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VCA4D
VALUE CHAIN ANALYSIS FOR DEVELOPMENT

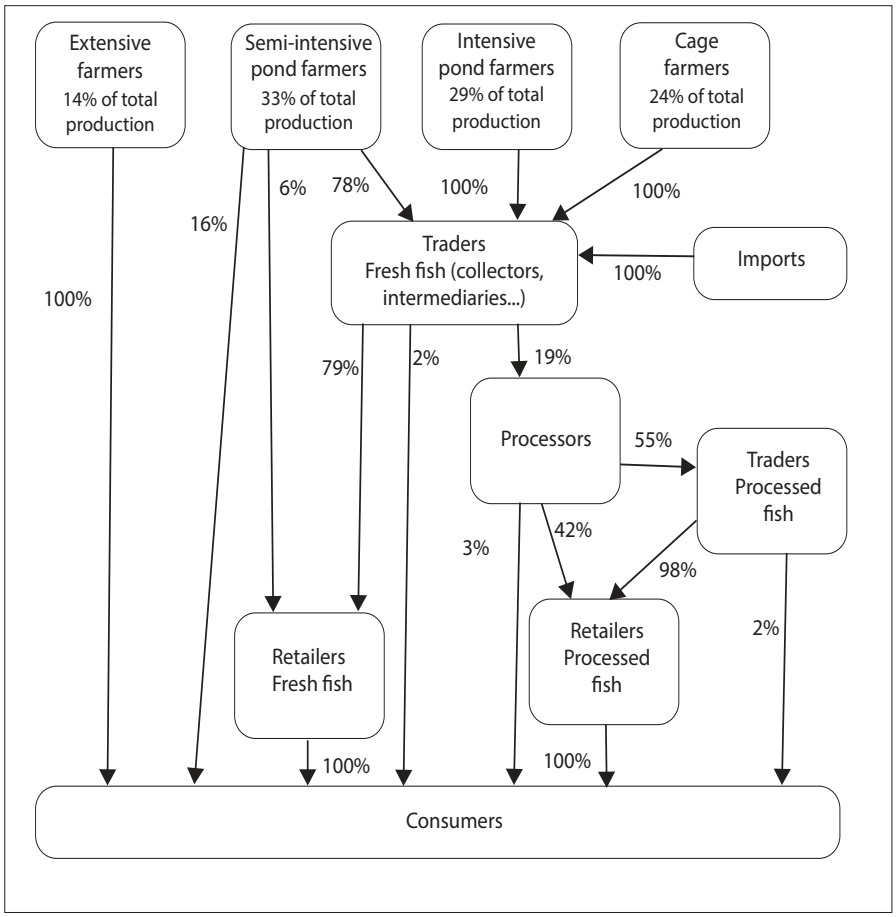
Aquaculture value chain analysis in Cambodia

Value chain analyses assist in informing policy dialogue and investment operations. They help the understanding of how agricultural development fits within market dynamics. They permit an assessment of the value chains' impact on smallholders and businesses.

The European Commission has developed the methodological framework for analysis. It aims to understand to what extent the value chain allows for inclusive growth and whether it is both socially and environmentally sustainable.

The value chain context

Aquaculture development in Cambodia is recent compared to its neighbouring countries in South East Asia. Production has been growing in the last decade, whilst imports of farmed fish from Vietnam and Thailand remain high. Despite general availability of land and less polluted water in Cambodia, the value chain (VC) is suffering from low sanitary standards of inputs and products. Nevertheless, there is significant potential for growth and diversification of species and fish farming systems, in order to supply the domestic and regional markets more efficiently.



The European Union intervention

Agriculture and natural resources management has been identified as a focal sector in the Multiannual Indicative Programme 2014-2020 of the European Union (EU) with Cambodia, with the objective of bolstering the business environment and strengthening VCs.

