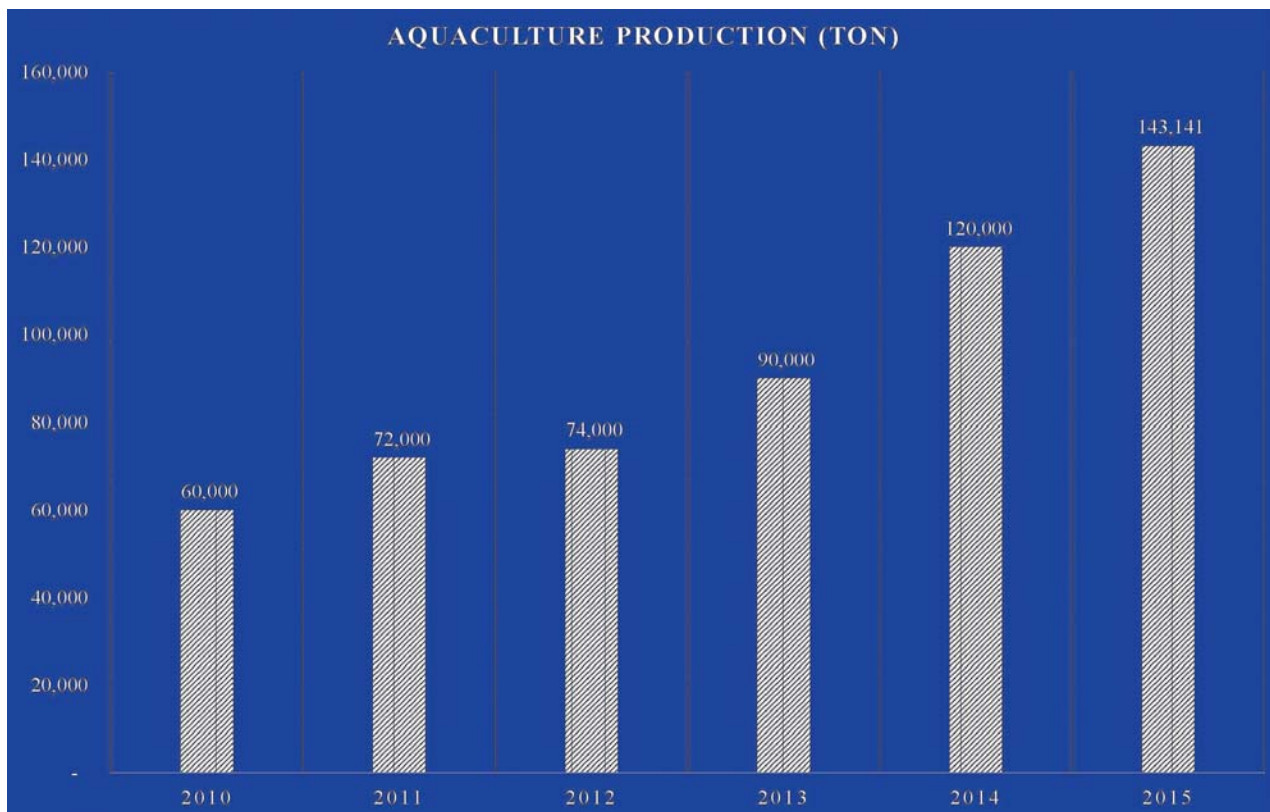


### 1. GEOGRAPHIC DISTRIBUTION AND PRODUCTION TRENDS

According to official government statistics, aquaculture in Cambodia has grown from around 14,000 tonnes in 2002 to 143,141 tonnes in 2015. Figure 3 shows the overall trend in aquaculture production, broken down by year 2010-2015 (FiA, 2016). The geographic distribution is illustrated qualitatively in Figure 4.

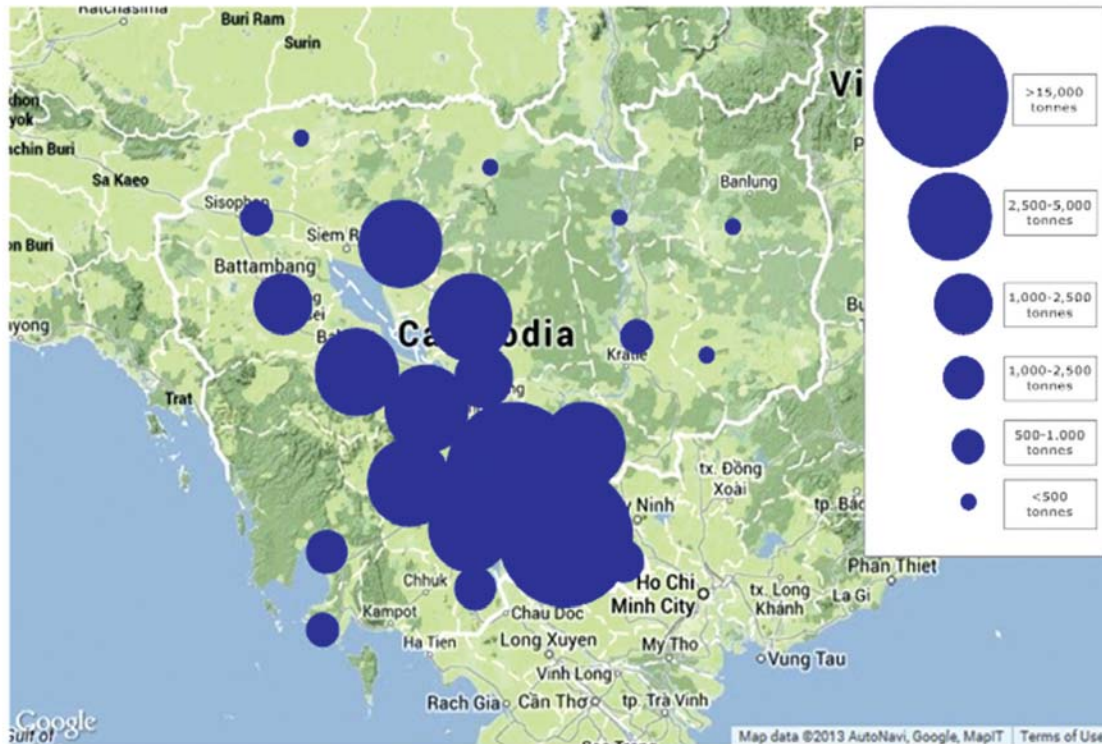
Aquaculture production is concentrated primarily where one would expect: in areas where soil, water and access to market are all relatively favourable. Cage aquaculture takes place primarily in the Great Lake, Tonle Sap and Upper Mekong. Most pond aquaculture is concentrated around Phnom Penh and in Kandal, with modest levels of production in Siem Reap, Takeo, Kampong Thom, Pursat, Kampong Speu, Kampong Chhnang and Prey Veng, and relatively small amounts in the remaining provinces.

**Figure 3: Aquaculture production trend in Cambodia 2010-2015**





**Figure 4: Geographic distribution of aquaculture production in Cambodia**



## 2. SYSTEMS AND SPECIES

Freshwater cage culture has been undertaken for many centuries, and continues to dominate aquaculture production, contributing roughly 50% of the total. The main species grown are giant snakehead (*Channa micropeltes*, 47%), pangas (*Pangasianodon hypophthalmus*, 27%) and hybrid catfish (*Clarias* 23%)<sup>6</sup>. The numbers of cages dipped significantly in the late 2000s in response to the ban on snakehead culture<sup>7</sup> but have climbed back up in the last two years probably due to wider availability of seed of pangas and hybrid catfish. Most cage culture takes place in the Great Lake (40%), the Tonle Sap (26%) and the Upper Mekong (18%) with the remainder primarily in the Lower Mekong and Brassac. Snakehead is fed exclusively trash fish; pangas and *Clarias* are usually fed low value “trash” fish mixed with rice bran and other ingredients in home-made feeds.

Freshwater pond culture has a shorter history, beginning in the 1960s. Although perhaps ¾ of production is from high input systems, the bulk of employment is in extensive or semi-intensive production. There is no accurate data on the number of households engaged in aquaculture, but this is estimated at around 66,654 in 2015.

<sup>6</sup> Official government figures for 2012

<sup>7</sup> This ban was introduced to conserve both wild fingerlings stocked in cages, and the excessive illegal use of small wild fish used as food





The main species grown in extensive and semi-intensive pond culture are pangasids (hatchery and wild sourced), silver barb, carps and tilapia (mainly hatchery sourced). Fertilization and a variety of feed supplements are used including rice bran, duckweed, termites, morning glory and fermentation wastes. In more intensive systems the main species are the same as those in cage culture – i.e pangas, snakehead and hybrid catfish. The latter has a significant advantage in being marketed at relatively small size, allowing for 2-3 crops per year. Feeding is similar to that used in cage culture.

Marine and brackishwater aquaculture is relatively little developed. There were some developments in shrimp aquaculture in the early 1990s, reaching more than 700t in 1995, but this declined due to disease, reliance on imported seed, and lack of skill. More than US\$0.5m has recently been invested in a large scale organic shrimp farm<sup>8</sup>, but production data is not yet available. Marine cage culture began in the late 80s and early 90s in Kompot and Koh Kong. It restarted in the early 2000's in Preah Sihanouk, Kampot and Koh Kong, based mainly on Seabass, Grouper and Cobia using wild and imported seed. Some seaweed farming took place in the mid-2000s under the auspices of a Malaysian company with production rising to more than 18,000t in 2005 but declined rapidly due to problems with stock, water temperature and disease. Now family scale seaweed farming is still producing in Kampot while blookcockle small scale is carried out in Preah Sihanouk, Kampot and Koh Kong Provinces.

Crocodile farming has grown rapidly with production increasing from 78,008 head in 2003 to 298,669 head in 2015. Most farming takes place in the Great Lake provinces of Siem Reap, Battambang, Banteay Meanchey, Kampong Thom and Kampong Chhnang, with some also in Preah Sihanouk Province. A large proportion of crocodiles are sold to Thailand as juveniles, where they are raised primarily for skin for the luxury clothing and accessory market. There appears to be a lost opportunity here to add value within Cambodia.

### 3. SEED PRODUCTION AND TRENDS

There has been rapid growth in production over the last decade from less than 20 million in the early 2000s to around 180 million in 2015. Nonetheless, 55% of seed is still imported and 13% sourced from the wild, with an estimated 32% being sourced from Cambodian hatcheries. 87% of domestic hatchery production is from private sector hatcheries.

In terms of species, most snakehead and pangasid seed is imported or sourced from the wild, while carps and Tilapia are more likely to be sourced from small scale hatcheries.

The number of private sector hatcheries is 307 in 2015<sup>9</sup> in which 294 are village hatcheries. However, distribution is uneven, with some provinces such as Ratanakiri, Kompong Cham, Kratie, Stung Treng having very few operational hatcheries while others (such as Phnom Penh) have many. However, a high proportion of non-functioning hatcheries is a feature in many provinces.

<sup>8</sup> See [http://devenco.com.kh/projects/project\\_details/5](http://devenco.com.kh/projects/project_details/5)

<sup>9</sup> Fisheries Administration 2015



#### 4. DEPENDENCE ON CAPTURE FISHERIES

Aquaculture is often presented and discussed as if it represents an alternative source of food production to capture fisheries, and furthermore, that as capture fisheries declines under pressure from increasingly intensive land use, infrastructure development (including roads, irrigation systems and dams) and fishing pressure, aquaculture can fill the demand gap, and furthermore allow for significant expansion of fishery production overall. This assumption is implicit in several higher level policy statements regarding aquaculture development.

Unfortunately, on the basis of current technology, this is far from the truth. Other than extensive pond aquaculture using fertilizer inputs only, all aquaculture production depends on feed inputs, and most of these feeds, especially in more intensive systems, include a substantial quantity of low value fish. This is true of the farm made feeds typically used for pangas farming (low value fish mixed with rice bran and a range of other ingredients) and the internationally traded compound pellet feeds which normally contain a significant percentage of fish meal, though increasingly – but only partially - replaced with vegetable proteins. The relative amount of fish in different fish diets varies significantly, but in most cases more than 1kg of low value fish is used to produce 1kg of farmed fish. For carnivorous species fed exclusively on low value fish, more than 4kg (and often closer to 7kg) of wild fish is used to produce 1kg of farmed fish.

This is not in itself a bad thing, because the conversion of low value fish to high value fish generates income and value added. It does mean however that aquaculture is not a solution to the difficulties in management of capture fisheries, nor to the limits to production implicit in a renewable natural resource. Indeed as aquaculture increases it will represent a significantly increased pressure on capture fisheries, with a strong incentive to fish for mixed small fish irrespective of their potential to grow into larger more valuable fish, their potential to be directly used as highly nutritious food by poor people, or their potential for conversion to other products such as prahok and fish sauce. There is a real danger that high quality food for the poor will be increasingly appropriated by relatively few large businesses, and converted to more expensive fish for sale in the cities and export markets. WorldFish Center has estimated that for its “best bet pathway” to achieving 188,000t aquaculture production would require 250,000t of wild fish as feed – or around 40% of total inland fisheries production.

