SDM Analysis Chicoa Fish Farm

Public Version

August 2020

Note that this SDM was being designed at time of the analysis. The report explores possible ways of implementing the out grower scheme, it is not a description of the actual or future model. Chicoa Fish Farms has used the results of this analysis to inform their potential out grower strategy and business model, but cannot be held accountable to meeting any targets included in the report.

Purpose of this study

1. Understanding the **strategy, profitability and sustainability** of Chicoa

2. Assessing to what extent Chicoa is able to manage **an inclusive outgrower model that helps earn farmers a living income**

3. Identifying **opportunities for technical assistance or investment** to improve the sustainability of Chicoa

Report outline

- Executive Summary
- Context
- SDM overview
- SDM performance
- Farmer performance
- Recommendations
- Annex

1. Executive Summary

Executive summary | the opportunity

Investment opportunity

- In Mozambique, Zambia, Malawi and South Africa, population growth and increased per capita fish consumption will push fish demand to between 919 and 1,986 metric ton (MT) per year by 2025.
- Traditionally depending on wild catch, the fishery sector is in decline, so investments in aquaculture are necessary to ramp up production and meet regional demand.
- Although aquaculture production in these countries has increased over the last few years, total supply only fulfills a fraction of total fish protein demand, and this gap is only set to grow if the limited investments in the sector are not scaled up.
- From a food security perspective tilapia is a promising investment as it is efficiently grown and an affordable source of protein.
- With Mozambique having one of world's lowest Human Development Indexes, and as structural gender disparities exist, growing the sector through scaling up inclusive and gender-sensitive business models provides a clear investment opportunity.

About the Chicoa Fish Farm (CFF) SDM

CFF is an important entry-point to develop the aquaculture sector in Mozambique and surrounding countries. While investments beyond CFF are required (feed mills, multiple training and service centres, processing plants, cold chain storage, distribution networks, etc.), CFF provides a strong foundation to build on and expand from:

- Lake Cahora Bassa, where CFF started in 2015, is ideally suited for fish farming due to favorable geographic, climate and water conditions. There are still large untapped areas for aquaculture to expand to, beyond the current growth ambitions of CFF.
- Building on their previous experience, CFF has set up a state-of-the art vertically integrated tilapia hatchery and production site.
- Already during early stages CFF has been able to attract private and public funding enabling investment to build its operations.
- With their core operations running, they are currently seeking to expand its services to nearby smallholder farmers (SHF) aiming to create employment opportunities and sustainable development in the region.
- CFF seeks to offer a full-service package consisting of training (farming, business practices, coaching, organizational skills), inputs (feed, fingerlings and cages), and access to markets and finance.
- CFF will mainly target nearby communities to become part of their SHF program, but will also supply services to independent individuals and small businesses.
- Moreover, the CFF team is knowledgeable about and sensitive to the business' social and environmental impact.

Executive summary | main barriers and risks to overcome

Main barriers to scale

- **Organizational capacity:** one of the main growth drivers is the farmer training throughput rate, limited by the capacity of CFF's production site to support trainees and the number of demo plot cages available for trainees (initially set at 12 cages per production cycle of 6 months). A faster throughput rate and an additional demo plot would increase the SDMs scale in number of farmers and production volumes.
- **Limited potential value capture:** given baseline assumptions on cage size and number of cages per farmer, annual production volumes and income per farmer remain low. As a result the SDM is unable to create enough value and charge fees that are sufficient to cover the cost of services without reducing farmer incomes to unsustainable levels. Larger cages and a more efficient cage-setup can significantly boost production volumes and farmer incomes, generating more value to be captured by the SDM.
- **No organizational and/or lending infrastructure:** there are no formal or informal SHF organizational entities with which service agreements can be made, nor through which loans can be extended to individual farmers. A combination of CFF balance sheet finance and VSLA-like (Village Savings and Loan Association) SHF groups should be in place to facilitate on-credit provision of inputs and equipment.
- **Non-existent smallholder aquaculture:** strongly limiting the growth rate of the SDM is absence of smallholder aquaculture in the region. Locals have no experience in aquaculture, many lack literary and/or business skills, and few have the resources to invest in setting up their own farms. An effective training program and on-going coaching and supervision is required to generate desired results. For further scale up CFF will need to look beyond the direct vicinity of their current vertically integrated farm and SHF service hub.
- **Limited aquaculture infrastructure:** CFF is limited by the lack of infrastructure such as no in-country feed mills and limited cold chain storage facilities. In order to achieve actual scale and impact, investors will need to have a regional and sector-wide perspective, investing in multiple feed mills, processing and cold storage facilities, connecting producers, and replicating vertically integrated service hubs such as CFF and a financial mechanism (e.g., a revolving fund) to facilitate SHF on-lending.

Main risks

- **Founder dependency**: currently CFF operations are still heavily dependent on the two founders with extensive experience and critical feed, production and fish breeding capabilities. CFF would need to quickly strengthen its core team, transfer responsibilities and find ways to disseminate the knowledge the two founders hold.
- **Farmer performance:** the projected productivity and profitability of the SHF managed cages is unproven in this context. Without adequate supervision, testing, data collection and an approach to continuous improvement, productivity and farmer income targets will probably not be met.
- **Farmer relationships:** many farmers in the region are illiterate; many have never engaged in entrepreneurial activities and few of them have experience in working in group settings. At the same time, SHFs are expected to manage tilapia for 6 months, engage in contracts with multi-year loan repayment agreements and collaborate in group-settings. Whether intentional or unintentional the cause, without effective training, coaching and relationship management, this could lead to farmers quitting, farmers not repaying and/or uneven distribution of profits among them.
- **License to operate:** as CFF grows it will attract increasing attention from local entrepreneurs, communities, governments and other businesses with economic and/or political interests. While some might seek to collaborate, others might seek to hinder CFF's success. This can be in the form of local disputes, unreasonably strict legal requirements to operate or long administrative processes. Without a clear understanding of the local politics and proactive risk-management, this could drive up costs and delay scale-up.