The EU has identified actions in the fisheries and aquaculture sectors in order to enhance food security, improve nutrition, and increase the value added throughout the VC to benefit rural households, through the 'Cambodia Programme for Sustainable and Inclusive Growth in the Fisheries sector'.

Figure 1 : The product flows of the aquaculture VC in Cambodia

Functional analysis

Farming systems and species

Fresh fish farming systems in Cambodia are diverse, but can be aggregated into **four main systems**: semi-intensive ponds (33% of total volume produced); intensive ponds (29%); freshwater cages and pens (24%); extensive ponds, rice-fish farming, freshwater prawn and frogs (14%) (Figure 1). Semi-intensive systems can be divided into low input (polyculture) or high input (monoculture) systems. The main species are pangasius (fresh/ dried/ fermented), snakehead (fresh/ dried), giant snakehead (fresh/ dried), clarias (fresh/ smoked), climbing perch (fresh), and low-trophic-level species grown in polyculture (fresh) (Figure 2).

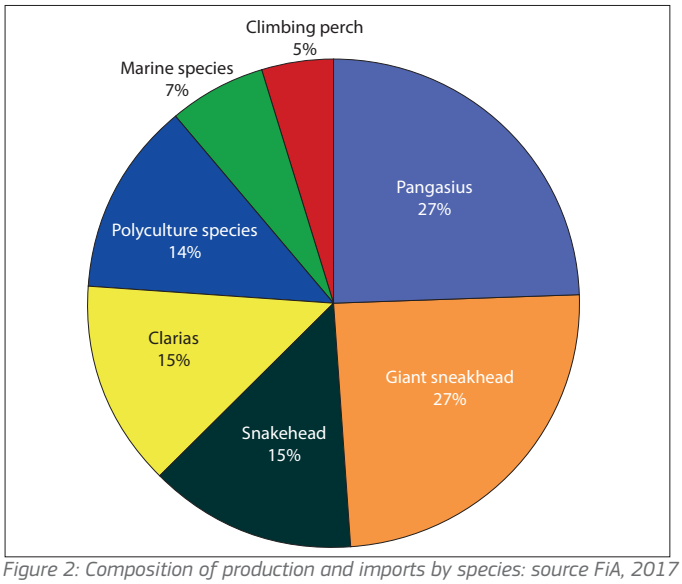


Figure 2: Composition of production and imports by species: source FiA, 2017

Production volume

There is uncertainty about the volume of production. According to the official statistics, freshwater and marine aquaculture production reached **170,000 mt in 2016 (scenario 1)** with an average annual growth of 20% over the last 3 years, in accordance with the national strategic goals for the development of the sector. A calculation according to the cantonment annual reports seems to be closer to a production volume of **82,000 mt (scenario 2)**, although this might also be over-estimated when looking at the potential productivity of farms and according to interviews with key informants. The results presented in this brief are related to scenario 1.

Imports

Cambodian fish farmers are competing with significant volumes of cheap imported fish. While Vietnam and Thailand are geared towards supplying the international market, they also export fish of low quality to Cambodia. The volume of imports are estimated at **120,000 mt** annually. Cambodian consumers prefer nationally produced fish; however, these products may only be affordable for more well-off consumers.

Geographical distribution

Freshwater aquaculture production is concentrated in particular around the **Tonle Sap Lake and River,** while it is less developed along the Mekong River upstream from Phnom Penh. An informal market network with many intermediaries in the chain results in fish being transported extensively in the whole country. Processing is widespread in different areas, but the province of Battambang represents a processing hub, with many processors clustered together in one location. Major urban markets for farmed fish include the capital city Phnom Penh, and provincial capitals such as Ta Khmau (Kandal), Battambang, Siem Reap and Kampong Cham (Figure 3).