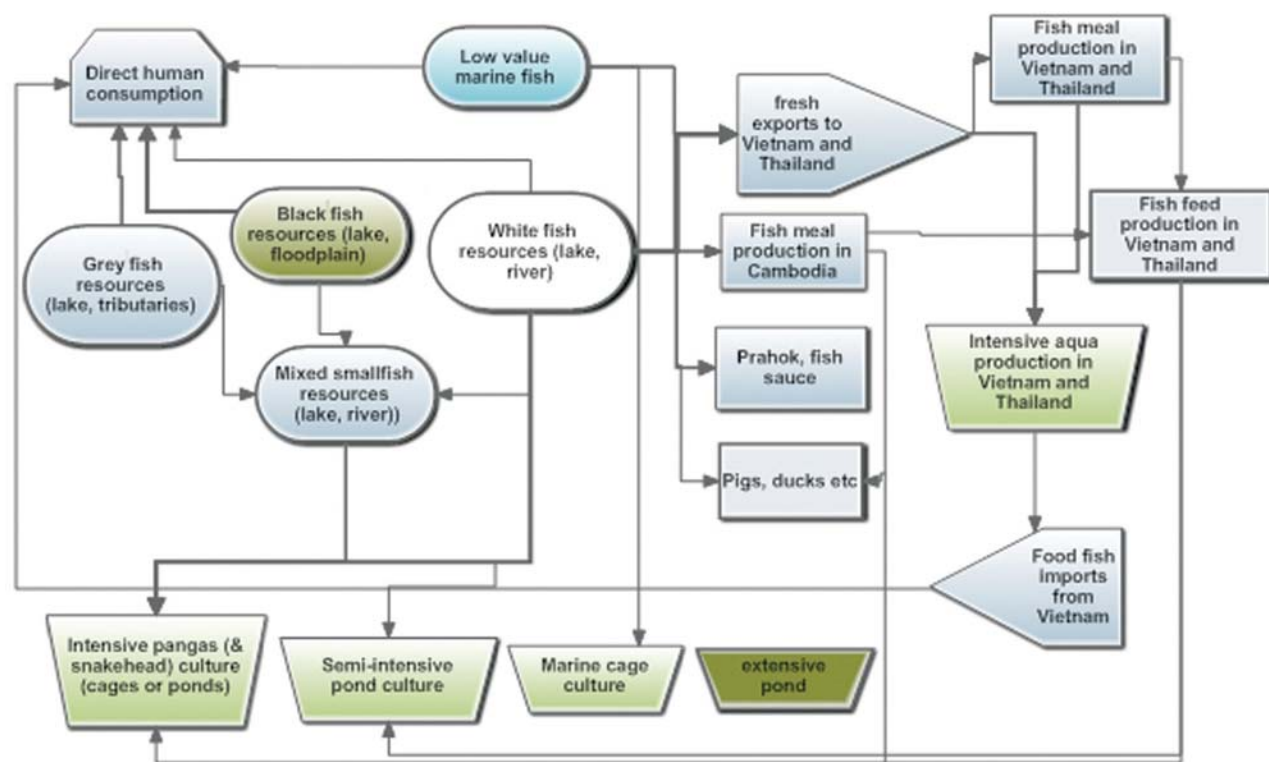
The use of Cambodia’s abundant and valuable fishery resources is illustrated in Figure 5. It is important not only that this resource is well managed, but that it is used as efficiently as possible to meet the needs of both nutrition and economic growth. Aquaculture undoubtedly has a role to play in adding value to this resource within Cambodia, but it is incumbent on the sub-sector to ensure that it is used efficiently, and that value added is maximised for every unit of this finite resource that is used. Furthermore if fish





farmers in Cambodia can use low value fish more efficiently than their competitors in Vietnam and Thailand, then they will be able to pay slightly more, and ensure that a greater proportion of the resource is subject to value added within the country.

**Figure 5: The use of Cambodia's fishery resources**



## 5. PERFORMANCE AND EFFICIENCY OF DIFFERENT AQUACULTURE SYSTEMS

It is important to understand that different forms of aquaculture contribute in different ways to national development needs, and present different challenges in terms of sustainability.

A key issue relates to the efficiency of resource use, since this has implications for economic efficiency, natural resource use efficiency, and environmental impact. Different systems are more or less efficient in terms of productivity per unit of land, labour or feed input. Usually there are trade-offs between these – systems which are low in terms of productivity per unit area of land may be high in terms of productivity per unit feed input, and vice versa. Different forms of aquaculture may meet different policy objectives, and may be more or less appropriate depending on the nature of resource constraints and relative costs.

The strengths and weaknesses of different forms of aquaculture as practiced in Cambodia are summarized in Table 2. The strengths and weaknesses of aquaculture production in Cambodia in general are discussed in Section 5.



**Table 1: Strengths and weaknesses of different aquaculture systems**

Aquaculture system/species	Strengths	Weaknesses
Rice field aquaculture	<ul style="list-style-type: none"> <li>• Low capital</li> <li>• Low feed input</li> <li>• May enhance rice yield in organic systems</li> <li>• Supplements rather than replaces rice production</li> </ul>	<ul style="list-style-type: none"> <li>• Limited production per unit area</li> <li>• Species used typically low value</li> <li>• Risk of loss of stock from flooding and theft</li> </ul>
Low input tilapia and carps pond polyculture systems	<ul style="list-style-type: none"> <li>• Low input costs</li> <li>• Limited pressure on capture fishery resources</li> <li>• Relatively low disease risk</li> <li>• High profit margin and value added per unit production - resilient to changes in input prices</li> </ul>	<ul style="list-style-type: none"> <li>• Relatively high capital costs (ponds) per unit production</li> <li>• Relatively low production per unit area used</li> </ul>
High input freshwater and brackishwater pond culture	<ul style="list-style-type: none"> <li>• High production per unit area of land</li> <li>• High profit per unit area of land during favorable market conditions</li> <li>• Large regional and global markets</li> <li>• Good potential for processed and value added products</li> <li>• Potential for export earnings.</li> </ul>	<ul style="list-style-type: none"> <li>• High input costs</li> <li>• Significant pressure on capture fishery resource</li> <li>• Slim profit margins and low value added per unit production</li> <li>• High risk of disease</li> <li>• High financial risk – sensitive to disease losses, increased input costs or reduced market price.</li> </ul>
Freshwater and marine cage culture	<ul style="list-style-type: none"> <li>• Relatively low capital costs per unit production</li> <li>• Ease of husbandry and observation</li> <li>• Year round production</li> <li>• Good markets for most species</li> </ul>	<ul style="list-style-type: none"> <li>• Limited high quality accessible sites</li> <li>• High input costs</li> <li>• Significant pressure on capture fishery resource</li> <li>• Slim profit margins and low value added per unit production</li> <li>• High risk of disease</li> <li>• High financial risk – sensitive to disease losses, increased input costs or reduced market price</li> </ul>
Brackishwater pond culture	<ul style="list-style-type: none"> <li>• Very high production per unit area of land</li> <li>• High profit per unit area of land during favorable market conditions</li> <li>• Large regional and global markets</li> <li>• Good potential for processed and value added products</li> <li>• Potential for export earnings.</li> </ul>	<ul style="list-style-type: none"> <li>• Potential for pollution of water body</li> <li>• High input costs</li> <li>• Significant pressure on capture fishery resource</li> <li>• Slim profit margins and low value added per unit production</li> <li>• High risk of disease</li> <li>• High financial risk – sensitive to disease losses, increased input costs or reduced market price.</li> </ul>



Since feed is a key input to most modern aquaculture systems, food conversion rate (feed input/fish production, FCR) is a widely quoted measure of performance. However this is a purely quantitative ratio, and gives little indication of resource use efficiency in terms of social-economic benefit generated per unit of resource used – a more important objective from a strategic economic development perspective. This might be measured for example in terms of value added per unit of feed (dry weight equivalent), perhaps more rigorously as value added per unit of protein or fishmeal used. This is referred to in this report as economic food conversion efficiency (EFCE). EFCE varies significantly between species, and depends on the nutritional needs of the fish, the food conversion efficiency (FCR), and the market price of the product. Based on current prices and technology as used in Cambodia, pangas production has a very low EFCE, snakehead probably has somewhat higher EFCE, and low input systems generally have high EFCE. Given the need to use the capture fishery resource efficiently, EFCE is used as a key indicator for successful implementation of the strategy.

Otherwise, it is clear that the various forms of aquaculture all have strengths and weaknesses, and an economically resilient aquaculture sector which meets the needs of a range of policy objectives should therefore be diverse, encompassing all the major forms of aquaculture as set down in Tables 1 and 2.

## 6. GOVERNMENT AND DONOR SUPPORT

Government support to the aquaculture sector is provided primarily through the Fisheries Administration's Department of Aquaculture Development (Office of Administration and Extension; Office of Freshwater Aquaculture; Office of Marine Aquaculture; Office of Community's Fish Refuge Pond). Its work is implemented through officers in the FiA Inspectorate and at Cantonment level. Other relevant departments of FiA include Fisheries Post-harvest Technologies and Quality Control, the National Institute of Aquaculture Research and Development, and the newly established Marine Aquaculture Research Development and Extension Center. Further scientific support may be offered by Inland Fisheries Research and Development Institute and the Marine Fisheries Research and Development Institute. Thirteen hatchery "centres" serve the more practical needs of broodstock research, development and maintenance as well as some seed production.

This government support is supplemented by significant expertise in aquaculture research within the WorldFish (CGIAR) Center which has an active regional office in Phnom Penh, and the activities of Development partners in the form of direct support through aquaculture support projects (e.g. JICA FAiEX and USAID Harvest) and indirect support through rural development NGOs.

Most extension support is from development partners and relatively high quality, but limited in both time and space. Extension messages may be mixed, reflecting particular perspectives associated with different Development Partners or implementing NGOs. There is no consistent, coordinated, motivated, country-wide, long term advisory framework or delivery system.

# 5

## STRENGTHS AND WEAKNESSES OF AQUACULTURE IN CAMBODIA



The main strengths and weaknesses of aquaculture in Cambodia have been summarized in the background and status sections and are summarized in Table 3. Opportunities and threats are discussed in more detail in section 6.

**Table 2: Strengths and weaknesses of aquaculture in Cambodia**

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• Favourable temperature regime</li> </ul>	<ul style="list-style-type: none"> <li>• Dry season extremes</li> </ul>
<ul style="list-style-type: none"> <li>• Abundant water across much of country for 6-9 months</li> </ul>	<ul style="list-style-type: none"> <li>• Dry season shortage (March-May) across most of the country</li> <li>• Uncontrolled flooding in many areas</li> </ul>
<ul style="list-style-type: none"> <li>• Significant irrigation infrastructure in some parts of the country; substantial investment and upgrading underway</li> </ul>	<ul style="list-style-type: none"> <li>• Large parts of system poorly maintained, and management weak</li> </ul>
<ul style="list-style-type: none"> <li>• Suitable soil for ponds across much of country</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of clarity regarding land title, may be a disincentive to investment and limit access to finance/credit</li> </ul>
<ul style="list-style-type: none"> <li>• Many existing under-utilised ponds and water bodies</li> </ul>	
<ul style="list-style-type: none"> <li>• Strong household, local, national and regional demand for fish and fish products</li> </ul>	<ul style="list-style-type: none"> <li>• Prices seasonally low, associated with abundant wild fish</li> <li>• Significant inter-annual price variation related to varied production of capture fisheries</li> <li>• Poor market information available to farmers at local and national level</li> </ul>
<ul style="list-style-type: none"> <li>• Low labour costs</li> </ul>	<ul style="list-style-type: none"> <li>• Limited skills and educational standards; outmigration</li> <li>• Limited business skills and product marketing strategy</li> </ul>
<ul style="list-style-type: none"> <li>• Ready supply of low value “trash” fish and rice bran that can be used as cost effective and reliable aquaculture feed</li> </ul>	<ul style="list-style-type: none"> <li>• Dependency on capture fishery:               <ul style="list-style-type: none"> <li>- increases pressure on wild fishery</li> <li>- reduces availability of low cost fish to poor</li> <li>- may reduce “downstream” value added</li> </ul> </li> <li>• Home made feeds often poor quality leading to inefficient use of trash fish</li> </ul>



Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• Ready supply of good quality pelleted fish feeds</li> </ul>	<ul style="list-style-type: none"> <li>• All pelleted feeds imported from Vietnam and Thailand</li> <li>• Very limited quality assurance</li> <li>• Informal “taxes” lead to high transport costs</li> </ul>
<ul style="list-style-type: none"> <li>• Ready supply of fry and fingerlings</li> </ul>	<ul style="list-style-type: none"> <li>• Most seed currently imported</li> <li>• Very little quality assurance</li> </ul>
<ul style="list-style-type: none"> <li>• Relatively little disease so far</li> </ul>	<ul style="list-style-type: none"> <li>• Poor national and local biosecurity</li> <li>• Disease prevention and management systems poorly developed</li> </ul>
<ul style="list-style-type: none"> <li>• High water quality in many areas</li> </ul>	<ul style="list-style-type: none"> <li>• No strategy, plans or regulations to guard against cumulative impacts in excess of environmental capacity</li> </ul>
<ul style="list-style-type: none"> <li>• Many indigenous fish species that might be domesticated, and history of research on such species</li> </ul>	<ul style="list-style-type: none"> <li>• Limited follow through or sustained production of some promising indigenous species</li> </ul>
<ul style="list-style-type: none"> <li>• Government hatcheries throughout most of the country, and significant hatchery skills across government, private sector and NGO</li> </ul>	<ul style="list-style-type: none"> <li>• Most government hatcheries underperforming, with poor management and protocols</li> <li>• Lack of clarity of role and function of government hatcheries</li> </ul>
<ul style="list-style-type: none"> <li>• Increasing numbers of private sector hatcheries</li> </ul>	<ul style="list-style-type: none"> <li>• Limited access to high quality broodstock</li> <li>• Poor biosecurity</li> <li>• Poor protocols and stock management</li> </ul>
<ul style="list-style-type: none"> <li>• Significant history of training and capacity development in freshwater aquaculture</li> </ul>	<ul style="list-style-type: none"> <li>• Historic training mostly project based with no long term national strategic extension support</li> <li>• Leakage of trained personnel at higher levels to other sectors/activities</li> </ul>
	<ul style="list-style-type: none"> <li>• Lack of electricity at many sites</li> <li>• Relatively high electricity and fuel costs</li> </ul>

This summary analysis suggests that while there is significant potential for further aquaculture development in Cambodia there are significant challenges, and concerted efforts will be required to ensure a dynamic and sustainable future.