Executive summary | recommendations

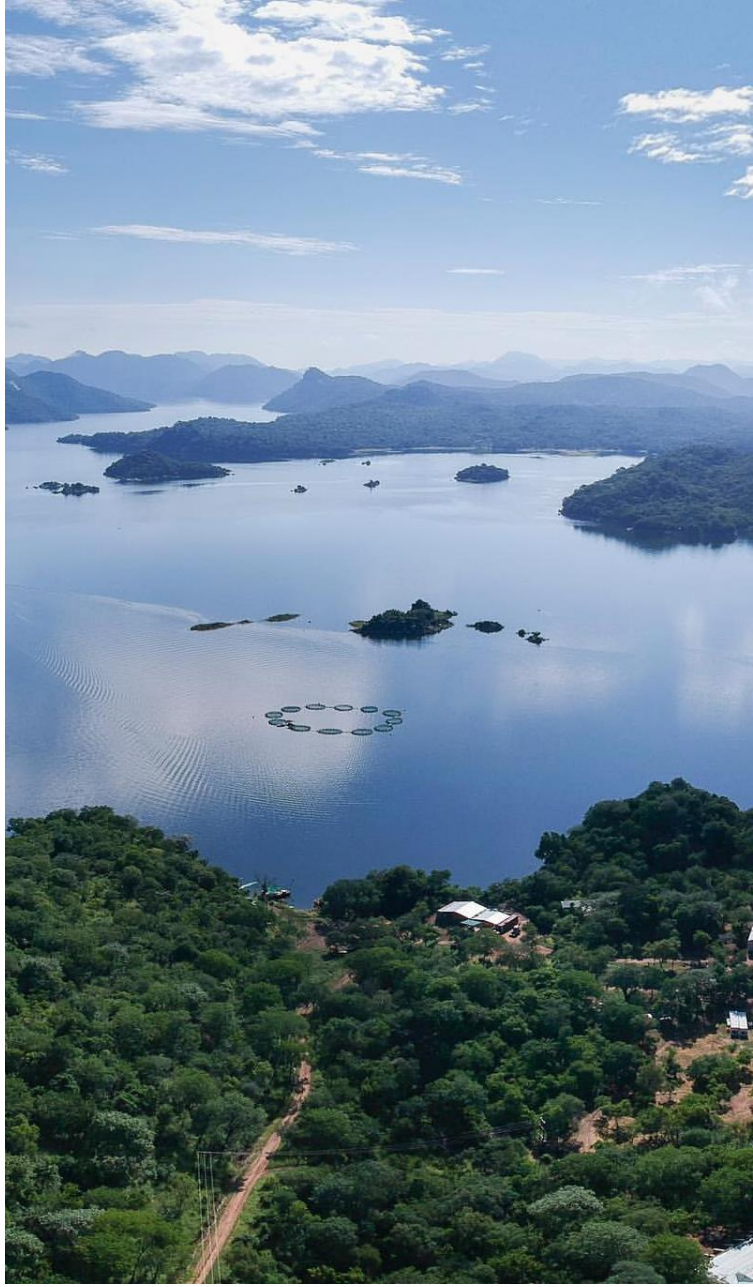
Narrow SDM

Scope

Broad Sector-wide

Key recommendations to strengthen the SDM and increase profitability and impact compared to the baseline scenario (as shown in graphs on the next slide).

1. **Improve organizational setup:** investing in an additional demo plot allows training 24 (versus 12) farmers per 6-month production cycle, resulting in 552 (instead of 276) trained farmers by 2025. Building larger cages and implementing larger cage setups (i.e., fewer farmers per cage) will improve SHF incomes from $277 to $567 per farmer per year. A data infrastructure needs to be in place to monitor results and improve cage design. By increasing production and farmer incomes, the SDM can then charge appropriate fees to cover the costs of service provision.
2. **Attract support for VSLA capacity building and administration:** SHFs would need to be organized into VSLAs to save upfront, organize among themselves (based on complementary skills) and receive inputs and equipment on credit. Working with these informal groups, coupled with working capital financing via CFF's balance sheet, has several benefits over setting up formal cooperatives. Regardless, extensive capacity building beyond CFF's current expertise is required to set up well-functioning VSLAs with which CFF can sign long-term service and repayment contracts.
3. **Co-design and implementation of farmer on-lending infrastructure:** to provide the input and equipment loans the SDM requires a financial manager and financial/legal entity to manage working capital and cash-flows. Moreover, it must have a data collection infrastructure and contracts with SHFs in place to manage repayments, track performance and mitigate risks of defaults. While on the short term CFF could manage the financials for this project, on the longer term a region-wide revolving fund could be established to facilitate SHF beyond the scope of CFF.
4. **Collaboration on social inclusive strategy for the sector:** CFF follows an ambitious socially-inclusive strategy, caring for its workers and future SHFs. Setting the example, the SDM can greatly contribute to building an inclusive aquaculture sector. The SDM and NGOs should work closely together in implementing industry best practices; learning from future efforts; and sharing those lessons with the wider aquaculture sector as it develops.
5. **Feasibility study on feed cost reduction:** while the soon to be constructed feed mill reduces feed costs (avoiding 17% IVA) it also creates a growing market for locally produced soy and maize – an opportunity to further develop smallholder farming in the region. Another promising alternative is insect-based feeds. A feasibility study should be conducted to map the agro-climatic conditions, potential farmer base, existing and required infrastructure, the business model and potential implementing partners for both soy/maize and insect-based feeds production.