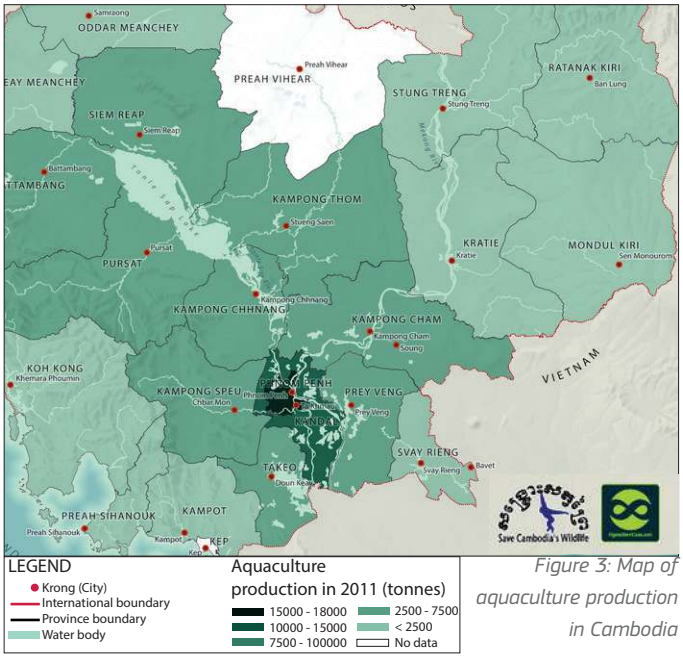


Figure 3: Map of aquaculture production in Cambodia

Inputs

Feed and, to a lesser extent, **seed are the two major inputs for fish farming.** Two types of feed are used: homemade feed and pelleted commercial feed. There is no commercial feed production in Cambodia, although at least one company is considering it. Almost all commercial feed is imported from Vietnam. Low value fish (often referred to as **trash fish**) from capture sources and seafood processing waste are being used as protein inputs into home-made feed. For seed, there are three main sources: local hatcheries (mainly carps, tilapias and barbs), imported from Vietnam (mainly pangasius, snakehead and clarias species), and wild. Significant numbers of snakehead fingerlings are imported informally.

Governance

Transactions in all nodes of the chain are based on fish being traded without formal contracts or agreements. However, transactions still exhibit characteristics of relational coordination in aspects such as reputation and spatial proximity. Social ties play a key role for both parties in a transaction.

Economic analysis

Profitability for the actors

Due to the relatively high costs of consumables, farming fish is weakly profitable for some types of producers, such as cage producers (home-made feed being the major cost) or high input semi-intensive producers. The net profit margin and the return on investment (ROI) are particularly high for the low input semi-intensive producers, the intensive producers, the processors and the retailers. The net profit is high for the traders because of the volume of their sales (Figure 4).

Value added and contribution to growth

The total value added (VA) of the sector has been estimated at **399 million €,** contributing **2.4% to the national GDP**, **9.2% to the agricultural GDP** and **41.2% to the fisheries GDP**.

The rate of integration for the VC (total VA/production) is 83%, demonstrating a good linkage with the national economic activities and strong development potential.

Macro-economic impact

The contribution of the VC to the public funds balance is limited to 0.69% of the national budget, however **the contribution to the budget of the Ministry of Agriculture is 42.6%.** There is contribution from taxes, quotas licenses for licensed imports of fish, feed and seed. At the same time, the Government presently misses out duties on a large volume of unreported / unlicensed imports of both fish and feeds.

The VC balance of trade is negative (**-132 million €**), due to both the high level of imports of farmed fish (67 million €), and inputs (65 million €), and the low level of exports of farmed fish.

As for the viability in the international economy, the prices of imported farmed fish are consistently lower than domestic market prices. However average international prices in the region are higher. The nominal protection coefficient, when calculated with the prices of farmed fish (same species) as it enters Cambodia is therefore higher than 1, while it is below 1 when calculated with the international prices. This corroborates the fact that farmed fish imported into Cambodia is of inferior quality and a 'by-product' of its neighbouring countries.