# 6



## OPPORTUNITIES FOR AQUACULTURE DEVELOPMENT

Opportunities depend to a large degree on the scale of aquaculture enterprise envisaged. There is no strict boundary between small and large scale aquaculture – indeed there is a continuum in terms of both scale and other characteristics. Nonetheless, for the purposes of this strategy:

- Small scale means an enterprise requiring less than 1 full time person, operated as part of a wider family based agricultural or fishing enterprise.
- Small to medium scale (SME) enterprise is an enterprise requiring at least 1 full time person, but based largely on family labour and occasional part time labour.
- Large scale means a full time specialist enterprise with an owner/manager and more than one full time employee.

### 1. OPPORTUNITIES FOR SMALL SCALE AQUACULTURE

There is a substantial history of support for small scale aquaculture in Cambodia dating back to the late 80s and early 90s. This support has encompassed:

- Promotion of community fisheries – exploiting, enhancing and sharing the benefits to be derived from well managed (and in some cases artificially stocked) community ponds and associated aquatic habitat.
- Promotion of rice field fisheries – with some stocking of small connected ponds and ditches.
- Support for digging ponds capable of serving multiple functions of fish rearing, irrigation and household use.
- Support for small scale fish breeding and nursing using small ponds and “hapas”
- Support for low intensity farming based primarily on on-farm resources, but using supplements where appropriate to optimize utilization
- Support for small scale fish breeding using small cement hatcheries in addition to ponds (e.g. JICA FAIEX)
- Support for more intensive small scale pond production using appropriate fertilization and/or commercial pellet (e.g. USAID HARVEST project)
- Support for strengthening farmer networks and association



Many of the historic projects associated with these activities have had rather little long term impact - in part because of poor markets for cultured fish compared with preferred wild species; in part because of the relatively small increment to income generated by low input fish farming of a small pond; and in part because of the project based nature of most interventions and the lack of longer term consistent extension support. Nonetheless around 40,000 households are engaged in the production of more than 10,000 tonnes using this form of aquaculture, and the impact of this on nutrition and poverty alleviation is likely to be considerable.

Furthermore, the market preference for wild species is likely to be changing, or at least, the absolute value of farmed species appears to be increasing, and is likely to increase further as wild stocks decline. Furthermore, projects such as FAIEX and HARVEST, by encouraging modest intensification, are helping farmers generate more significant income, which is desirable in its own right but may also encourage some farmers – and especially those in the most favourable locations, to invest in more ponds or cages and become SMEs, and in some cases large scale fish farmers.

There are however inherent risks in encouraging intensification, given the significant costs of inputs, substantial risks associated with flooding in some areas, limited or poor quality water at the end of the season, highly seasonal market prices, and the ever present threat of disease. A combination of poor feeding practice and one of these external factors may lead to significant losses, and in some cases debt. Furthermore, in the medium term, lower cost production from SME and large scale aquaculture will be a major threat, along with cheap imports from abroad. Indeed, as the sector develops it is inevitable that many small scale producers will fail to compete with those with more resources or skills or both. Either way, without increasing understanding of markets, input productivity, and farm finance (basic business skills) – small scale farmers using relatively intensive techniques will find it hard to survive. In any case low input systems should not be abandoned. Low input rice-fish and low input polyculture systems, while generating less income per hectare, may nonetheless become more competitive as the price of inputs – and especially feed - rises (and there is no doubt that it will).

Despite the constraints and risks therefore, there remain significant opportunities for small scale aquaculture, and RGC will continue to support its more widespread development. The main conditions for success of small scale aquaculture will include:

- Wider availability of reasonably priced high quality seed of a range of species.
- Wider availability of reasonably priced high quality fish feeds suitable for a range of species.
- Better understanding of both the technical and the business (finance, marketing, risk) dimensions of aquaculture production

Given the substantial costs implicit in support for a large number of smaller scale producers, the RGC will continue to depend on significant help from development partners. It is important however that this support is coordinated, consistent, longer term, builds on historic lessons, and adjusts to commercial and economic realities as these evolve.



## 2. OPPORTUNITIES FOR SMALL-MEDIUM SCALE AQUACULTURE

Small to medium scale aquaculture (i.e. small business focused on aquaculture production) has been given rather little attention in the past from either government or development partners. There is now increasing interest in this sub-sector as a means of achieving economic development, employment generation and more efficient production of fish compared with small scale operations.

The potential for SME development in Cambodia is particularly good. Domestic demand is high, related to the long tradition of eating abundant wild fish and the likely decline of wild capture fisheries in the future. SMEs are particularly well placed to found businesses based on domestic markets, and then expand into high value regional markets.

The constraints are also significant. Although Cambodia has significant history of research and development of breeding a wide range of indigenous species, this work has not been fully consolidated or commercialized. Good quality seed of a range of suitable species are not available, and the likelihood is that emerging SMEs will be forced to grow the relatively abundant pangas or hybrid catfish, and be faced with serious competition from imports or larger scale producers and relatively low prices. In addition many emerging SMEs with significant skills and experience are constrained by lack of land or poor water supply. They may also lack finance and business/marketing expertise.

A new approach is therefore required to facilitate development of this potentially important sub-sector. In so far as there are fewer SMEs than small scale producers, the challenges of effective support should be somewhat less. The main conditions for success of small-medium scale aquaculture are similar to those for the small scale sector, but with several additions:

- Ready access to reasonably priced high quality seed of a range of species in demand in domestic and regional markets
- Ready access to reasonably priced high quality fish feeds suitable for a range of species
- Improved understanding of both the technical and the business (finance, marketing) dimensions of aquaculture production
- Access to more or better land and year round water resources to allow for sustainable expansion of the business
- Access to credit for business expansion

While many of these conditions are common to all scales of enterprise, it is arguable that a tailored support programme for SMEs focusing on business development support, appropriate finance, and facilitating access to better or more land and water resources could be justified.



### 3. OPPORTUNITIES FOR LARGE-SCALE AQUACULTURE

The natural advantages of Cambodia and its strategic position suggest that larger scale commercial aquaculture in Cambodia could generate significant quantities of farmed fish and be regionally competitive. There are advantages and opportunities related to good water quality, ready access to low cost trash fish (at least seasonally), relatively little disease (as yet), the wide range of species that might be cultured, and relatively good access to strong regional markets. Many of the constraints on small scale aquaculture do not apply to larger scale; and in general terms larger scale enterprises are likely to be able to produce fish more efficiently. However, an emerging commercial sector faces several significant challenges:

- There is as yet no large scale processing factory operating to international standards, nor is there effective containerized logistics through which to access regional and international markets
- Vietnam dominates the world market in frozen and other processed catfish (pangas) and has surplus production and processing capacity. Vietnam, Thailand and China are all highly efficient aquaculture producers with substantial infrastructure in place which is effectively “written off”. Margins for regionally and internationally traded products are extremely slim and in some cases negative, and it will be very difficult for Cambodian producers to compete successfully in the medium term and generate adequate return on investment.
- Existing technology for intensive pangas production is inefficient in terms of wild fish resource use, generating little added value per unit of wild fish consumed.
- While there appear to be large sheltered but well flushed areas suitable for marine fin-fish culture, many of these sites are not available because of prior usage rights allocated to tourism interests.
- The country remains highly dependent on imported seed of dubious quality and a relatively limited range of species.
- Lack of business enabling environment quality infrastructure and legal framework governing fishery products limiting the access to and integration into ASEAN market.

For the country to be successful there will need to be a major strategic effort to ensure sufficient low cost seed of higher value species is available to meet market demand, improved efficiency in the utilisation of trash fish as feed, the ability to access sites in favourable locations, high levels of business and market acumen, better market information, and an effective planning and management system that will prevent over concentrated and unsustainable development.

Finance is available, but there may be opportunities for partnerships between financiers and technical/business support to grow sustainable aquaculture companies. The main requirement here will be for the identification and possibly designation of zones suitable for large scale aquaculture development, around which support and development efforts could be focused.



#### 4. CONTRIBUTION TO DEVELOPMENT OBJECTIVES

Using detailed scenario analysis, and taking an “optimal” pathway, they project 2024 total production of 740,000 tonnes . Farm infrastructure investment would be \$200 million generating an annual net income of \$127 million for half a million households of which 85% are small holder farmers.

**Table 3: Contribution of aquaculture to development objectives**

Bright green represents strong contribution with paler shades lesser contribution. Pink represents a possible negative impact.

Development objectives	Small scale aquaculture		SME	Large scale	
Improved nutrition and food security (household level)	Capable of producing small amounts of low cost nutritious fish		Will be driven by high value niche market opportunities rather than nutrition	Tendency to produce large quantities of relatively low cost fish (positive)	Increasing pressure on wild fish resources (negative)
Poverty alleviation (increased income)	Significantly increased income possible	But even modest intensification associated with significant risk	Will significantly improve livelihoods of significant numbers of producers and traders	Limited impact; indeed may be negative since small scale producers will not be able to compete	
Food security (national level )	Limited contribution		Modest contribution	Large quantities of relatively low cost fish	May be at the expense of wild fish
Economic growth (employment)	Modest		Significant	Modest. At sufficient scale, significant jobs are created in processing	



Development objectives	Small scale aquaculture	SME	Large scale
Economic growth (value added)	Very little	Modest to significant. With sufficient variety of species and markets value added could be very high	Modest. Income is high, but value added may be a very small proportion of this
Export earnings	Very little	Could be significant at regional level	Significant. However as production increases and switches to the use of pelleted feeds, the import content of inputs will increase, reducing net export earnings
Sustainability	High	Continued dependence on inefficient use of trash fish is problematic, but value added per unit input should be higher.	Continued dependence on inefficient use of trash fish is problematic; Environmental pollution and chronic disease are commonly associated with larger scale intensive production

It is clear from this analysis that aquaculture can make a significant contribution to poverty alleviation, improved nutrition, food security and economic growth. Through its interaction with fisheries it also has the potential to negatively affect the availability of wild fish to the poor; and over-rapid/over-concentrated development of intensive culture could have negative environmental effects, lead to chronic disease problems, and financial insecurity. These issues are summarized in Table 4.

Small, medium and larger scale aquaculture all have their role to play in delivering policy objectives, at least in the short and medium term. In the longer term it may be that small scale aquaculture will not be able to compete effectively in the market place, and its relative importance in delivering development targets may be reduced.

It is notable that while all scales of aquaculture have potential, SME looks particularly attractive, being more competitive than small scale aquaculture while at the same time making significant contribution to both employment and income. Furthermore, a fair number of SMEs are likely to be more flexible and responsive to changed input costs and market conditions than larger scale aquaculture.



#### 4.1. SUSTAINABILITY AND ENVIRONMENTAL IMPACT

Fish farming in the region has a very mixed record in terms of sustainability, and indeed is largely characterized by boom, bust and environmental degradation.

Shrimp farming in Thailand, Vietnam, and China, and pangas farming in Vietnam have all been characterized by over-concentrated and poorly planned development, over intensive production resulting in high losses from disease, poor broodstock and seed quality, and significant organic and chemical pollution. These problems have been compounded by over-production, falling prices and widespread debt.

There is a great opportunity here for Cambodia to learn from the mistakes of its neighbours and create a facilitating but regulated environment, so that the problems of pollution and overproduction are avoided.

Intensive aquaculture involves high feed inputs – typically comprised of fresh trash fish or fish meal mixed with a wide variety of other feed ingredients in farm-made or commercially manufactured pellets. Despite much historic and continuing research, and fish meal and/or fresh fish remain as cost effective ingredients of aquaculture feeds. This applies particularly in Cambodia because of the availability of low cost (if seasonal) “trash” fish. The use of this limited and often poorly managed renewable natural resource remains a major question mark over the sustainability intensive aquaculture at global and national level, and aquaculture cannot continue to expand unless it is able to increase the efficiency with which it uses this resource.

#### 5. IMPLICATIONS FOR STRATEGIC PRIORITIES

Taken together, the analysis of strengths and weaknesses of aquaculture as whole, and the potential for different scales of aquaculture summarized above suggests the following strategic priorities:

- The need to conserve the fishery resource; and in order to expand aquaculture production the necessity to use fish as feed more efficiently
- The need for diversity: a mix of species/systems and scale of enterprise:
  - to meet a range of development needs
  - to increase flexibility and responsiveness to market, economic and environmental change
- The need for a wider range of high quality seed available in sufficient quantities, at reasonable price, in the right places, at the right times.
- The need for good technical training and advice, development of business and marketing skills, and access to good market information.
- The particular opportunities for SMEs.

Feed, while important, is not at present a critical economic constraint (though some immediate action is required with regard to quality assurance). Compound feed is an international commodity which can be imported at reasonable price, and Cambodia has something of a comparative advantage in the ready availability of seasonally available trash fish which can be stored for several months and used as a cheaper

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partial substitute.