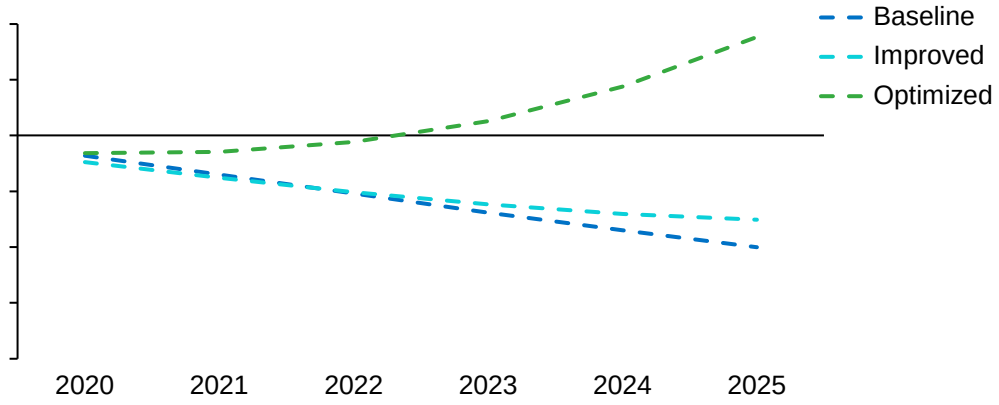


Executive summary | estimated impact of recommendations

Projected SDM performance by 2025

CFF cumulative EBITDA

Includes sourcing/service revenues and expenses

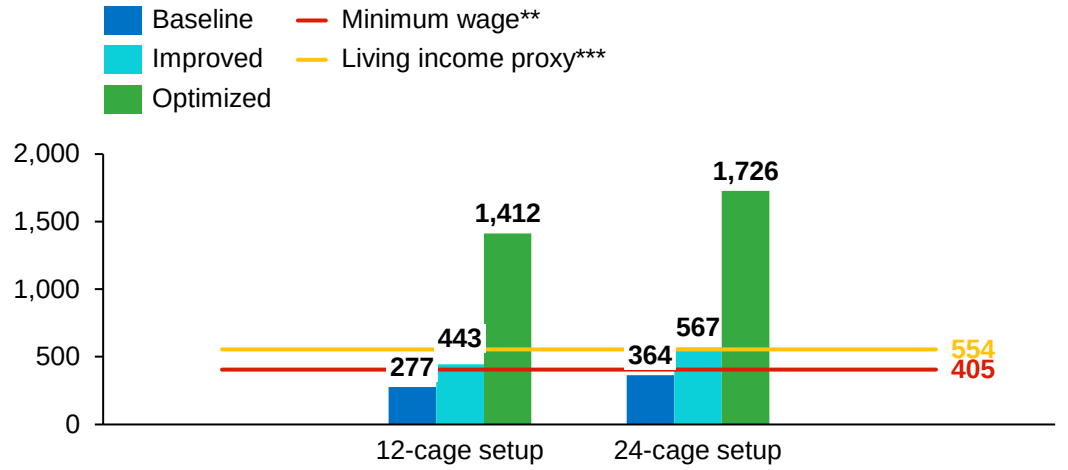


**Revenues, expenses and Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA) have been calculated as if the SDM is a standalone entity.*
*** Baseline assumptions are those that have been defined in early-stage conversations during this SDM analysis. Throughout the process, alternative scenarios have been developed, tested and proposed (see for outcomes, the results on the next slide).*

Projected farmer performance by 2025

Annual household income per cage setup* in USD/year

Compared to poverty line and living income proxy



** Cage setups are described in more detail here*
*** The minimum wage in the fishery sector is equal to 4,390 MZN per month*
**** The living income proxy is set by CFF stating that an individual should make a minimum of 6,000 MZN per month.*

Near the finalization of the SDM analysis, key assumptions on cage setup and prices charged to farmers have been revised, resulting in a commercially viable smallholder business model and increased per farmer incomes. The outcomes of this scenario are added later – after the full draft writeup – and marked green in above graphs and throughout the report.

Please note that all figures and graphs in this report are projections. At time of writing no actual smallholder model exists beyond the first batch of trainees being signed up and the first cage prototypes being constructed. Various scenarios have been explored – do not use numbers without proper understanding of underlying assumptions, practical limitations and feasibility.

Executive summary | exploring unchartered territories

Rationale for investing in CFF to contribute to sector development

- **Professionalism:** the CFF SDM is a sophisticated, premium quality model that comprises of high quality, durable materials (e.g. long optimized feed performance; healthy fingerlings and resulting fish; the cages have a lifespan of about 10 years).
- **Social inclusiveness:** at the same time the model takes into account systemic inequalities, such as deeply entrenched gender imbalances / patriarchal norms; equitable access for small-scale farmers; youth employment; the longer-term impact on an individual's development and livelihood when they are denied adequate education during their childhood, and how these factors need to be addressed within the design of the SDM in order to create a sustainable aquaculture sector.
- **Frontrunner:** CFF can be considered a frontrunner in various areas: no successful aquaculture ventures exist in Mozambique; comparable, high-quality, vertically integrated SHF tilapia models in Sub-Saharan Africa (SSA) are few; communities in the region are largely unorganized and have no experience with fish farming; hardly any agribusinesses in the region seeks to structurally address social issues such as illiteracy, gender disparities and youth unemployment. Setting up, testing and developing a model that has not been done before without existing infrastructure to support it, requires significant initial outlay investment.

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- **Impact before scale:** CFF seeks to strike a balance between creating a model that will be truly transformative and successful for those who engage in it, and economies of scale. The former requires CFF to start smaller, at a greater cost, with close oversight and with scalability and modularity in mind. At the same time scale needs to be achieved relatively quickly to ensure commercial viability of the business and generate sector-level impact.
- **Partnerships to scale:** the ideal scenario would be to find funding for the more expensive smaller start up, but to design that model in a way that is predisposed to scaling (e.g. the cubes cage set up), has a lot of reviewing stages factored in for adjusting to learnings as we implement, and to couple this with key partnerships that emphasise and enhance the value of the project. Examples of key partnerships are local authorities for buy in/ support; national institutes for learning purposes; NGOs that support livelihood development or provide business/ literacy/other skills training the participants would need; funding partners; and retail outlets.
- **Laying the foundations for sector development:** other African countries may have fairly well-established routes to market for fresh fish - Mozambique does not. CFF is simultaneously investing in developing this infrastructure and trying to remain functioning during COVID-19, scale in accordance with business projections, develop the local markets, create awareness about tilapia amongst all levels of consumers, differentiate their product, and also empower/ provide opportunities for local solutions/ efficiencies to organically step in and address these gaps.

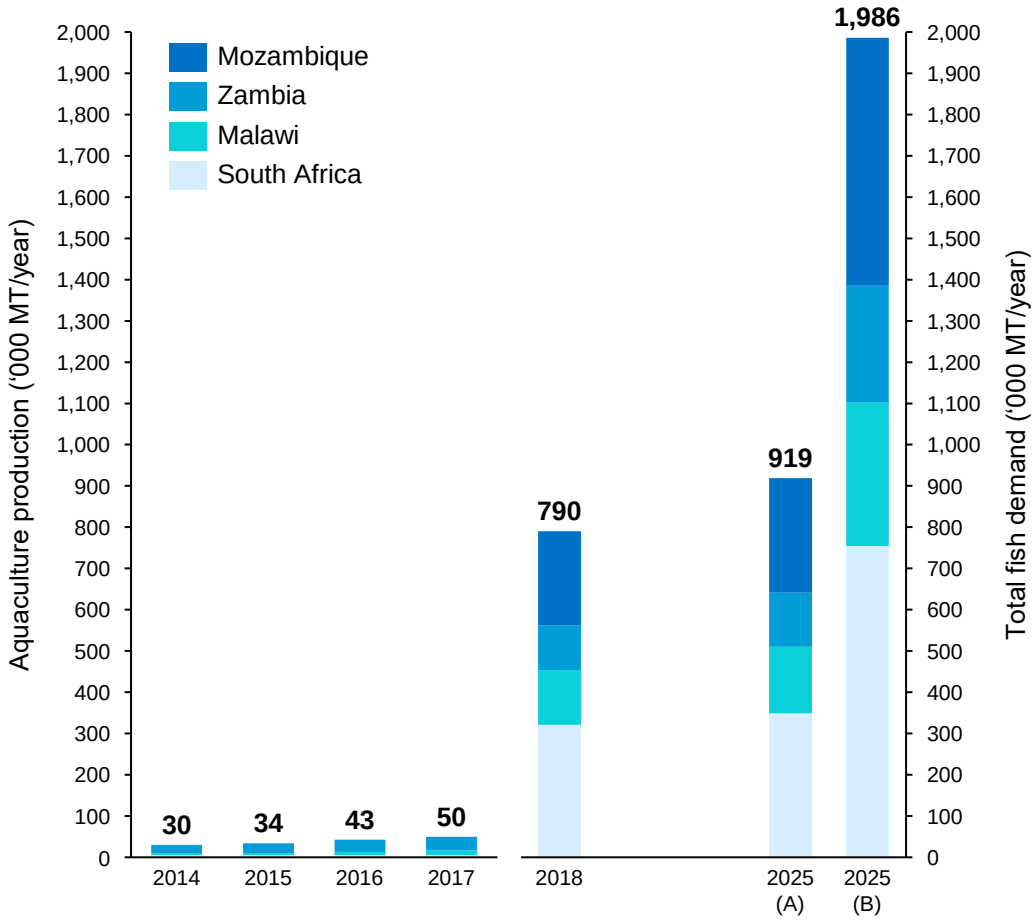
2. Context

Introducing the Mozambican aquaculture sector, its challenges and priorities

Aquaculture development is essential to meet a growing protein demand

Total annual aquaculture production ('000 MT) per country[4]