Growth inclusiveness and jobs

Almost 92% of the direct VA is composed of profits for the actors of the VC (farmers, traders, processors, retailers), **but only 7% goes to farmers and 3% to small farmers** (Figure 5). Nevertheless, the majority of the semi-intensive low input producers have a portfolio of livelihood activities (mainly in agriculture), and fish farming still provides an important contribution to their food security. This is the same for the extensive and rice/fish farmers.

Overall, the VC generates **80,000 jobs** (full-time equivalent). The majority of these jobs are self-employment or family labour (93% is self-employed), while a small proportion is hired labour. Men undertake most of the hired wage labour (63%), particularly for heavier tasks such as digging ponds, lifting, loading and transport. The majority of wage labour is year-round but some is seasonal.

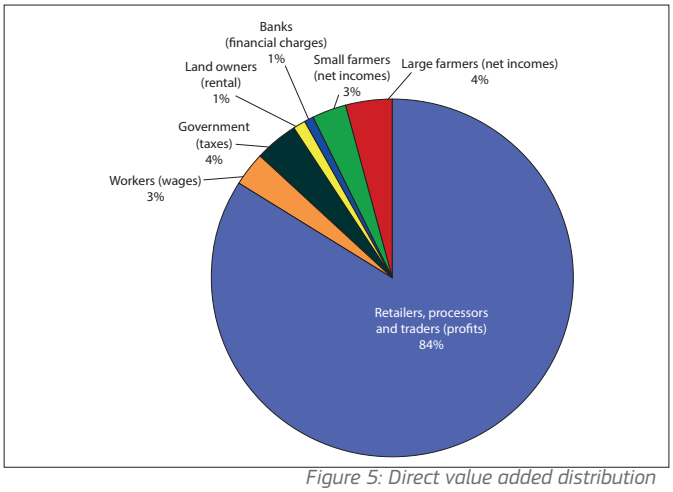


Figure 5: Direct value added distribution

	SI ponds low input producer	SI ponds high input producer	Cage producer	Int. ponds producer	Trader	Processor	Retailer
Output kg	234	6,274	1,695	41,082	515,000	84,000	16,000
Output €	285	8,114	2,187	64,649	825,502	106,409	51,661
Costs	191	7,470	2,125	53,958	776,463	80,377	36,264
Net profit	94	644	62	10,691	49,039	26,032	15,397
Net value added	100	2,281	157	16,108	51,946	29,919	15,524
Net profit margin	32.9%	7.9%	2.8%	16.5%	5.9%	24.5%	29.8%
ROI	49.0%	8.6%	2.9%	19.8%	6.3%	32.4%	42.5%

Legend: SI. Semi-intensive / Int. Intensive / Net profit = output - costs

Figure 4: Costs and profits for the main actors

WHAT IS THE CONTRIBUTION OF THE VALUE CHAIN TO ECONOMIC GROWTH?

The economic sustainability of the VC is threatened by the low profits at farm-level, competition from neighbouring countries and high costs of inputs. This VC contributes more than one third to the fisheries GDP. It presents a high rate of integration within the national economy.

Nevertheless, its contribution to the public funds balance is limited and the impact on the balance of trade negative. Prices for imported farmed fish are consistently lower than those produced locally. However, the average international prices in the region are consistently higher, meaning that farmed fish from Cambodia could be competitive in the global economy if quality is improved.