## A VISION FOR AQUACULTURE IN CAMBODIA IN 2030



### 1. GOAL

Given the aim of the strategy as set down in the introduction, the policy context as set down in section 3, the following is taken as the overall objective or goal for the strategy:

*a commercially viable and environmentally sustainable aquaculture sector contributing to food security and nutrition, socioeconomic development, GDP and export earnings.*

Taking account of the issues and potential highlighted in previous sections, it is also useful to translate this goal into a more detailed picture of what aquaculture in Cambodia might look like in 2030 – its potential future status if the strategy were to be completely successful.

### 2. A VISION FOR AQUACULTURE 2030

Cambodia is respected throughout the region and in global seafood markets as having developed a strong, diverse and sustainable aquaculture sector meeting the nutritional needs of the poor as well as growing demand for high value fishery products in national, regional and international markets. A wide range of added value products are produced at both local and national level, and total value added in the sector makes a significant contribution to GDP. The fish and fish products are of high quality, and safe to eat. Small to medium-scale aquaculture has remained viable and competitive by improving its efficiency and producing a range of medium to high value fish for local and national niche markets. Low cost but nutritionally valuable fish are also produced as a by-product of these enterprises, and also through enhanced rice field fisheries and small “back-yard” pond production systems. A proportion of wild low value fish from both freshwater and marine sources is still used as an input to aquaculture production, primarily after conversion to fish-meal and incorporation in high quality fish feeds formulated specifically for each species or genus. A strict regime is however in place to ensure that this resource is sustainably managed, and Cambodia claims the highest ratio of value added to wild fish input to aquaculture in the region. Commercial aquaculture is highly efficient and produces a smaller range of medium to high value species with niche markets in the region and globally. Most of these farms have some form of quality and/or sustainability accreditation. All operate to national best management practice standards, and according to commune or district level environmental management plans. A relatively small but highly efficient processing sector produces export quality products meeting all international food safety and quality standards.



### 3. OVERALL PERFORMANCE INDICATORS

A strategy should have a means of measuring achievement against its overall goal. The various dimensions of the goal are summarized in table 5, along with high level indicators of progress, and how these indicators might be measured in practice.

Development objective	Performance measure	Supporting data
Poverty alleviation (socio-economic development)	<ul style="list-style-type: none"> <li>• Increased income and/or nutritious food availability for the poor</li> </ul>	<ul style="list-style-type: none"> <li>• Rural livelihoods survey</li> <li>• Per capita consumption of fish</li> </ul>
Food security	<ul style="list-style-type: none"> <li>• Ratio of national production to imports</li> </ul>	<ul style="list-style-type: none"> <li>• National statistics</li> </ul>
Economic growth (GDP)	<ul style="list-style-type: none"> <li>• Sum of value added for the aquaculture sector including upstream and downstream activities</li> </ul>	<ul style="list-style-type: none"> <li>• Combination of periodic sector survey and national statistics</li> </ul>
Employment generation (socio-economic development)	<ul style="list-style-type: none"> <li>• Employment in the aquaculture sector</li> </ul>	<ul style="list-style-type: none"> <li>• National statistics</li> </ul>
Export earnings	<ul style="list-style-type: none"> <li>• Net export earnings of aquaculture sector (export value less imports value of feed, seed and other inputs)</li> </ul>	<ul style="list-style-type: none"> <li>• National statistics on exports plus periodic survey on import content of production</li> </ul>
Sustainability	<ul style="list-style-type: none"> <li>• Ratio of value added to fish input as feed (value and quantity)</li> <li>• Water quality in aquaculture zones</li> <li>• Incidents of chemical contamination in aquaculture products</li> </ul>	<ul style="list-style-type: none"> <li>• Periodic sector sample survey</li> </ul>



**Table 4: High level performance indicators for the aquaculture sector**

Production itself (i.e. tonnes of aquaculture production) is not a useful measure of any of the development objectives listed above or of the goal as a whole, and will not therefore be used as a performance measure for the successful implementation of this strategy - though it may be used as part of the calculation of other performance measures. Its widespread use as a headline indicator often acts as a perverse incentive. Rapid increase in production typically results in marketing problems, lower prices, reduced value added, and inefficient use of limited natural resources. This has already occurred with pangas farming in Vietnam and shrimp farming in China and Thailand. This strategy will use value added as the primary measure of economic benefit, and shorter term implementation plans should also use value added (or contribution to GDP) rather than production targets. Its use in the SPF, along with specific production targets is unfortunate, and a revised SPF should adopt the use of value added rather than production as a key performance measure. The SPF 20% annual production growth target can be replaced with 15% sector GDP growth.

Sustainability is multi-dimensional and arguably needs a wide range of indicators. For the purposes of this strategy however we highlight an indicator which addresses the main environmental pressures arising from aquaculture development, and integrates this with the primary measure of economic benefit. A high ratio of value added to the quantity of wild fish used as aquaculture feed measures how efficiently we are using the main natural resource input for delivery of the main economic benefit. Furthermore, a high value for this indicator is also likely to result in less waste feed and other fish wastes entering the natural environment and causing pollution. This is an innovative and important indicator which is relatively easy to estimate through periodic (5year) sample survey.

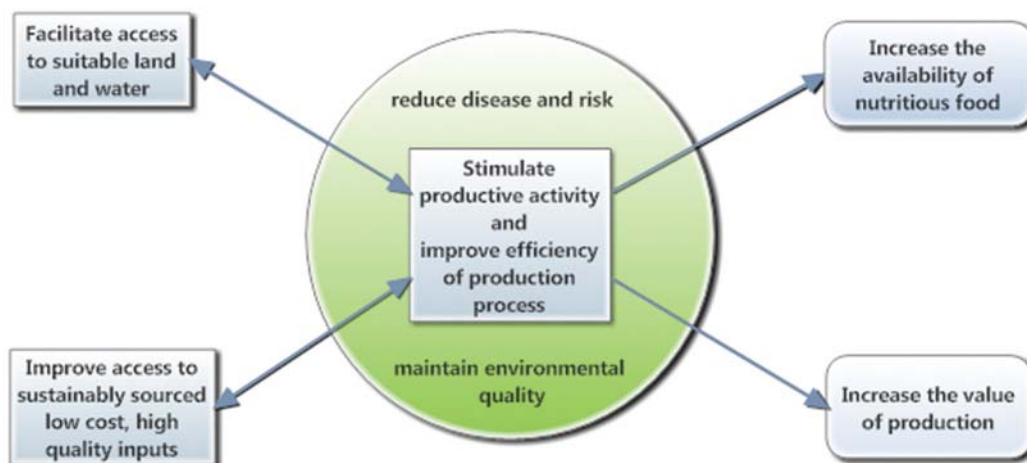
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## A FRAMEWORK FOR ACTION

An effective strategy designed to realise the goal and vision must draw on an understanding of the whole system of aquaculture production, and an analysis of opportunities and constraints in relation to each part of that system. Overall priorities for action can then be determined.

The following diagram (Figure 6) summarizes the key elements or components of the aquaculture production system in Cambodia, and the key outputs or benefits generated.



**Figure 6: Elements of a strategy for aquaculture development**

The following 7 strategic objectives serve as a practical framework to address the key issues related to these various elements:

1. To increase access to high quality seed for a range of species in demand in local, regional and global markets
2. To increase access to sufficient and consistent supplies of high quality water, and to reduce flood risks
3. To ensure widespread availability of sustainably sourced, reasonably priced, high quality feed suitable for a range of species



4. To improve efficiency, profitability and sustainability of aquaculture production through increased knowledge, skill and organisation
5. To maintain environmental quality and minimize loss from disease
6. To increase the quality and value of production
7. To facilitate access to credit as appropriate to the needs, potential and risks associated with aquaculture development.

Delivery of all these objectives will require a more effective enabling policy, legal and institutional framework.

Strategic actions relating to each of the above objectives are presented in the logical framework (Annex 1).

The rationale and priorities for these actions are discussed in the next section.

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## STRATEGIC PRINCIPLES AND PRIORITIES

There are weaknesses and opportunities relating to all the key elements of Cambodia's aquaculture economy as portrayed in Figure 6, and strategic actions are required in relation to all the proposed objectives. These actions are explained and summarized in the following sections, and set down more rigorously in the Logical Framework Analysis (Annex 1).

In addition there is a need for overall strategic guidance in implementing these actions, and this is provided in the form of a guiding principle.

### 1. A GUIDING PRINCIPLE: DIVERSITY, SUSTAINABILITY AND VALUE

Even at local level, Cambodian fish farmers must compete in a regional market –which will include wild and farmed fish from Cambodia and adjacent countries. Other countries in the region are more advanced in aquaculture production – in terms of infrastructure, scale, technology, timing of production, and capacity to distribute product. Cambodia on the other hand has the advantage of good water quality, limited serious disease, broadly favorable climate, abundant seasonal low cost fish that can be used as high quality feed, low wages (though these are rising), a growing demand gap for freshwater species in local markets, and a wide range of species with aquaculture potential.

It is unlikely that Cambodia will be able to compete with Vietnam and Thailand in the major arenas of mass production of pangas and whiteleg shrimp for international markets; or if it does, the margins will be slim, benefits limited and investment unlikely to be recouped. There are however substantial opportunities associated with a large range of higher value freshwater, brackishwater and marine species in both local and regional markets. To develop technologies, skills and marketing channels for these species will take time and investment, and the rate of increase of production may be less than some would wish; but steady and strategic development is essential if the country is to build a competitive, profitable and sustainable aquaculture sector.

Marketing a wide range of higher value species will generate more value added for the farmer, and value added, not total income or production, is the best overall measure of economic performance. It also has the advantage of generating environmental as well as social and economic benefits, since high value added is founded on a high ratio of output value to input quantity and value. In other words, high added value implies efficient use of resources to generate social and economic benefits.

## 2. CRITICAL CONSTRAINTS

**Seed:** The most serious constraint to the realization of this principle at all scales of aquaculture development in Cambodia is the right amount of high quality seed of the right species/size in the right place at the right time. Ultimately this is for the market to determine, but in the early stages of development the distribution channels and information network are inadequate to allow for an efficient market. In any case seed production is constrained by erratic demand: periodic losses from flooding result in variable willingness to invest in seed, and hence highly variable demand for seed.

**Seasonality of supply and demand:** A second significant constraint is the highly seasonal price of fish, and the constraints on timing of harvest imposed by a seasonal and in most areas rain-fed water regime. If farmers get the timing wrong, they receive a poor price. If they have invested heavily in seed and feed, they make significant losses. On the other hand price seasonality can be a significant opportunity if the producer is capable of exploiting it. There may also be downward pressure on price as a result of low cost farmed fish imported seasonally from Vietnam and Thailand.

Significant inter-annual variation in prices also takes place related to variation in production from capture fisheries, and the interplay between supply and demand at regional and global level. Thus a downturn in global demand for pangas may result in a flood of low value imports from Vietnam.

**Water:** Lack of high quality water, or seasonality of water supply constrains flexibility in production timing to meet market demand, and increases risk of loss at end of production cycle.

Flooding is a direct threat which greatly increases risk and indirectly leads to erratic demand for seed, undermining the business viability of the emerging hatchery sector.

**Feed:** Increased production of fish in Cambodia cannot be achieved without more efficient use of the lower value fish which is used as feed in more intensive aquaculture systems, and/or a shift to greater use of compound pelleted feeds. More efficient use of feed will also result in less pollution, less disease, better growth, and improved profitability.

## 3. MEETING THE CHALLENGE: OBJECTIVES AND STRATEGIC ACTIONS

The following provides a narrative of the key elements of the strategy. A more formal presentation is provided in Annex 1 (Log frame) including objectives, performance indicators, actions, milestones, responsibilities, and risks. A summary of objectives, actions and timeframe is provided at the end of this section in Table 6.

### **Objective 1 (Seed): To increase access to high quality seed for a range of species in demand in local, regional and global markets**

There is an immediate need to enforce disease and quality control checks on imported seed, and strengthen legislation and institutions where necessary.

The problems of price level, price variation and competition can be effectively addressed by having access to a wider range of seed species at critical times of year, so that high value species can be produced and sold at the time of year when prices are highest. This must ultimately be a private sector function, but government can kick-start and backstop the process – through training in breeding techniques and making available high quality broodstock of a range of species; and through much better support to



farmers in terms of advice on production scheduling and optimizing production for specific markets (i.e. general business and marketing skills).

The actions required to achieve this are summarized in the log frame (Annex 1) and are demanding. There is a need for a major rationalization of the government hatchery infrastructure, improved management and motivation in government hatcheries and broodstock holding facilities, and clear definition and differentiation of roles between public and private sector. This will not be achieved by running ad hoc project based development projects. It requires a comprehensive long term (at least 10 year) National Program for Broodstock Development, Management and Distribution, coupled with a parallel initiative to train and support private sector hatcheries. This will require a high level of coordination between government, NGOs and development partners.

The key elements of this program will include:

- A clear **definition of government and private sector roles** – with FiA primarily responsible for developing breeding technologies, and developing, maintaining and distributing high quality broodstock to private sector hatcheries. Government will not compete with the private sector in seed production.
- **Rationalization of existing government hatcheries and associated research centers**, leading to a simplified structure with two central research units (freshwater & marine); 4 or 5 regional broodstock centers; and possibly a series of seed supply development centers, or seed markets at cantonment level.
- **A clear structure for program management within government**, output based incentives, and capacity building and training in appropriate technical, managerial, and communication/extension skills, possibly through overseas training.
- On-going **appraisal and selection of target species** for breeding taking into account technical and market (local, national, regional, global) characteristics.
- A coordinated **private sector hatchery support program** including elements which address access to suitable sites and water for specialist SME and large scale hatcheries, and technical and business development support packages.