Total annual fish demand (in '000 MT) per country



Projected demand for protein

The markets where Chicoa currently sells (Mozambique, Zambia, Malawi and South Africa), had a combined annual demand for fish of **790,000 MT/year in 2018**. The range of future demand is captured in two scenarios:

- **Scenario A:** based on population growth projections by the World Bank[1] and assuming constant fish protein intake, this will grow to **919,000 MT/year by 2025** (16%).
- **Scenario B:** understanding per capita fish consumption correlates with GDP per capita[2], and assuming an increase in fish consumption per capita close to the worldwide average protein demand, fish demand can grow up to **1,986,000 MT/year by 2025** (151%).
  - Mozambique, Zambia and Malawi all experienced above average GDP pc growth in the past 5 years, while South Africa's GDP pc growth in this period was slightly below average.[3]

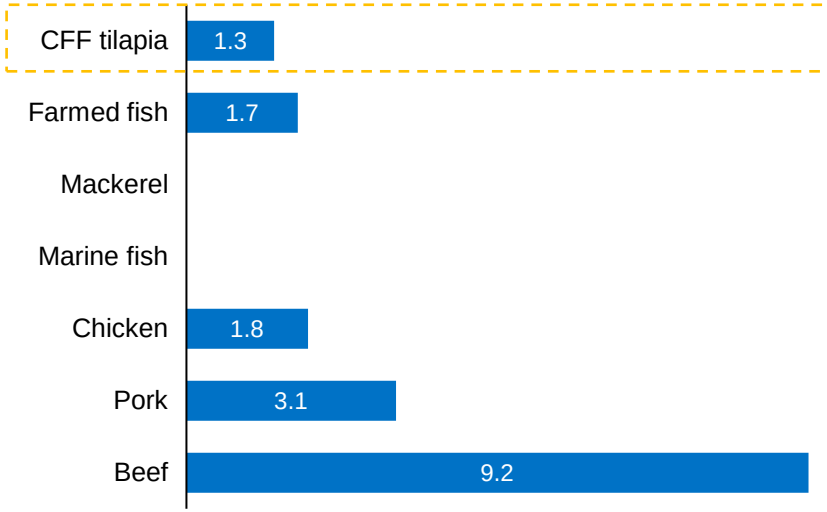
Aquaculture sector

- Aquaculture is increasing regionally (Mozambique, Zambia, Malawi and South Africa), with production almost tripling between 2010 and 2017.[4]
- Mozambique's aquaculture sector is nascent, especially in comparison with neighbouring countries.
- Currently more than 8,000 Mozambican farmers are involved in the practice of small-scale aquaculture.[5]

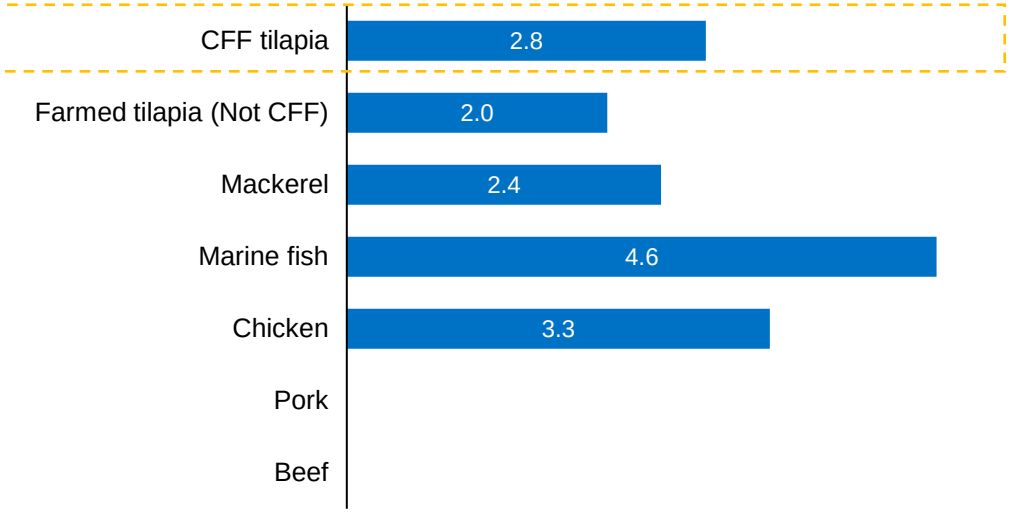
Sources: 1) World Bank population indicator (2019); 2) FAO: The state of world fisheries (2018); 3) World Bank GDP growth indicator (2018); 4) FAO FishStat (2019); 5) Club of Mozambique (2019)

Efficiently grown tilapia is an affordable source of protein

Average Food Conversion Ratio (FCR)[1,2]
Kg of feed required to gain 1 kg of body weight



Price point comparison[3]
USD per kg of different sources of protein



Fish farming is a more **efficient way to produce animal protein** than other livestock for two primary reasons.