Social Analysis

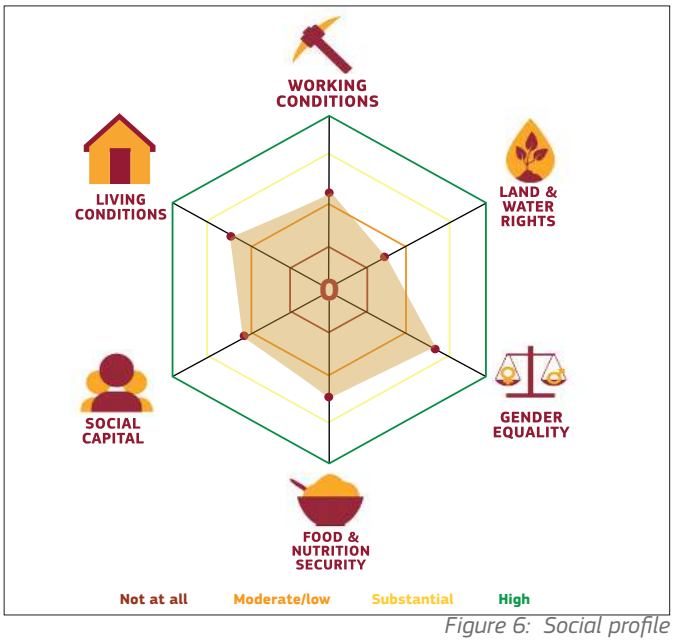


Figure 6: Social profile

Working conditions	• Good wages for workers but limited awareness of the Cambodian Code of Conduct for Responsible Fisheries (CAMCODE). • Health and safety at stake arising from poor handling of fish waste, stagnant water, lack of protective clothing, waste material from garment factories containing plastics used as fuel for cooking fish feed.
Land and water rights	• Low levels of awareness of tenure rights. Commercial expansion of aquaculture could have detrimental environmental impacts on local communities.
Gender equality	• Women participate extensively in aquaculture activities, but are underrepresented in leadership positions and decision making processes in fisheries policy.
Food and nutrition security	• Aquaculture contributes substantially to food and nutrition security of households, especially in areas without capture fisheries • Despite high levels of fish consumption there are still high rates of stunting, underweight and micronutrient deficiencies in children. • Health and nutrition is affected by poor sanitation and water pollution.
Social capital	• Few farmers' organisations at community level. • Limited access to information, training, markets (especially for women that are cage producers).
Living conditions	• Poor sanitation and water pollution also influence the quality of aquaculture production and consumption. • Low access to health and education services, in particular for cage producers.

IS THIS ECONOMIC GROWTH INCLUSIVE?

Prices for farmed fish in Cambodia have seen a downward trend and this puts the long-term sustainability of the sector under pressure. The poorest people in rural communities are less likely to participate than medium to better off households. This is attributed to the lack of land for pond production, and to the limited availability of family labour and of finance.

Women are proportionately more represented in the semi intensive and small cage production systems than in the intensive ponds and large-scale cage production . Landless people can participate in aquaculture through cage production. Further attention to these production systems could create more inclusive opportunities.

Inclusiveness can be further enhanced if interventions on credit and finance, technical information and advisory services for aquaculture are tailored to different scales of operation and made available for women and youth.

IS THE VALUE CHAIN SOCIALLY SUSTAINABLE?

The lack of farmer-based organisations limits the bargaining power of producers. It also inhibits access to information, training and input markets.

Risks arise from the sanitary conditions of production such as water pollution due to poor sanitation and industrial effluent in some locations and fish waste and waste water produced during processing. Social infrastructure is still limited in coverage, services and access (health, sanitation, technical advice, training…) for producers and post-harvest operators, restricting capacity development, product quality and potential benefits.

Nevertheless, the VC appears socially sustainable, but further developments of large-scale enterprises might negatively affect vulnerable groups and the environment if working conditions are not improved.

Environmental analysis

The analysis focused on five production systems crossed with three species or group of species (Figure 7). They were broken down into two groups for comparison: (i) semi-intensive mixed fish and intensive and semi-intensive pangasius systems; (ii) cage and pond snakehead systems. **The main environmental impacts were found on human health and ecosystems quality** (Figure 7).