## **Objective 2 (water): To increase access to sufficient and consistent supplies of high quality water, and to reduce flood risks**

The risks posed by flooding can be addressed through several strategic activities – ranging from individual or cooperative efforts by farmers to reduce flooding risks or improve water storage (primarily through building higher dykes) to improve irrigation and water management infrastructure – possibly in designated aquaculture development zones. In so far as such investment increases flexibility in most forms of land use, it is likely to be cost effective in the medium and long term.

Under this objective *FiA will lobby to raise the profile of aquaculture, incorporate its needs into irrigation development and renovation schemes, and engage effectively in the practical development and management of these schemes at Cantonment and local level.*

The **identification of areas with high aquaculture potential**, the designation of special aquaculture development zones, and ultimately the establishment of serviced “aquaculture parks” all have advantages and disadvantages. They may serve as a focus for attracting investment; for more efficient delivery of inputs and support services; for the development of suitable water and other infrastructure; for the



coordinated management of water; and for concentration/aggregation of product encouraging development of processing and efficient distribution and marketing. They are likely to be particularly valuable and easier to implement and support in marine areas, or in specific parts of permanent water bodies (rivers, lakes, reservoirs). On land opportunities are more constrained by current usage and competition from other development activities, but there may be some suitable areas (especially of government land). The Fisheries Administration will explore opportunities in this regard and set up a series of pilot projects. These projects will also help meet objective 5 (environment and disease).

**Objective 3 (Feed): To ensure widespread availability and efficient use of sustainably sourced, reasonably priced, high quality feed suitable for a range of species**

Feed is not yet a critical constraint - or at least not a particular weakness - in the emerging Cambodia aquaculture economy. Pelleted feed is a widely traded international commodity; Vietnam and Thailand are both highly efficient fish feed manufacturers and feed can be imported with ease; and Cambodia has its own resource of seasonally very cheap “trash” fish which can be fed directly to some species or combined with other ingredients to make an adequate quality farm-made feed.

However, there are several problems, some of which will become much more acute in the future. The legal low value (“trash”) fish resource is both limited (in absolute quantitative terms) and seasonal; and other potentially valuable small fish may be caught illegally at other times and used as fish feed. In this sense aquaculture represents a pressure on the wild fish resource, rather than an alternative to it, with a range of potential negative effects on the capture fishery itself and those who benefit from it, including the very poor. It is essential therefore that the resource is used sustainably and efficiently.

On farm feeds are of mixed quality, formulations often sub-optimal, and storage protocols inadequate. Imported pellets are also sometimes of poor quality or inadequately labelled. Feeding strategies may also be wasteful. Poor feed or feeding practices often generate much higher levels of waste, and this in turn may cause water quality problems.

To address these issues requires action at several levels. More effective management of the wild resource is beyond the scope of this strategy, but awareness of the pressure attributable to aquaculture must be raised amongst fish farmers and government officials alike.

A wide range of actions can be taken to increase the efficiency of feed use, including better quality control of imported feeds; research on improved feed formulations, storage and handling appropriate to different species; improved information and extension relating to the costs and benefits of different feed types, formulations, and feeding strategies; encouragement for the establishment of an aqua-feed mill in Cambodia; and research to identify more “feed efficient” fish with good market potential.



#### **Objective 4 (knowledge): Improve efficiency, profitability and sustainability of aquaculture production through increased knowledge, skill and organization**

Aquaculture extension in Cambodia is currently mainly project related, limited in time and space, sometimes contradictory, makes limited use of the wide range of mechanisms and expertise already available in the country.

To address these generic weaknesses a **National Aquaculture Information and Extension Centre (NAIEC)** will be established – either based on the existing Administration and Extension office of Department of Aquaculture Development or located in one of the Universities. This Center will be small and efficient, offering primarily a coordinating role to access, link, and deploy the substantial expertise already in existence throughout the country (in projects, NGOs, government, research institutions etc.); ensure widespread access to, and distribution of, guidance and information; and source/organize training. This center and/or the network of expertise on which it may draw, could then be contracted by Government, Development Partners, NGOs and farmers themselves to provide packaged advice and training.

In terms of the content of extension advice, developing **business skills** is a key requirement for aquaculture development at any scale, and historic extension initiatives have been weak in this regard. Fish are not a simple product -there are many kinds, size and quality of seed, a range of alternative production techniques and levels of intensity, different sources, quality and seasonal availability/price of feeds, many products (species, size, processing), and many markets. The particular issue of seasonality of market price for both inputs and product is critical. Without significant business analysis skills it will be difficult to manage the various elements of the enterprise to optimize profit. Indeed, without such skills, even the more extensive forms of production may be regarded as relatively risky and many will fail. On the other hand price variation may be regarded as an opportunity, and the ability to produce the right product at the right time will dramatically increase profitability at any scale of production.

To minimize the risks, and maximize the opportunities will require a shift in emphasis from technical assistance to a combination of technical assistance and business development. This is already being undertaken – e.g. under the USAID HARVEST program, but needs to be rolled out much more widely, and this will be an important early task for the NAIEC. Several specific strategic actions designed to broaden extension support to incorporate business skills development are presented in Annex 1.

Business skills alone are inadequate without good market information. There is a need for an immediate comprehensive **assessment and analysis of national and regional market opportunities**, as well as more routine but longer term national market information. **A telephone and internet based aquaculture marketplace will be established**, with information posted by suppliers and producers themselves, to allow for much more effective linking of input suppliers with farmers, and farmers of all scale with actual or potential buyers. This will be reinforced and enhanced through periodic regional market outlook and opportunity briefs. Again, the NAIEC will play a key role is facilitating development of the market place and disseminating market information.

More specific extension and advisory needs will need to be implemented according to the scale of development:



**Small scale.** Small scale farmers – existing and potential – are far too numerous to allow for direct engagement of government or support projects across large swathes of the country and over extended periods of time, though they are invaluable as demonstration projects. But there are numerous opportunities for increasing knowledge and understanding of aquaculture opportunities and aquaculture methods, through better dissemination of knowledge and experience. The key here is raising awareness generally, and the provision of better extension materials and training to **key intermediaries** – agricultural extension officers, rural development NGOs, schools, vocational trainers, lead farmers, SMEs, farmer associations, suppliers, traders – and better dissemination through the various and increasingly effective media (TV, radio, internet). This will be a core activity for the NAIEC.

**Small to medium scale enterprises (SME).** It is arguable that the needs of small to medium scale aquaculture enterprise have been neglected in the past. Although their very existence is testament to some success and business skill, their understanding of longer term technical, economic and market trends and opportunities is often limited, and their ability to access suitable land, water and high quality seed and feed constrained by a wide variety of physical, and financial constraints. **A special SME support package** will be developed for these farmers – who may have a significant role in exploiting and developing national and regional markets. This package might include financial support for investment in water or pond infrastructure or access; assistance with access to new sites for purchase or rental; assistance with business development; market analysis and marketing strategy; optimizing the use of seasonally available feed inputs; as well as the more conventional technical assistance. Insofar as there will be far fewer SMEs than small scale farms, at least in the short to medium term, and that these farms often generate significant income and employment, targeted action should be highly cost effective.

**Large Scale.** Large scale production may be home-grown, arising from successful SMEs; or the result of investor interest in establishing a new commercial operation with professional management. The former is already dealt with above.

For the latter, the twin requirements are a) conducive business environment - which is beyond the scope of this strategy – and b) reliable information about investment opportunities. An understanding of investment opportunities will depend in large part on the availability of up to date **market analysis** coupled with direct support in the identification of suitable sites. This would be made easier if each province were to develop its own inventory of suitable areas and/or specific sites, and set down its policies with regard to supporting aquaculture development in those areas. In some cantonments this may result in designation of special aquaculture development zones; in other areas it might comprise a much less formal and more flexible system of information about possible suitable areas or sites. Taken together these inventories would comprise a national aquaculture resource inventory that would be used as an investment prospectus for would-be investors and/or farmers.



### Objective 5 (Disease and Environment): Maintain environmental quality and minimize loss from disease

Environmental degradation and chronic disease are not yet major issues for aquaculture development in Cambodia, but they have caused major problems in all other countries in the region where development has been rapid. They have caused huge losses (tens of millions of dollars) to the industry as a whole, as well as financial disaster and debt for many farmers. Furthermore the image of the industry in developed markets has been tarnished to the detriment of export prices. There are also problems related to other water users – domestic, industrial and agricultural chemical pollution.

These problems can be avoided, and Cambodia has a unique opportunity in this regard. There are three distinct elements:

- farm based measures, typically know as GAP (good aquaculture practice);
- area based methods (addressing water quality and disease in the wider environment) dependent on establishing an effective disease and environmental management system; and
- national measures related to biosecurity and the management and movement of diseased stock.

Precautionary action at all three levels will be required to ensure that such problems are avoided, but this presents a particular challenge for successful coordination and implementation.

**Development of GAP standards and guidance** will be an important activity for the Department of Aquaculture Development, working closely with the NAIEC. It is probable that there will need to be a graded system, allowing for basic guidance and where possible accreditation for small scale farms; more rigorous GAP for SMES; and GAP to international standards for larger scale farms and those involved in production for export.

Environmental and disease problems are most likely to arise in areas of relatively concentrated development where conditions are particularly suited to aquaculture development. Higher level management initiatives will be targeted at these areas; and these areas in turn may be designated as ***pilot aquaculture development zones***, which will also contribute to objective 2. This will require close association between FiA at national and cantonment level and authorities at district and commune levels, and integration of aquaculture into water development and environmental management plans. The key to success here will be the establishment of ***environmental and disease management systems*** – management frameworks which incorporate agreed environmental and disease indicators; reference or action levels in relation to these indicators; monitoring systems for these indicators.

These measures will be reinforced through more effective ***border biosecurity***, to ensure that fish diseases do not enter the country with seed, broodstock or other live fish.



### Objective 6 (post-harvest): Increase the quality and value of production

Increasing value will not only depend on strategic marketing of a greater range of valuable species, but also on the quality of the product and ability to respond to specific market needs or standards. Improved market information as proposed under objective 4 will contribute strongly to this – buyers can specify their own standards - and these may be driven both by market needs and standards set by government for application further along the market chain, for example at processing establishments, markets and ultimately retail outlets.

It is important nonetheless that government develops and implements a **range of best practice and quality standards**. GAP has been addressed under objective 5; but product quality and best practice handling and storage standards will also need to be elaborated and promoted. This will be the responsibility of the Ministry of Commerce, but FiA (Post-harvest) will be closely involved. Given the large numbers of farms, traders and market outlets, widespread enforcement will be difficult and beyond the resources of government at the present time. The way forward in the first instance will be through **awareness raising and better information dissemination through NAIEC, the media, trader and farmer networks**. Historically there has been very little engagement between government or projects and markets and traders, and this is an important weakness that needs to be addressed. This again relates to the wider lack of support for the business and marketing dimensions of aquaculture development.

One of the critical pre-conditions for promoting and enforcing best practice in production and handling in order to meet specific market needs, or national and international standards, is **full registration and licensing of fish farms and fish traders**. Farm registration is already a requirement under the fisheries law, but it will be necessary to improve enforcement and possibly adjust the size thresholds or change these to production thresholds, given the potential to produce very large quantities of fish from a relatively small area or volume using input intensive systems.

However this will not be enough, and the large number of farms and traders involved will usually not allow for public sector initiative and control at the farm level. It will be crucial therefore, as the sector develops, to help develop and engage more effectively with **groups, associations and networks of farms and traders** – either within “aquaculture zones” or more widely.

Quality control of products for export to developed markets such as US and Europe will be largely self regulated – through standards imposed by buyers.



### **Objective 7 (Finance): To facilitate access to credit as appropriate to the needs, potential and risks associated with aquaculture development**

Access to credit in Cambodia is fair by global standards, and it would be inappropriate to seek more favourable loan terms for aquaculture than are normal for other forms of rural enterprise – especially since this may encourage over intensification.

However, there is a specific problem for small scale loans where the payback schedule may not take account of the longer cropping cycle in most forms of aquaculture. The government and donors will work together to seek credit arrangements appropriate to the nature of aquaculture cropping cycles.

There is also an argument for special grant and credit schemes for SME establishment and development, already addressed under objective 4.

## **4. CREATING AN ENABLING LEGAL AND INSTITUTIONAL FRAMEWORK**

An enabling framework is not an objective as such – rather a means to achieving those objectives. Most of the elements of such a framework are already in place; the weaknesses lie in implementation, and in some cases the detail. Some of these weaknesses, and specific actions to address them have already been detailed under the relevant objectives above. Others will become evident as the various strategic actions discussed above are developed and implemented, and efforts will be required to adjust, refine and elaborate institutions and regulatory frameworks as appropriate. In several cases responsibility for this will lie with another Ministry, and effective engagement with these ministries will be required in order to make progress.

Key areas where improvement is needed include:

- Fishery management and regulation relating to small low value fish used as aquaculture feed
- Water management systems that are effective and take account of needs of aquaculture
- Land rights and concession systems favorable for aquaculture development
- Effective and efficient/rapid control of quality, safety and disease status of imports and exports of seed, feed, and live fish.

The first of these is important, within the scope of FiA responsibility, but beyond the scope of this strategy. The second and third will require joint efforts by a range of institutions, and the strategic actions themselves (for example those relating to aquaculture zones and disease/environmental management plans) will provide a focus for this engagement. The fourth area will require action from the FiA Department of Post-Harvest working closely with the Ministry of Commerce (Camcode).