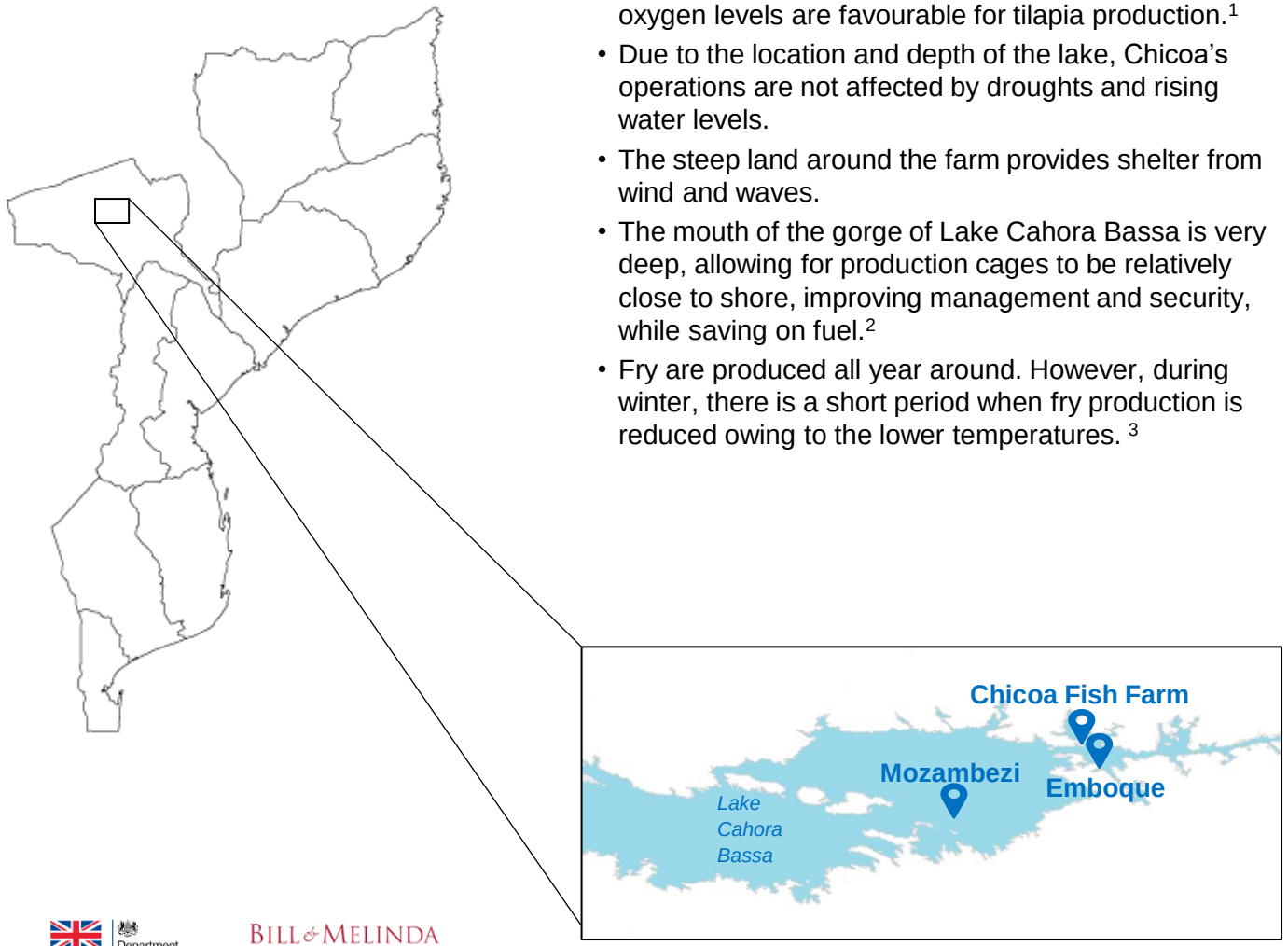
- Metabolism: unlike warm-blooded land grazers, fish are cold blooded and require less energy to maintain their metabolism.
- Water environment: fish expend less energy to maintain upright in the water column, whereas livestock have to contend with gravity.

Fish is an **affordable source of protein** compared to other sources of animal protein.

- Chicoa's tilapia competes with other sources of affordable protein, mainly chicken and other types of farmed and wild caught fish.
- The farmed tilapia is mainly imported from China. This is of considerably lower quality, and therefore not Chicoa's direct competitor.
- Some prices differ between markets. The graph shows the average price across all markets.

Sources: 1) FCR efficiency, Jillian P. Fry et al (2018); 2) Comparative economics, Ramon M. Kourie (2017); 3) CFF Sales and Distribution Strategy 2018-2025 (2018)

Lake Cahora Bassa is ideal for aquaculture development



Growing conditions

- High water quality, large water exchange and high oxygen levels are favourable for tilapia production.[1]
- Due to the location and depth of the lake, Chicoa's operations are not affected by droughts and rising water levels.
- The steep land around the farm provides shelter from wind and waves.
- The mouth of the gorge of Lake Cahora Bassa is very deep, allowing for production cages to be relatively close to shore, improving management and security, while saving on fuel.[2]
- Fry are produced all year around. However, during winter, there is a short period when fry production is reduced owing to the lower temperatures. [3]

Activity around Lake Cahora Bassa

- Lake Cahora Bassa has an area of 2,750 square kilometers, making it Africa's fourth-largest artificial lake.[4]
- There are two main fish species that are caught and commercially sold : Kapenta and Nile tilapia.
  - **Kapenta** is not as capital intensive as aquaculture. The kapenta industry has been operational for more than 20 years on the lake. It is well-established as an industry, including commercial companies and small-scale fishermen.
  - **Nile tilapia** occurs naturally in the lake and is captured by local fishermen. These catches are then sold to regional traders, some trading as far as the Great Lakes region.
- Tiger fish, Nile tilapia and other species are caught for subsistence.

The only other aquaculture ventures have a few tilapia cages or ponds as a side project, while their core business is kapenta fishing. Chicoa Is situated in Emboque, this is the largest village on the lake, comprising around 2,000 people. Other smaller settlements are scattered around the lake and on the route to Tete.

Sources: 1) NABC (2015); 2) Chicoa website (2020); 3) Chicoa investor deck (2019); 4) Chicoa Project Proposal (2018)

UKaid Department for International Development

BILL & MELINDA GATES foundation

CHICOA FISH FARM

the sustainable trade initiative

3. Strategy

Understanding CFF's strategy and business model

As an established fish farm in Mozambique, CFF is well positioned to start serving smallholder farmers in the region

Establishment

- CFF was founded in 2015 by Gerry McCollum and Damien Legros.
- Gerry is an engineer with over 20 years experience in aquaculture in Africa, and Damien is an aquaculturalist who (over 30 years) has set up multiple tilapia farms in Africa and around the world.
- Since its establishment it has received USD 3,285,000 of funding from 3 different investors and USD 1,180,000 from 4 different institutional funding partners.

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CFF operations

- CFF is a vertically integrated company that breeds, grows, sells and exports tilapia fish.
- They sell three different products; Fresh whole round fish on ice, frozen whole gutted fish and frozen fillet.
- Currently their main markets are Mozambique, Malawi and Zambia, but they aspire to extend to Zimbabwe, South-Africa and Tanzania.
- CFF currently has 85 employees working on the farm.
- Their sales amount to around 150 MT per year (2018).
- They want to grow their current site to a production of 5,000 MT/year by 2025.
- CFF aims for further vertical integration, constructing a feed mill and a processing plant.

Smallholder program

- Chicoa aspires to extend their business with an outgrower model. By 2025 they aim to include 450 smallholder farmers in this program to create local impact and boost the aquaculture sector.
- Their farm will serve as a ‘center of excellence’ for these outgrowers and will boost the aquaculture sector in the region.
- They will provide these outgrowers with services, like loans, inputs and training, to help them start up their own fish farms.
- Chicoa also invests in local impact projects like a school and a clinic. When Chicoa is at full size (producing 5,000 MT/year) these investments are expected to be USD 100,000 per year.