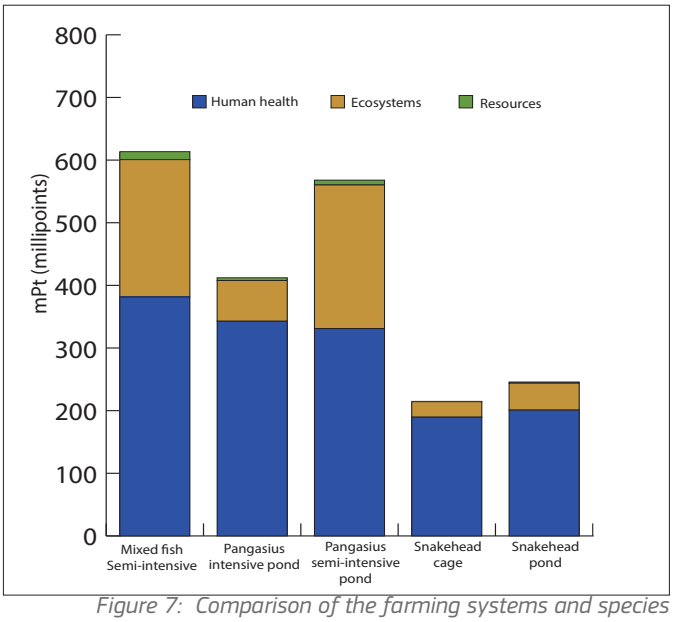


Figure 7: Comparison of the farming systems and species (at farm gate)

Mixed fish and pangasius systems

Due to the inclusion of rice as a feed source, there are high Global Warming Potential (GWP) emissions as well as a contribution to human toxicity as an effect of pesticides used at the production level. Conversion to an alternative selection of raw material for the feed would benefit human toxicity effects; however, this could lead to competing claims on local sources of raw materials. Nevertheless, due to the use of rice by-products in aquaculture, one could argue that although mechanisms for circular economy have been implemented, the inputs still contribute significantly to the VC.

Freshwater ecotoxicity is highest in these production systems (mainly in the intensive ones), the reason being the **release of antibiotics, medicines and chemicals** affecting the ecosystem. These also have a potential feedback to human health.

Snakehead cage and pond systems

Intensive pond cultures and cages have a high impact on freshwater ecotoxicity (antibiotics, chemicals drugs).

One of the main concerns about environmental sustainability is the **pressure on local fish stocks** to be used as feed, although local trash fish used as feed contributes to a lesser extent than rice to GWP emissions.

The drawback of these production systems is the **high toll they take on the ecosystem** and the **depletion of local fish stocks** when extracting the small fish, especially in the Tonle Sap basin, in an uncontrolled and irresponsible way (as it is currently the case), due to its high feed conversion ratio (kg of fish/ kg of feed). This puts a lot of pressure on fresh water resources leading to a decline in catches.

In cage cultures, **the release of undigested nutrients (nitrogen)** via the water, and sediment is higher than in pond systems due to direct interaction with the surrounding waters, and thus greater direct release to the natural system.

Trade and processing

The transport systems for fish, both nationally and for imports, are highly conducive to the contamination and **spread of diseases**. The combustion of fossil fuels for transport (combust toxic components in the air, water and soil) creates human toxicity.

For **processing**, the absence of control on potential disease transmission and the lack of information on the source of inputs and of consideration of intra-species procedures, may be **conducive to diseases**. Organic waste is directly discarded into the river system (fish blood, processing water, etc.) without treatment, leading to local eutrophication and impacts on the local environment in areas with a high level of concentration of activities. The use of fossil fuels, as coal, in periods of rain when the fish are being dried with semi-open oven systems is also an issue.

IS THE VALUE CHAIN ENVIRONMENTALLY SUSTAINABLE?

One of the main concerns about the environmental sustainability of aquaculture is the pressure on local fish stocks for feed use. There are indications of excessive pressure on the fisheries system (declining catches) due to a lack of regulation and enforcement.

The VC is very dynamic with the involvement of a high number of smallholders. However, hygiene practices in the chain are highly limited, leading to food safety risks. Notably, the trade system is highly informal and the transport for both domestic and imported fish contributes to the spread of diseases, by fish and through the water in which they are transported. An adequate system to prevent, control, foresee and avoid disease is not yet in place.