## 5. IMPLEMENTING THE STRATEGY

It is important to identify mechanisms to ensure some responsibility is borne for the various actions and initiatives required. The log frame identifies the key players who will need to be engaged to promote the various actions and initiatives. Some leadership will however be required to initiate action and assign more specific tasks and responsibilities.

### Objective task forces

In the first instance we propose five small task forces be convened under the auspices of the TWG Fisheries. Their remit would be to develop detailed short to medium term plans to develop actions and initiatives, secure funding, and assign responsibilities as appropriate, for the first 5 objectives (i.e. seed, water, feed, extension and disease/environment). All of these objectives require coordinated action involving different institutions/stakeholders and significant funding. Delivery of objective 6 will be a specific responsibility of Department of Post-harvest working closely with Department of Aquaculture. Objective 7 is a relatively minor task requiring initiative from Department of Aquaculture.

### Cantonment implementation plans

In parallel with these task forces, the Cantonment level FiA, working closely with the chairs of the various task forces, will develop more locally based plans and specific proposals in support of the strategy.

### Monitoring, review and adaptation

We have identified a significant number of performance indicators for this strategy, listed for each objective in the log frame, many of which cannot be measured using standard government statistics. Many countries undertake annual farm surveys to gain a better understanding of the performance of the sector, but this is probably not possible given available resources. A 4 or 5 year sample survey, and appropriate analysis, is therefore proposed to provide this information. Depending on the results, it may then be necessary to revise and improve the strategic plan and reprioritise strategic actions.

**Table 5: Summary of Actions and indicative time frame**

Objectives and activities	Timeframe			
	2016	2020	2025	2030
<b>Objective 1 (Seed): To increase access to high quality seed for a range of species in demand in local, regional and global markets</b>				
1. Enforce disease and quality control checks on imported seed, and strengthen legislation and institution where necessary	■	■	■	■
2. National Program for Broodstock Development, Management and Distribution (NPBDM)	■	■	■	■
3. National Program of support for private sector hatcheries and nursing operations	■	■	■	■
4. Nation seed quality incentives initiative	■	■	■	■
<b>Objective 2 (Water): To increase access to sufficient and consistent supplies of high quality water, and to reduce flood risks</b>				
5. Improve water supply and management at farmer or farm group level	■	■	■	■
6. Develop nation aquaculture resources inventory (NARI)	■			
7. Area based planning and management of water resources and infrastructure for aquaculture	■	■	■	■
<b>Objective 3 (Feed): To ensure widespread availability and efficient use of sustainably sourced, reasonably priced, high quality feed suitable for a range of species</b>				
8. Standards development and enforcement	■	■	■	■
9. Design and implement feed quality research program	■	■	■	■
10. Encourage manufacture of compound fish feeds within Cambodia	■	■	■	■
11. Research on ecology, economy and management of low value fish resource conducted and applied	■	■	■	■
12. Improve management of fisheries resources that are used in aquaculture feeds	■	■	■	■
<b>Objective 4 (Knowledge): Improve efficiency, profitability and sustainability of aquaculture production through increased knowledge, skill and organization</b>				
13. Establish national aquaculture information and extension center (NAIEC), and a national aquaculture extension system (NAES)	■	■	■	■
14. Undertake national and regional market survey, and establish mechanism for publishing annual market opportunity and outlook briefs	■	■	■	■
15. Establish phone/internet based market information exchange	■	■	■	■
16. Establish special small medium enterprise (SME) development support programme	■	■	■	■
17. Facilitate establishment of farmer associations, forums, networks, news and information exchange systems	■	■	■	■
18. Strengthen aquaculture education in schools and communities	■	■	■	■
19. Strengthen higher level education and research	■	■	■	■
20. Prepare aquaculture development prospectus for large scale investment	■	■	■	■



Objectives and activities	Timeframe			
	2016	2020	2025	2030
<b>Objective 5 (Disease and Environment): Maintain environmental quality and minimize loss from disease</b>				
21. Establish a water quality and disease management system for aquaculture zones				
22. Develop and implement a Good Aquaculture Practice(GAP) standard for aquaculture in Cambodia				
<b>Objective 6 (Post-harvest): increase the quality and value of production</b>				
23. Enforce licensing and registration of all farms				
24. Promote appropriate use of chemicals				
25. Develop, disseminate and enforce where appropriate harvest, post-harvest and transportation standards and guidelines				
26. Strengthen links between GAP and market premium				
<b>Objective 7 (Finance): To facilitate access to credit as appropriate to the needs, potential and risks associated with aquaculture development</b>				
27. Modify standard loan condition to take account of the length of the production cycle in aquaculture				
28. Support farmer associations in establishing credit group and similar micro-credit initiatives				







# ANNEX



## ANNEX 1: LOG FRAME





**ANNEX 1: LOG FRAME**

<b>Intervention logic</b>	<b>Indicators and performance measures</b>	<b>Means of verification</b>	<b>Risks and assumptions</b>
<p>GOAL</p> <p>Commercially viable and environmentally sustainable aquaculture sub-sector contributing to food security, socioeconomic development, GDP and export earnings</p>	<ol style="list-style-type: none"> <li>i. Increased income or nutritious food availability for the poor</li> <li>ii. Ratio of national production to imports</li> <li>iii. Per capita fish consumption</li> <li>iv. Sum of value added for the aquaculture sector</li> <li>v. Employment in the aquaculture sector</li> <li>vi. Net export earnings of aquaculture sector</li> <li>vii. Ratio of value added to fish input as feed (value and quantity)</li> <li>viii. Water quality in aquaculture zones</li> <li>ix. Incidents of chemical contamination in aquaculture products</li> </ol>	<p>Rural livelihoods survey</p> <p>National statistics</p> <p>National statistics</p> <p>National statistics/survey</p> <p>National statistics/survey</p> <p>National statistics/survey</p> <p>National statistics</p> <p>Sample survey</p> <p>Sample survey</p>	<p>Highly dependent on:</p> <ul style="list-style-type: none"> <li>• developments in regional markets and competition;</li> <li>• effective management of the fishery resource (an in particular that part exploited for aquaculture feed or fish meal); and</li> <li>• the effective implementation of the strategic activities set down below</li> </ul>
<b>Objective 1 (Seed): Increase quality, quantity and diversity of seed available to farmers</b>			
<b>Results or outcomes</b>	<b>Indicators</b>	<b>Method/information</b>	<b>Risks and assumptions</b>
<p>Farmers able to buy sufficient quantities of:</p> <ul style="list-style-type: none"> <li>• high quality, disease free seed</li> <li>• wide range of preferred (profitable or nutritious) species suited to different production systems</li> <li>• at reasonable price</li> <li>• at optimal time of year (in order to harvest when price high)</li> </ul>	<p>SPF</p> <ol style="list-style-type: none"> <li>i. Annual fish seed production (target 250million by 2019)</li> <li>ii. Research and development to identify commercially viable production of indigenous species in cooperation with regional initiatives i.e. MRC NSPADC</li> <li>iii. Ratio of sector value added to seed production (numbers)</li> <li>iv. The number of species being commercially produced by hatcheries (&gt;1m seed pa)</li> <li>v. The number of months for which each species is available in commercial quantities</li> <li>vi. The sum of the number of species produced in commercial quantities in each province; and</li> <li>vii. The average price of seed.</li> </ol>	<p>Fishery statistics</p> <p>Annual research reports</p> <p>5 year farm survey with national statistics</p> <p>Cantonment fishery statistics</p> <p>Analysis of electronic market data (see obj. 4)</p>	<p>These results or outcomes are also dependent on effective engagement with and development of private sector hatcheries to use and maintain quality broodstock in seed production.</p> <p>Measurement of the outcomes will be difficult.</p> <p>Fishery statistics are inaccurate, and not broken down by species at national level, although this is available at cantonment level.</p> <p>The five yearly survey is likely to be more accurate, and data from electronic market place will serve as excellent cross check.</p>

Activities	Milestones	Responsibility and time scale	Risks and assumptions
<p>1. Enforce disease and quality control checks on imported seed, and strengthen legislation and institutions where necessary</p>	<ul style="list-style-type: none"> <li>• Establish FiA/Camcontrol/TWG task force to review, establish and promote improved standards, regulation and enforcement relating to live fish, dead fish and seed entering the country ( disease/ phytosanitary status, origin and quality)</li> <li>• Clarify inspection protocols (visual and analytic) and improve as necessary</li> <li>• Explore option of limiting imports to those from inspected and approved or certified hatcheries</li> <li>• Develop and enforce transportation standards and protocols for live and dead fish</li> <li>• Strengthen laboratory support, subject to demand</li> <li>• Strengthen staff capacity – management, technical (inspection &amp; analytic)</li> </ul>	<p>FiA to initiate, working closely with Camcontrol who would implement, supported by OIE focal points</p> <p>Year 1 and on-going.</p>	<p>Will probably require long term increased resources for appropriate staffing and support facilities</p> <p>Will require effective cooperation between FiA and Ministry of Commerce (Camcontrol)</p>
<p>2. National Program for Broodstock Development, Management and Distribution (NPBDMD)</p>	<ul style="list-style-type: none"> <li>• Appoint country programme coordinator</li> <li>• Develop/write NPBDMD (policy and plan). This will include: <ul style="list-style-type: none"> <li>- Clarification of government and private sector roles in broodstock management and seed production</li> <li>- Designation of responsible institutions for specific functions (research on new species; broodstock improvement; broodstock maintenance; routine breeding to supply private sector broodstock needs; broodstock distribution and quality control of private hatcheries</li> <li>- Detailed plans for rationalisation of existing government hatchery facilities, with strategic improvements as necessary</li> <li>- Preliminary assessment of species with good technical and economic potential as a focus for R&amp;D (see also obj 4- market study)</li> </ul> </li> <li>• Seek funding in support of implementation of NPBDMD</li> <li>• Undertake training and capacity building</li> </ul>	<p>FiA with Development Partner support</p> <p>Initiate year 1; implement in two phases, years 2-6 and 6-11</p>	<p>This will need significant funding for institutional strengthening, facility upgrades, basic operational expenditure, and research and development over a substantial period of time – preferably 10 years</p> <p>Similar initiatives have been proposed in the past and have failed – through entrenched interests; lack of will to rationalise; high operational costs; and short term project based support.</p> <p>This will only succeed if the management dimensions are supported along with the technical dimensions, and so long as focus is maintained on getting quality broodstock out to private hatcheries.</p> <p>Collaboration in regional research initiatives could lever substantial additional resources</p>

	<p>appropriate to functions, and improve management systems</p> <ul style="list-style-type: none"> <li>• Produce high quality broodstock of wide range of preferred species</li> <li>• Ensure efficient distribution of quality broodstock to the private sector</li> </ul>		
3. National program of support for private sector hatcheries and nursing operations	<ul style="list-style-type: none"> <li>• Further strengthen engagement of government seed centres with private sector hatcheries</li> <li>• Seek funding for tailored support package to private sector hatcheries, building on existing work of HARVEST and JICA, but increasing support for SME and larger scale hatcheries. Coordinate this action with SME support package (obj. 4)</li> </ul>	<p>FiA, JICA and USAID already engaged in support to small scale hatcheries - but they need to be rolled out more widely.</p> <p><i>Years 1-5 and on-going</i></p>	
4. National seed quality incentives initiative	<ul style="list-style-type: none"> <li>• Strengthen role of cantonment centres in providing advice on seed quality</li> <li>• Explore use of a seed quality feedback/information system associated with electronic market system (Obj 4)</li> <li>• Develop GAP standard and inspection procedures for private hatcheries</li> <li>• Develop certification or approval system for hatcheries implementing GAP and/or traders sourcing from approved hatcheries</li> </ul>	<p>FiA</p> <p>NAIEC</p> <p>FiA with MoC</p> <p>Years 1-5; GAP and certification years 5-10</p>	<p>Certification of hatcheries is notoriously difficult in the early stages of development, so the emphasis is likely to be on better exchange of information about seed quality in the short to medium term</p>
<b>Objective 2 (Water): Improved access to suitable water and sites, and protection from flooding</b>			
<b>Results or outcomes</b>		<b>Method/information</b>	
<b>Indicators</b>		<b>Risks and assumptions</b>	
<ul style="list-style-type: none"> <li>• More reliable and higher quality year-round water supply for existing farmers allows farmers to produce according to market demand</li> <li>• Less risk of flooding for existing farmers</li> <li>• New entrants able to find and use suitable sites with reliable-</li> </ul>	<p>SPF indicators</p> <p>i. indicator 7.5. The development and implementation of Fisheries Cantonment plans responding to Commune plans and consistent with FiA policy</p> <p>NSPADC</p> <p>ii. Average number of months sufficient water available to farmers and/or proportion of farmers with year round access to sufficient water</p>	<p>Document review</p> <p>5 year sector survey</p> <p>Document review</p>	<p>Highly dependent on effective collaboration and coordination between FiA/MAFF/MoWRaM</p>

and high quality water resources	<ul style="list-style-type: none"> <li>iii. Explicit account taken of aquaculture needs and opportunities by Farmer Water User Com ganisations and documents</li> <li>iv. Examples and dissemination of experience in the use of spring water and groundwater for aquaculture development</li> <li>v. Proportion of reservoirs and community ponds stocked or with cages</li> <li>vi. Pilot projects on aquaculture development zones implemented</li> <li>vii. Proportion of suitable cage sites occupied by aquaculture on rivers/coasts</li> </ul>	<p>Case studies and newsletters</p> <p>Questionnaire to cantonment</p> <p>Questionnaire to cantonment</p>	
<p><b>Activities</b></p> <p>1. Improve water supply and management at farmer or farm group level</p> <p>2. Develop national aquaculture resources inventory (NARI)</p>	<p><b>Milestones</b></p> <ul style="list-style-type: none"> <li>• Develop/strengthen/integrate small scale flood protection and water storage initiatives with NGOs</li> <li>• Secure funding for a water investment support fund</li> <li>• Guidance on opportunities and costs associated with development of groundwater resources</li> <li>• Promote development of spring-water resources for aquaculture and especially hatchery development</li> <li>• Define suitable site and /or zone criteria for cage and pond culture development, including physical/environmental suitability,access, availability etc</li> <li>• Work with Cantonment and commune level government to map suitable areas at local level</li> </ul>	<p><b>Responsibility and time scale</b></p> <p>FiA, MAFF, DP, NGOs</p> <p>Some DP projects already facilitate and part fund small scale initiatives (raised dykes or net barriers).</p> <p>Will require national workshops, case studies, extension/advisory materials, donor support</p> <p>Years 1-10</p>	<p><b>Risks and assumptions</b></p> <p>Depends very much on enthusiasm of farmers to invest.</p> <p>If such infrastructure can be developed as part of/coordinated with more general agricultural improvements costs and risks will be reduced</p>
		<p>FiA DAD, with Cantonment</p> <p>FiA</p> <p>Years 1-2</p>	<p>Risk of this becoming an expensive and abstract GIS exercise.</p> <p>Better undertaken by a national coordinator working with aquaculture staff and private sector representatives at cantonment and district level, including field appraisal.</p>