To grow their business and the sector, CFF builds on their expertise to achieve vertical integration and optimize operations

Goals & Aspirations

- Become leading fish producer in the region (5,000 MT/year by 2025)
- Produce tilapia efficiently and sustainably
- Boost economic prosperity in the region through job creation (pay minimum wage and benefits to 100 employees by 2025) and entrepreneurship (450 smallholder farmers reached, producing 3,000 MT/year by 2025)
- Have farmers earn incomes of 6,000 MZN per month
- Improve livelihoods through social projects (school, healthcare) and food security (local sales of protein)

Where to Play

High Priority Areas

- Build strong presence in Mozambique, Zambia, Malawi and South Africa
- Focus on fish sales to high-end customers via restaurants
- Focus on fry and feed sales to communities, entrepreneurs and other businesses around the lake

Lower "priority" areas

- Direct sales via local markets
- Encourage sales by entrepreneurs to communities
- When successful, expand fry and feed sales to other regions in Mozambique

How to Win

Points of Differentiation

- Benefit from first mover advantage and investment momentum
- Maintain high level of professionalism and efficiency of operations
- Differentiate products in terms of quality and product type (heads, fillets, whole fish, color of the fish)
- Focus on fish sales first, while developing breeding and feed production capacity (vertical integration)
- Create synergies and mitigate risk by developing aquaculture activity in the region

Points of parity

- Maintain good relationships with local stakeholders
- Suitable farming conditions
- Proximity to markets

Capabilities Required

- Investors with experience in aquaculture, willing to take on long positions
- Management team that is able to draw in investment, build a local team and phase out as company scales
- Extensive experience and knowledge of fish breeding and feeding operations
- Locally empowered marketing and sales team
- Continuous monitoring and improvement processes in place
- Local authority/leadership within the company to transfer knowledge
- Effective relationship management with local stakeholders for buy -in and risk mitigation

Clear opportunities exist to leverage CFF to facilitate scale of and positive impact within the aquaculture sector

	Helpful	Harmful
Internal	**Strengths** • CFF has established markets in Tete, Nampula, Palma, Maputo and Beira • CFF has built cold chain storage facilities and coordinates with others to optimize its efficiency • CFF has extensive experience in fish breeding in African contexts ensuring healthy fingerlings • CFF has extensive experience in feed production leading to high-quality feed with low FCR[1] • CFF's team is well positioned to tackle gender-related challenges, actively aiming to recruit women, providing them with equal opportunities (e.g., providing 3 months maternity leave) • CFF commits to paying a living wage (incl. housing allowances) to all their employees • CFF has a strong employee training program in place • CFF has strategically built their farm to capitalize on ideal aquaculture conditions: in an area sheltered from wind and waves, with deep waters and close to the shore • CFF monitors and tests their fish regularly for any diseases; takes sanitary precautions to avoid contamination from external sources; avoids introducing other tilapia strains to the lake • Farmers will be taught how to identify and control diseases	**Weaknesses** • Operations are heavily dependent on its founders and their experience and expertise • Feed is still imported, requiring to pay a 17% IVA tax when resold to small scale farmers[4] • CFF is in a remote area, with very limited existing infrastructure • CFF has no experience setting up a smallholder model
External	**Opportunities** • CFF's tilapia is a relative cheap, local source of protein, and it is enriched with Omega 3 which makes it more nutritious than wild fish • There is no aquaculture competition in the nearby region nor on the lake • The population of this region is among the fastest growing in the world[2], and GDP is increasing[3]. Based on the African average, the potential demand for fish in the region is 400,000 tons per annum.[4] • By constructing a feed mill in-country, CFF can be exempt from the 17% IVA tax they currently have to add when reselling to farmers. • Local unemployment is high and rising. People are looking for jobs and entrepreneurial activities • Food security in Emboque is low; most proteins are being imported. • Educational and healthcare facilities in Emboque are inadequate • Aquaculture is a relatively climate resilient practice • Warm temperatures, high water quality, large water exchange and high oxygen levels are favourable for fish production[4]	**Threats** • Tilapia perishes quickly when it is not cooled, therefore supplying markets is challenging. It requires investment in just-in-time distribution and retail outlets[4] • Theft of produce is a serious issue in the region • For its capital investments and cages, CFF is dependent on imports from mainly China with long travel times • Large gender disparities exist • Literacy is low among all adults, even more among women • Locals have no to limited experience with farming, long-term investments and organizing themselves • CFF is located on a natural water body, that can be exposed to pathology risks

Legend: **Economic** | **Social** | **Environmental**

Sources: 1) Chicoa Project Proposal (2018); 2) World Bank population indicator (2019); 3) World Bank GDP growth indicator (2018); 4) Chicoa investor deck (2019)

A continuous learning approach is necessary to learn what works best in developing smallholder aquaculture in the region

Continuous improvement

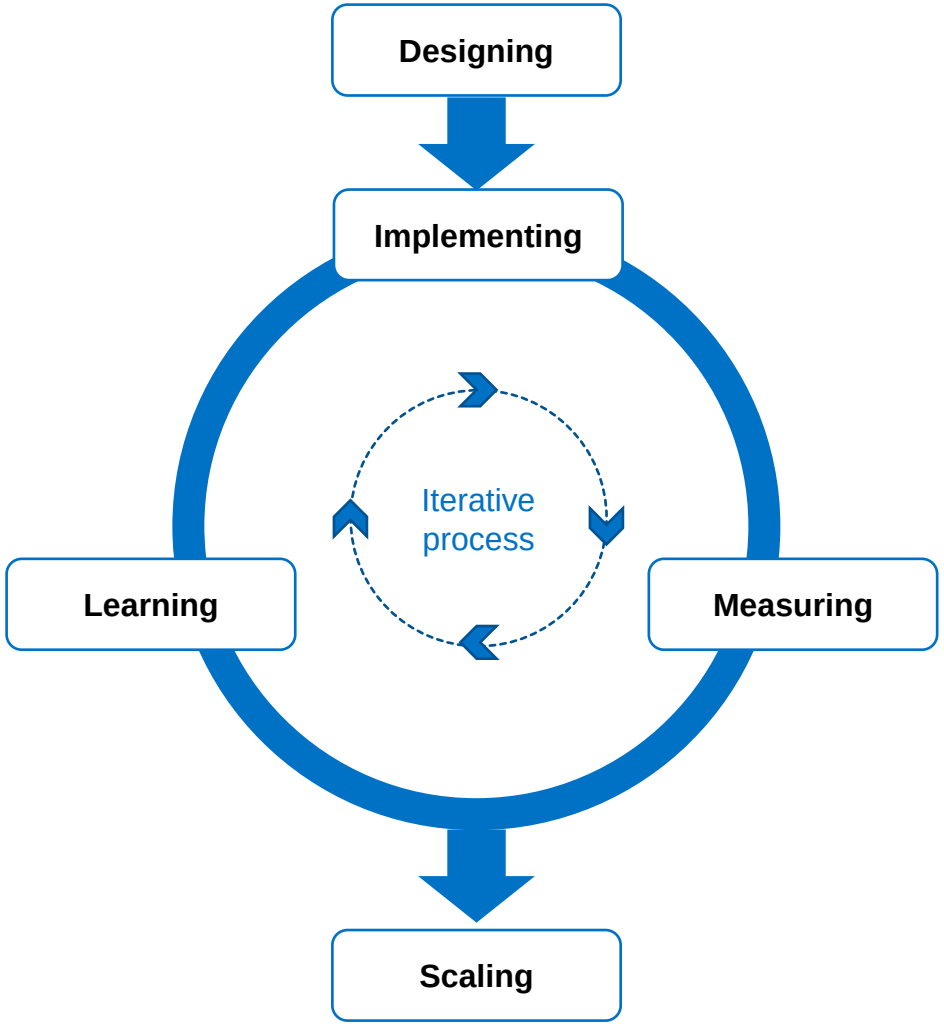
CFF can be considered a frontrunner in various areas:

- No other aquaculture producers with CFF's current capacity are operational in Mozambique
- Comparable, high-quality, vertically integrated SHF tilapia models in SSA are few
- Communities in the region are largely unorganized and have no experience with fish farming

Outcomes

With so many unknowns, it is critical for CFF to continuously pilot, test and improve business ideas and practices before scaling up. This approach has led to multiple innovations to their operations:

- In-water breeding (versus on land)
- Non-intrusive approach to harvesting fry
- Durable, modular cage design for the hatchery and SHF cages



Risk-sharing design of SHF model

Like their hatchery and own production, the SHF model should be implemented and improved based on continuously updated building blocks. Insights can be derived at key moments, such as after completion of the first training, the first SHF harvest, the first year of operations. Working assumptions should be tested as soon as possible:

- Is the farmer recruitment process effective and efficient?
- Is training batches of 24 farmers the most effective and feasible way?
- Are farmers indeed attaining expected yields of 1,350 kg/cage? If not, why?
- Are farmers able to pay back their inputs?
- Are farmers able to independently sell their fish?
- Are farmers willing and able to organize themselves and collectively (independent from CFF) manage a 12-cage setup?

By taking a learning approach CFF can improve their service offering and setup over time.

To run effective operations, CFF relies on input suppliers, knowledge partners, and local authorities

Organization	Organization type	Function (within this SDM)	Revenue model (within this SDM)	Incentive for participation (within this SDM)
CHICOA FISH FARM	Private company (Mozambique)	• Designing of the program • Overall oversight and implementation • Provision of inputs to farmers • Training and coaching farmers	• Increased sales volumes	• Increased sales revenue • Development of the sector • Risk sharing by adding revenue streams from sales of inputs
AQUAZUR	Private company (Mozambique)	• Manufacturing of cages for Chicoa • Manufacturing of cages for outgrowers	• Margin on the sales of cages	• Increased client base • Increased sales
aquafeeds	Private company (Zimbabwe)	• Manufacturing of feed for Chicoa • Manufacturing of feed for outgrowers	• Margin on the sales of feed	• Increased client base • Increased sales
Maize & soya farmers	Farmers (Mozambique)	• Production of maize and soya to supply Chicoa's feed mill (this is a low priority future aspiration)	• Margin on the sales of produce	• Increased sales and income
	Ministry of Sea, Inland Waters and Fisheries (Mozambique)	• A solid partner who will promote and facilitate the development of aquaculture	• None	• Promote and facilitate the development of aquaculture as a priority area over the next decade
AGÊNCIA DO ZAMBEZE	Government body (Mozambique)	• Potential partner for the outgrower project • Potentially complicating the development of sector due to bureaucracy and diverging interests	• None	• Facilitate and support economic and social development in the region

To reach its impact and return targets its depends on a combination of investments from private and public sector

Organization	Organization type	Function (within this SDM)	Revenue model (within this SDM)	Incentive for participation (within this SDM)
AQUA SPARK	Investment fund (The Netherlands)	• Investment	• Return on investment	• Realize effective and lasting impact • Extract learnings on upscaling of sustainable aquaculture businesses in Africa
Private investors and minority shareholders	Private investors (The Netherlands and Southern Africa)	• Investment	• Return on investment	• Return on investment
DEG KFW BANKENGRUPPE	Development bank (Germany)	• Financing and support	• Return on investment	• Generating local added value and promoting private sector investments in emerging countries
idh the sustainable trade initiative	Foundation (The Netherlands)	• Aid in designing / setting up the SDM • Prototype SDM models through technical assistance	• None (grant funded)	• Catalyse investment into smallholder business models to create sustainability at scale
gain Global Alliance for Improved Nutrition	Foundation (Switzerland)	• Financing of equipment	• None (grant funded)	• Improve food security and nutrition for vulnerable people
AGRICULTURE FAST TRACK	Multi-donor trust fund (throughout Africa)	• Defray preparation costs	• None (grant funded)	• Contribute to food security and support to smallholders

While benefitting the wider community, CFF will primarily be working with farmer groups and individual entrepreneurs…

Scope of SDM analysis

	Farmer groups	Individual farmers	Businesses	Communities	Buyers
Description	People from the local community looking to set up their own fish farms.	Independent entrepreneurs from the region.	Formal aquaculture businesses in the region (e.g. Mozambezi).	People surrounding Cahora Bassa, mainly poor and unschooled.	Local end consumers from the region (Mozambique and neighboring countries).
Service needs	Looking for opportunities to generate income out of bare necessity. They are often illiterate and lack the knowledge and means (individually) to start fish farming.	Seek to generate more income, often building on existing businesses. They need high quality fry and feed, and possibly also coaching from Chicoa. Already have potential to invest.	These organizations need high quality fry and feed for effective tilapia production.	Basic necessities like, among others, employment and education.	Affordable and nutritious sources of protein.
Services provided	• Training • Coaching • Cages on credit • Feed • Fingerlings • Financial services • Support for sales and distribution	• Coaching • Cages on credit • Feed • Fingerlings	• Quality feed • Quality fingerlings	Employment opportunities Schooling Medical facilities Infrastructure	The different tilapia products produced by CFF and their small-scale farmers, serve all market segments and all income brackets.

…offering a full farm services package at cost, including farmer organization and access to finance and markets

CFF Operations

Overhead (to be allocated among **own production*** and **outgrower model)**

On-farm production*
- Chicoa breeds their own fingerlings in an on-farm hatchery. These are sold as well as used for their own production.
- In the future, they will also produce their own feed in their on-farm feed mill. This is sold as well as used for their own production.
- They use these inputs to grow, process and sell tilapia.