Aquaculture in Cambodia is generally performed on a traditional and low technology basis. From a sustainability perspective this is not directly considered a risk. However, the lack of efficiency, knowledge (capacity and transfer), level of organisation, and application of best farming practices is considered a risk for the sustainable continuation of a large part of the production system.

Main findings

Major risks and specific recommendations

Competition with imported fish: given the present state of the sector and the enabling environment, it is difficult for Cambodia to compete with Thailand and Vietnam on species for which they have an international supply chain and a competitive advantage.

Animal health and food safety: an adequate system to prevent, foresee and avoid disease is not yet in place. A more robust disease management, mitigation and control system is recommended.

Use of low-value freshwater capture fish for home-made feeds: this feed sourcing allows for low CO2 eq emissions and has a particularly high Feed Conversion Ratio. Programmes to develop the accessibility of local commercial feed formulated for the species and conditions of Cambodia are recommended.

Pesticides from Mekong to product and vice versa: accumulation in fish through fresh water trash fish used as feed. It is advisable to analyse the content of residues in feeding fish as well as in end products, to avoid introducing human health problems via new aquaculture procedures (or species).

Lack of good aquaculture practices: are considered risks for the sustainable continuation of a large part of the production system. Further investment in farmer support and knowledge transfer, for both men and women, is needed. Existing strategies and action plans to promote women's participation need active promotion both among fisheries personnel and VC actors, with emphasis on training, practical implementation and monitoring, together with the required financial resources to support this.

Lack of water: there is a risk of lack of sufficient and continuous water supply in some geographical areas, due to the effects of longer dry seasons, and shorter and heavier wet seasons. This implies economic risks. Zoning plans to better address where aquaculture can take place are needed, as areas with low water availability are unlikely to be profitable and sustainable.

Working conditions: There is a need to increase awareness of the content of the CAMCODE. It is important that the conditions of labour are monitored, particularly issues around health and safety, hygiene, working hours and hazards of chemical use for producers.

Nutrition and sanitation: A sustained programme of improvements in sanitation and latrine construction is needed to reduce infections and improve water quality.

General recommendations for sustainability

Contribution to economic growth: as it is currently difficult for the Government to regulate the entrance of fish to Cambodia, it is recommended to improve knowledge on the market's segmentation. This would allow quality to be taken into account in market oriented strategies for development (consumer information, quality control measures, targeting of niche external markets segments for quality fish, etc.).

Social sustainability and inclusiveness: ensure that development efforts recognise the differences in economic capacities and contexts of actors through the different systems and segments of the VC. This suggests a differentiated aquaculture development strategy tailored to different needs (credit and finance, technical information, etc.) to enhance inclusiveness.

Environmental sustainability: reliance on local resources needs to be optimised, and sustainable management of local fisheries is required. Improvement in the efficiency of feed and the use of local resources in the entire aquaculture chain is recommended. Moreover, a targeted disease management and fish health program is required, with attention to knowledge and awareness of farmers.

Value Chain Analysis for Development (VCA4D) is a tool funded by the European Commission / DEVCO and is implemented in partnership with Agrinatura. **Agrinatura** (http://agrinatura-eu.eu) is the European Alliance of Universities and Research Centers involved in agricultural research and capacity building for development. The information and knowledge produced through the VC studies are intended to support **the Delegations of the European Union** and their partners in improving policy dialogue, investing in VC and better understanding the changes linked to their actions.

VCA4D uses a systematic methodological framework for analysing VC in agriculture, livestock, fishery, aquaculture and agroforestry. More information including reports and communication material can be found at: https://europa.eu/capacity4dev/value-chain-analysis-for-development-vca4d-

This document is based on the report "Aquaculture Value Chain Analysis in Cambodia 2017", by Froukje Kruijssen (KIT), Adrienne Martin (NRI), Marnix Poelman (WUR), Viryak Sem (national expert) Only the original report binds the authors.