<p>3. Area based planning and management of water resources and infrastructure for aquaculture</p>	<ul style="list-style-type: none"> <li>Secure higher level policy commitment (e.g. Strategy for Agriculture and Water) that irrigation infrastructure will be developed and managed for both agriculture and aquaculture in priority areas</li> <li>Pursue this at all levels through closer working relations: MoWRaM, MAFF, and DAD, Cantonment, Commune</li> <li>Integrate aquaculture development and environmental management plans into commune level plans</li> <li>Establish pilot aquaculture development zones <ul style="list-style-type: none"> <li>Shortlist candidate sites based on NARI</li> <li>Negotiate with cantonment and commune government, owners, concession holders etc</li> <li>Select pilot aquaculture development zones</li> <li>Prepare pilot zone development plans (including e.g. water; power and road infrastructure; extension and advisory services; water management and GAP (see objective 5); disease management; registration/license conditions; processing)</li> <li>Evaluate pilot strengths and weaknesses</li> <li>Implement objective 5 actions</li> </ul> </li> </ul>	<p>FiA working with other administrations in MAFF, MoWRaM, Cantonment and Commune authorities (joint working groups at national and Cantonment levels)</p> <p>At its simplest an aquaculture development zone would be a colour on a map, with implicit support (e.g. preferential concessions) for aquaculture development.</p> <p>At its most advanced an “aquaculture park” would be equivalent to a significant irrigation scheme with supporting roads, power, ponds; with fish farms and processing sites for rent; and associated rules and regulations</p> <p>Years 1-15</p>	<p>Significant risks of limited progress. Historically there has been very limited coordination, and irrigation maintenance and management is widely regarded as poor</p> <p>Zones or parks may concentrate disease and water quality problems - if rigorous management and operational protocols are not followed. There are good and bad examples globally.</p>
<p><b>Objective 3 (Feed): To ensure widespread availability of sustainably sourced, reasonably priced, high quality feed suitable for a range of species</b></p>			
<p><b>Results or outcomes</b></p>	<p><b>Indicators</b></p>	<p><b>Method/information</b></p>	<p><b>Risks and assumptions</b></p>
<ul style="list-style-type: none"> <li>Effective quality control and accurate labelling on imported feeds</li> <li>Quality of farm made feeds high, and storage of ingredients optimised</li> </ul>	<p>SPF</p> <p>i. Indicator 1.7 The level and nature of domestic feed production for aquaculture: use of locally produced vegetable ingredients increased by 60%</p> <p>NSPADC</p>	<p>5 year farm survey</p>	<p>Given adequate information exchange the market itself should result in appropriate quality feeds. Facilitating a more effective market is therefore crucial to success.</p> <p>Investment will be made in feed plants once</p>

<ul style="list-style-type: none"> <li>• High quality pelleted feeds specially formulated for different species readily available</li> <li>• More efficient use of low value fish and other feed ingredients</li> <li>• Opportunity costs of using low value fish in aquaculture and other value added enterprises fully understood</li> <li>• Low value resource better understood and sustainably managed</li> </ul>	<ul style="list-style-type: none"> <li>ii. Food conversion rates, and especially trash fish conversion rates when using either commercial pellet or farm made feed</li> <li>iii. Ratio of value added to quantity of fish used as feed</li> <li>iv. Ratio of value added to cost of fish used as feed</li> <li>v. Proportion of farms using high quality commercially formulated feeds</li> <li>vi. Price of “trash fish” (will rise rapidly if aquaculture expands and does not increase efficiency of use, and/or management regime inadequate)</li> </ul>	<p>5 year farm survey</p>	<p>demand reaches threshold levels (about 50,000t).</p> <p>Better understanding of cost effective and efficient use of feeds on part of farmers is crucial to success of this objective, and actions under objective 3 will need to be well coordinated with those under objective 4.</p>
<b>Activities</b>			
<p>1. Standards development and enforcement</p>	<p style="text-align: center;"><b>Milestones</b></p> <ul style="list-style-type: none"> <li>• In parallel with Action 1, establish standards for imported fish feeds and other aquaculture supplies (labelling, source, ingredient information)</li> <li>• Enforce standards, with improved capacity at border and recourse to laboratory analysis of samples</li> </ul>	<p style="text-align: center;"><b>Responsibility/time frame</b></p> <p>Coordinated action along with Action 1</p> <p>Better taken forward as regional initiative e.g. with NACA/Seafood, but requiring strengthened institutions at national level</p> <p>Years 1-5</p>	<p style="text-align: center;"><b>Risks and assumptions</b></p> <p>Laboratory development very costly.</p> <p>Market information may be more effective in early stages</p>
<p>2. Design and implement feed quality research program</p>	<ul style="list-style-type: none"> <li>• Establish research consortium and secure research funding for program encompassing: <ul style="list-style-type: none"> <li>- Improved on-farm feed formulations for a range of species</li> <li>- Improved storage protocols to maximise nutritional value of feeds</li> <li>- Optimal feed formulations for new/emerging species</li> </ul> </li> <li>- Identification of feed efficient species with good market potential (coordinated with NPBDMD)</li> <li>• Disseminate findings on a continuous basis through NAIEC</li> </ul>	<p>FiA Research Institutes; Universities; private sector feed manufacturers; other research institutes in the region; Worldfish Center</p> <p>Major opportunities for regional level research collaboration and specialisation drawing on international research and/or donor funding</p> <p>Years 2-6 (phase 1) and 7-11 (phase 2)</p>	<p>Could become very complex, costly and long term unless rigorously managed, and with strong private sector involvement</p> <p>Risk that the focus would be on research publications rather than practical advice. Agreement with NAIEC on regular updates/news for dissemination would reduce this risk, as would appropriately worded research objectives</p>

<p>3. Encourage manufacture of compound fish feeds within Cambodia</p>	<ul style="list-style-type: none"> <li>Investment incentives (tax breaks)</li> <li>Stimulate demand through extension advice and information on performance of pelleted feeds and farm made feeds</li> </ul>	<p>Ministry of Commerce? NAIEC (see obj. 4) Years 3-6</p>	<p>With better understanding of costs and benefits of alternative feed practices (obj 4), and improved quality of imported feed (Action 8) demand for pelleted feed is likely to increase rapidly to the (roughly) 50,000t demand threshold required to justify investment in feed plant in Cambodia</p>	
<p>4. Research on ecology, economy and management of low value fish resources conducted and applied</p>	<ul style="list-style-type: none"> <li>Research on species caught and population characteristics</li> <li>Research on use and value of low value fish for different purposes</li> <li>Review management measures and implementation</li> </ul>	<p>FiA. Likely to be joint research programme between Government Research Institutes and Worldfish Center Years 1-3</p>	<p>Complex research programme requiring excellent management to maintain focus on commercially and environmentally important dimensions</p>	
<p>5. Improve management of fishery resources that are used in aquaculture feeds</p>	<ul style="list-style-type: none"> <li>Enforce existing fishery management regulations</li> <li>Design new measures specifically targeted at conservation of species and stocks used for aquaculture feeds</li> </ul>	<p>FiA. Largely outwith responsibility of aquaculture department Years 2-4</p>	<p>Relatively simple for the seasonal dai (migratory fish) fishery. Difficult to implement in the closed season given the numbers of small scale fishers involved.</p>	
<p><b>Objective 4 (Knowledge): Improve efficiency, profitability and sustainability of aquaculture production through increased knowledge and organisation</b></p>				
<p><b>Results or outcomes</b></p>		<p><b>Indicators</b></p>	<p><b>Method/information</b></p>	<p><b>Risks and assumptions</b></p>
<ul style="list-style-type: none"> <li>Seed producers and farmers have a high level of technical skill and knowledge relating to a wide range of species; and have good understanding of markets, production scheduling, and farm budgets</li> <li>Technical advice and backup readily available to farmers, NGOs and other extension agents</li> <li>Farmers well organised to facilitate knowledge exchange, water management, input</li> </ul>		<p>SPF indicators i. At least 85,000 trained fish farmers actively engaged in aquaculture by the end of 2019 ii. The number of schools actively engaged in aquaculture culture iii. The availability of technical guidelines for product standards and good practice NSPAD iv. Major rural development NGOs explicitly include aquaculture extension support (technical and economic) in their work programs v. The proportion of farmers with ready access to oral or written practical, technical and</p>	<p>Periodic survey of NGO support for aquaculture Periodic farm survey Information system reviewed every 2 years University/college graduate tracking Annual audit  Review of readily available NGO documentation  5 year farm survey</p>	<p>Existing project related extension and support is restricted in time and space. The wider government extension system is inconsistent and inadequate. Without a strong and motivated core or center ...little progress will be made.  This centre should be relatively small but well-resourced if it is to be effective.</p>

<p>sourcing and marketing</p> <ul style="list-style-type: none"> <li>• Up to date market and input information readily available to all.</li> <li>• Skills of trainers, extension workers and rural development professionals increased.</li> <li>• College aquaculture and agriculture graduates establish or work on fish farms</li> <li>• Wider population aware of the opportunities associated with aquaculture</li> </ul>	<p>commercial guidance</p> <ul style="list-style-type: none"> <li>vi. Functional, flexible, accessible phone and web based aquaculture input and market information system in place</li> <li>vii. The proportion of farmers, suppliers, traders who make use of this resource</li> <li>viii. Information (e.g. aquaculture profiles) readily available and visible at markets, community centres etc</li> <li>ix. Number of aquaculture graduates engaged in commercial aquaculture</li> <li>x. Profitability of fish farms</li> <li>xi. Ratio of value added to inputs – whole sector (basically a measure of profitability and efficiency)</li> </ul>	<p>Periodic farm survey</p> <p>University graduate records</p> <p>National statistics and periodic farm survey</p>	
<p><b>Activities</b></p> <p>1. Establish national aquaculture information and extension center (NAIEC), which would coordinate, support and facilitate rural development NGO activities and other extension agents in support of aquaculture throughout the country, thereby creating a national aquaculture extension system (NAES)</p>	<p><b>Milestones</b></p> <ul style="list-style-type: none"> <li>• Designate a higher education institution (or government unit) as the focus for extension and advisory support, and appoint national extension coordinator and full time extension assistant</li> <li>• Engage with universities, colleges, research centres and development partners to deliver regular training and advisory support to rural development NGOs, donor projects, farmer network representatives, aquaculture zone managers, input suppliers and traders, vocational trainers etc</li> <li>• Strengthen capacity to provide farm budgeting, farm management, marketing and business development advice</li> <li>• Coordinate, publish and disseminate a comprehensive range of aquaculture awareness and guidance materials using leaflets, internet, radio and TV, existing newsletters (catch and culture etc), newspapers</li> </ul>	<p><b>Responsibility</b></p> <p>FiA would need to review the options in terms of a government based or semi private based NAIEC probably centered in one of the universities.</p> <p>The costs of this activity should be relatively low since this is primarily an information and coordination activity</p> <p>Would also need a budget to commission e.g. locally suitable adaptations of extension materials; new materials on farm budgets, scheduling, markets etc</p>	<p><b>Risks and assumptions</b></p> <p>Government based extension systems tend to be inefficient.</p> <p>A semi private system based in a university (with donor and government funding in the first instance, but increasingly privatised as the sector develops) is likely to be more cost effective in the medium term.</p> <p>The coordinator and assistant will need to be highly motivated with excellent people and organisational skills.</p> <p>There is a risk that this center would seek to expand excessively drawing on donor/NGO funds. It is important that it remains small and efficient - coordinating, sourcing, distributing and organising rather than actually delivering extension.</p>

	<ul style="list-style-type: none"> <li>• Develop guidance suitable for small scale, SME and large scale aquaculture, addressing all dimensions of aquaculture – seed, feed, water quality, temperature management, budgeting, costs and benefits of alternative feeds/feed strategies, markets and production scheduling.</li> <li>• Encourage Development Partners to support and strengthen NAIEC and implement NAES throughout the country</li> </ul>	<p>Years 1-5 (phase 1) and 6-10 (phase 2). Ideally years 11-15 would be self funded.</p>	
<p>2. Undertake national and regional market survey, and establish mechanism for publishing annual market opportunity and outlook briefs</p>	<ul style="list-style-type: none"> <li>• Commission national and regional market survey (Identify high value species; describe price and volume variations and trends in Cambodia and adjacent countries; map out existing and potential distribution chains)</li> <li>• Prepare annual market opportunity and outlook briefs for hatcheries and farmers</li> <li>• Link with virtual market information resource (Action 15)</li> </ul>	<p>FiA with donor support (initial survey) NAIEC for commissioning and distribution of follow-up annual updates and briefs</p> <p>Years 1-2 (regional market survey) Ongoing annual market opportunity and outlook briefs</p>	<p>This is not desk based work, which would contribute little to what is already known. Rather it should be undertaken through practical work on the ground – i.e. market visits, interviews with traders, following supply chains, by native speakers/detectives.</p>
<p>3. Establish a phone/internet based market information exchange</p>	<ul style="list-style-type: none"> <li>• Appraise options for phone/internet based user updated market information service (seed, feed, other input, fish available; price or contact)</li> <li>• Develop and secure long term contract for service delivery and maintenance through modest subscription service system</li> <li>• Encourage use and dissemination through NGOs, farmer groups, commune authorities etc</li> </ul>	<p>FiA with donor support</p> <p>Years 2-4 (establishment) On-going (self-financed)</p>	<p>Will not be used if difficult to upload or access information. Best kept very simple in first instance and developed according to demand Will require a baby sitter (probably NAIEC) to nurture, promote and troubleshoot for some time after launch. Will require champions (e.g. key players in farmer networks and associations) to promote its use and demonstrate its utility</p>

<p>4. Establish special small-medium enterprise (SME) development support programme</p>	<ul style="list-style-type: none"> <li>• Assistance with site identification and access (rental, acquisition), and/or</li> <li>• Assistance with site development and improvement (negotiation; technical assistance; grant and loan assistance)</li> <li>• Assistance/ mentoring with technical issues, market research and business planning</li> </ul>	<p>FiA with donor support Basic programme would require minimum of 1 FTE + assistant over 5 years + grant, loan, and part finance for technical assistance and business mentoring Programme would contract NAIEC to source and deploy technical and economic assistance Years 1-5 possibly extended 6-10</p>	<p>Criteria for support need to be clear to avoid jealousies</p>
<p>5. Facilitate establishment of farmer associations, forums, networks, news and information exchange systems</p>	<ul style="list-style-type: none"> <li>• Continue work of DAD, JICA and HARVEST in strengthening farmer associations and networks</li> <li>• Encourage associations and networks to engage with NAIEC, NPBDM and feed research programme to access and disseminate the latest technical information, and make use of electronic market forum.</li> </ul>	<p>DAD, JICA and HARVEST, working with NAIEC and NPBDM Years 1-5.</p>	<p>The success of these associations is highly dependent on the dynamism of individuals, and their ability to network effectively. On-going support will be required but it is important that this is withdrawn before a culture of dependency emerges</p>
<p>6. Strengthen aquaculture education in schools and communities</p>	<ul style="list-style-type: none"> <li>• Identify schools in areas with greatest aquaculture activity or potential</li> <li>• Collaborate with NGOs to develop learning materials (NAIEC)</li> <li>• Develop and deliver weekend and evening classes and short courses (NAIEC)</li> </ul>	<p>Coordinated/promoted by NAIEC drawing on materials development expertise in Universities. Research centres etc Continuous/on-going</p>	<p>Very important to get the right level suited to local conditions. Basic fish biology and feeding a key element in this, along with basic understanding of markets</p>
<p>7. Strengthen higher level education and research</p>	<ul style="list-style-type: none"> <li>• Strengthen curriculum development and delivery, drawing on national expertise in diverse institutions and private sector.</li> <li>• Strengthen training in markets business and seafood trade</li> <li>• Encourage graduates to set up fish farm business</li> </ul>	<p>Some support from NAIEC but primarily responsibility of Universities and colleges themselves Continuous/on-going</p>	

<p>8. Prepare aquaculture development prospectus for large scale investment</p>	<ul style="list-style-type: none"> <li>• Following on from, or in parallel with aquaculture zone pilots (Action 7), develop investment prospectus based on market outlook and strengths of aquaculture zones (water supply; seed supply; market access)</li> </ul>	<p>FiA with donor support Years 3-4</p>	
<p><b>Objective 5 (Disease and Environment): Maintain environmental quality and minimize loss from disease</b></p>			
<p><b>Results or outcomes</b></p>			
<ul style="list-style-type: none"> <li>• Water quality and disease management system in place for aquaculture zones</li> <li>• Water quality in fish ponds or cages meets recommended best practice standards</li> <li>• Disease is rare</li> <li>• Chemical use in aquaculture is in line with GAP and national regulations</li> </ul>	<p style="text-align: center;"><b>Indicators</b></p> <ol style="list-style-type: none"> <li>Disease incidence</li> <li>Proportion of farmers implementing GAP at different levels</li> <li>Number of aquaculture zones with disease and environmental management system in place</li> <li>Proportion of zones operating within agreed water quality and disease standards</li> <li>Infringement of chemical use regulations</li> <li>Ratio of value added to cost of chemical/drug inputs</li> </ol>	<p style="text-align: center;"><b>Method/information</b></p> <p>Reports by OIE national and provincial focal points 5 year farm survey Cantonment reports Cantonment reports Farm performance survey</p>	<p style="text-align: center;"><b>Risks and assumptions</b></p> <p>Water quality sampling by MoE/MoWRaM takes account of location of fish farms</p>
<p><b>Activities</b></p>			
<p>1. Establish a water quality and disease management system for aquaculture zones</p>	<p style="text-align: center;"><b>Milestones</b></p> <p>Working with other government ministries and local authorities as appropriate:</p> <ul style="list-style-type: none"> <li>• Implement actions 1 and 7</li> <li>• Define water quality standards for aquaculture and other users</li> <li>• Assess environmental capacity</li> <li>• Establish limits to production and/or inputs and/or waste</li> <li>• Establish regulatory mechanisms to impose these limits</li> <li>• Monitor water quality and adjust standards/response mechanisms as required</li> <li>• Define and agree disease identification, reporting and response protocols</li> </ul>	<p style="text-align: center;"><b>Responsibility</b></p> <p>Routine part of FiA activity at Provincial level Some consultancy support may be appropriate for the pilot lots Years 2-6 and on-going</p>	<p style="text-align: center;"><b>Risks and assumptions</b></p> <p>Risk of heavy bureaucratic burden with limited practical impact Will depend on working with farmers on participatory development of an effective and appropriate water and disease management system. Much guidance is available.</p>

<p>2. Develop and implement a Good Aquaculture Practice (GAP) standard for aquaculture in Cambodia</p>	<ul style="list-style-type: none"> <li>• Review existing GAP standards (global and regional, and FAO guidance)</li> <li>• Develop a graded (small scale; SME; large scale) GAP standard for Cambodia</li> <li>• Disseminate through extension/information systems under objective 4</li> <li>• Require full compliance within aquaculture zones, and minimum compliance for any licensee.</li> <li>• Encourage compliance with global standards for exporters</li> </ul>	<p>FIA</p> <p>Plenty of templates available from Vietnam, Thailand, FAO, private sector - but requires some solid work to consult/workshop and agree level grading</p> <p>Years 3-5</p>	<p>Many bad experiences of limited incentive to follow GAP, and significant costs especially for smaller scale producers.</p> <p>Must therefore be kept simple, and traders and buyers should be engaged in the process to lever compliance.</p>
<p><b>Objective 6 (Post-harvest): Increase the quality and value of production</b></p>			
<p><b>Results or outcomes</b></p>			
<ul style="list-style-type: none"> <li>• Farmers able to produce and market a wide range of species and time production in line with market demand</li> <li>• The quality and safety of aquaculture products in local and regional markets is high, and in global markets complies with appropriate international standards</li> <li>• Export revenues are increasing</li> <li>• Incidents of food poisoning/contamination are decreasing</li> <li>• Farmers have access to real-time market information</li> </ul>	<p><b>Indicators</b></p> <p>SPF indicators</p> <ol style="list-style-type: none"> <li>The growth of fish exports</li> <li>Level of crocodile skin production and export</li> <li>The value of fish lost due to poor handling and processing</li> <li>The existence and membership of co-operative associations in the sector</li> <li>The improvement in linkage between markets and products and services at the community level</li> <li>The level of infrastructure available to support the development of fisheries sector</li> <li>The availability of technical guidelines for product standards and good practice and laboratory facilities to support sector stakeholders</li> <li>NSPADC</li> <li>Existence in each province of a focus for market information and product quality standards</li> <li>Up to date market information on fishery products available on the Agricultural market information site</li> </ol>	<p><b>Method/information</b></p>	<p><b>Risks and assumptions</b></p>

Activities	Milestones	Responsibility	Risks and assumptions
1. Enforce licensing and registration of all farm	<ul style="list-style-type: none"> <li>• Enforce licensing as per Fishing Law;</li> <li>• Make license renewal dependent on minimum operating standards, including standard record book</li> </ul>	<p>Routine FiA activity</p> <p>On-going</p>	<p>Licensing of small farms will remain a problem</p> <p>There may need to be some adjustments of the scale thresholds to ensure that all significant production is licensed</p>
2. Promote appropriate use of chemicals	<ul style="list-style-type: none"> <li>• Raise awareness of dangers of inappropriate use of chemicals</li> <li>• Enforce banned chemicals list</li> <li>• Inspections of traders and suppliers, and spot checks on farms in suspect areas</li> <li>• Guidance materials from NAIEC.</li> </ul>	<p>Routine FiA activity</p> <p>Synthesis and dissemination of latest information through NAIEC</p> <p>On-going</p>	<p>Inappropriate chemical use is usually a direct result of poor husbandry, practice, and routine biosecurity.</p> <p>Maintenance of high quality water and high production standards will automatically result in more responsible chemical use</p>
3. Develop, disseminate and enforce where appropriate harvest, post-harvest and transportation standards and guidelines	<ul style="list-style-type: none"> <li>• Ensure harvest protocols incorporated in GAP (Action 22)</li> <li>• Work with Ministry of Commerce and other relevant authorities to develop post-harvest, handling, market and transportation standards and protocols</li> <li>• Work with traders to more efficiently disseminate and promote good practices.</li> <li>• Train traders and buyers to recognize poor or contaminated product</li> <li>• Explore/develop requirement for declarations from traders that product is contaminant free</li> <li>• Develop appropriate documentation</li> <li>• Ensure processing licenses are conditional on appropriate standards - basic standard requirements and formats for process charts, procedures book etc irrespective of HACCP</li> <li>• Develop appropriate back up and support services (inspection regimes, lab services etc)</li> </ul>	<p>FiA (DAD and post-harvest) with MoC and NAIEC</p> <p>Engagement with traders/buyers to promote implementation</p> <p>Years 1-5 and on-going</p>	<p>It will take many years to introduce and implement standards throughout the value chain, given the number of producers/agents involved. Driving standards through key traders in the first instance and steadily expanding out from this base will be the most effective strategy.</p>

4. Strengthen links between GAP and market premium	<ul style="list-style-type: none"> <li>Working with SMEs, farmer groups, and associations, develop traceability and marketing initiatives</li> <li>Work with traders to encourage/facilitate price premium associated with standards</li> </ul>	FiA (post-harvest and DAD) with MoC? Engagement of buyers and traders	Traceability is easier for larger scale operations; and heavy imposition of traceability requirements may adversely affect small-scale producers. FiA will need to work with traders and buyers to promote market benefits from compliance. For example, buyers might be encouraged to apply a price differential related to national standards.
<b>Objective 7 (Finance): To facilitate access to credit as appropriate to the needs, potential and risks associated with aquaculture development</b>			
<b>Results or outcomes</b>			
<ul style="list-style-type: none"> <li>Farmers not excessively constrained by lack of finance</li> <li>Successful farms able to expand significantly</li> </ul>	<p><b>Indicators</b></p> <ol style="list-style-type: none"> <li>Credit loan conditions take account of aquaculture cropping cycles</li> <li>Credit dispensed</li> <li>Default rate</li> <li>Number of SMEs</li> <li>Growth of aquaculture production</li> </ol>	<p><b>Method/information</b></p> <p>Bank data by sector</p> <p>5 year farm survey</p> <p>National statistics</p>	<p><b>Risks and assumptions</b></p> <p>If credit is too readily available, farmers will expand or intensify too rapidly with negative effects on markets and resource use</p>
<b>Activities</b>			
1. Modify standard loan conditions to take account of the length of the production cycle in aquaculture	<p><b>Milestones</b></p> <ul style="list-style-type: none"> <li>Appoint TWG representatives to prepare general aquaculture business case and negotiate with banks and other credit providers for more supportive repayment schedules</li> </ul>	<p><b>Responsibility</b></p> <p>FiA working directly with Banks and NGOs</p>	<p><b>Risks and assumptions</b></p> <p>Banks do not like variations for particular sectors. The case will need to be well made.</p>
2. Support farmer associations in establishing credit group and similar micro-credit initiatives	Extend existing initiatives more widely across the country	Already in progress – maintain and strengthen throughout country	



**Department of Aquaculture Development**  
Fisheries Administration  
#186 Preah Norodom, Sangkat Tonle Bassac,  
Khan Chamcar Mon, Phnom Penh, Cambodia  
Website : [www.fia.gov.kh](http://www.fia.gov.kh)

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