Community services*
- Chicoa will support the local communities through education, health services, infrastructure, etc.

Farm services

Market access
1. Off taking: Outgrowers sell their fish to Chicoa, Chicoa then processes and resells the fish.
2. Processing: Chicoa charges a fee to process the fish for the outgrowers, who can then sell processed fish.
3. Marketing support: Chicoa supplies the outgrowers with cooler boxes and other necessary equipment to take their fish to market.

Farmer organization
- Chicoa will support outgrowers to organize themselves in an association or cooperative.

Access to finance
- Chicoa will devise a loan/savings scheme that enables small-scale farmers to access the capital needed to start farming.

Training
- People from nearby communities will be trained in fish farming techniques and business management.
- They will then manage their own cages on a CFF supervised demo plot.

Coaching
- Outgrowers and individual farmers can receive coaching and advice from Chicoa.
- They can leverage Chicoa's expertise by asking them all their questions.

Feed
- Chicoa will supply all farmers with high quality fish feed, charging a fee.
- In the future, this feed will be produced by Chicoa itself and the inputs will be sourced locally.

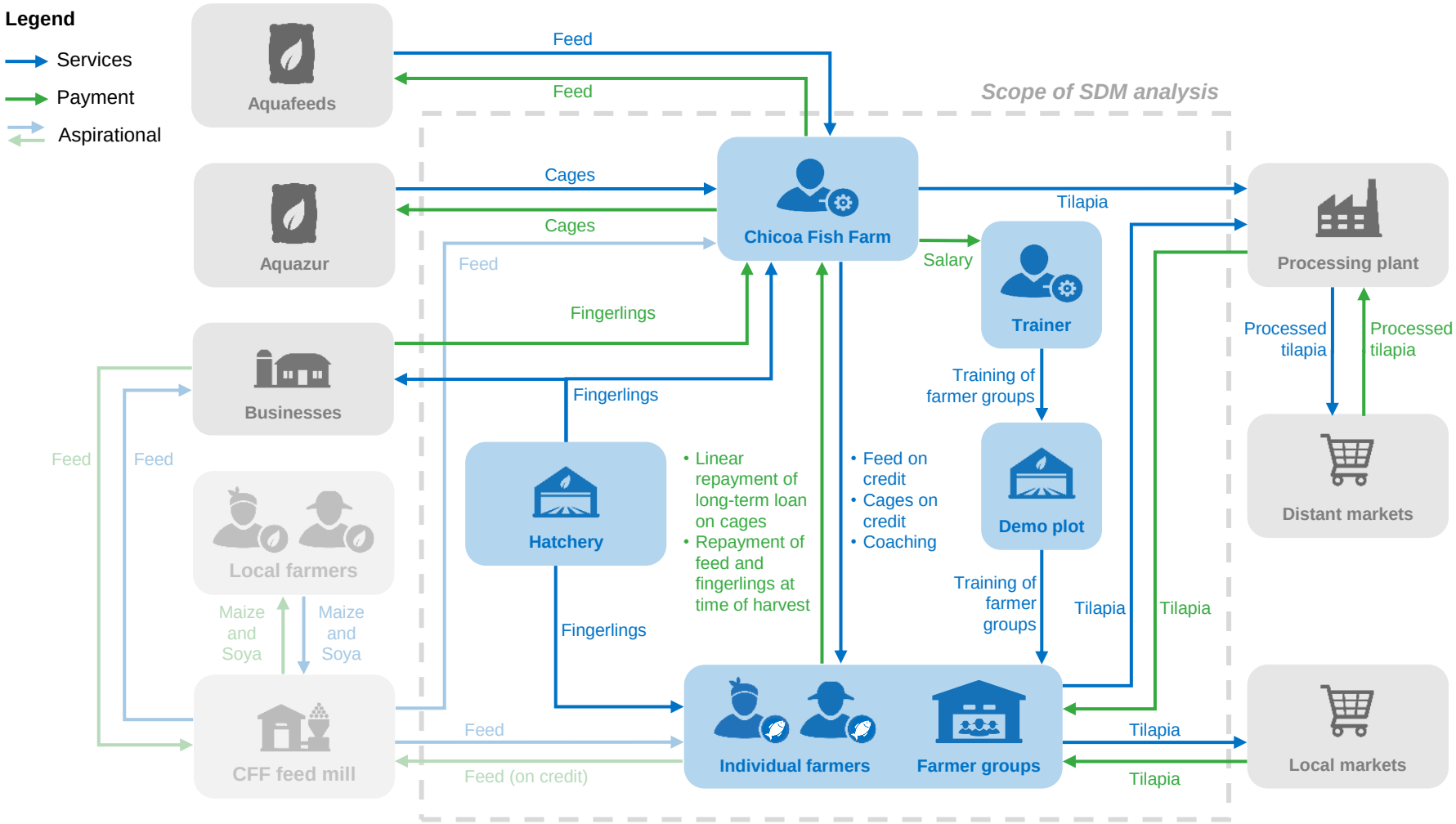
Fingerlings
- Chicoa will produce fingerlings at their hatchery
- Fingerlings are supplied to farmers charging a fee.

Cage provision
- Cages are manufactured by Aquazur (next to Chicoa's farm) and sold on credit at cost.

Margin

** Greyed-out components are not part of the SDM analysis*

To ensure timely delivery of high-quality services, CFF is focused on bringing production of inputs in-house



Vertical integration

CFF is seeking to become a fully vertically integrated farm and platform for service provision:

- Training is provided on CFF's demo plot
- Fingerlings are produced on-site.
- A CFF-owned mill, producing feed from local raw materials, is planned.
- Aquazur, the only cage manufacturer in the region, is closely related to CFF and located on the same site.
- CFF has started constructing an on-site processing plant.

Potential training set-up: CFF will select, train and supervise farmers, who can farm independently after the first cycle

Nearby communities

CFF farm & training center

Demo plot

Recruitment (4 weeks)

Sign-up

- CFF distributes sign-up lists within the community.
- Farmers willing to join can sign up as long as they have an identity card, health card, and basic literacy and numeracy.
- Farmers should be willing and available to work 6 days a week for 8 hours a day.

Farmer interviews

When interviewing the farmers CFF looks for:

- Clear motivation for tilapia farming
- A sense of entrepreneurship
- Basic understanding of financial management
- The position within the household and decision-making power

Farmer selection

After a community meeting and 2 interviews per farmer, 24 farmers are selected in coordination with the village leader

Training (14 weeks)

Organization

- Farmers are grouped into 6 groups of 4 to ensure quality of training and minimal pressure on operations.
- Practical training takes place on-site at the hatchery, main production cages and processing facility.

On-site training

Farmers are trained on-site on breeding, feeding, production and harvesting. The goal is that they become familiar with all the processes, understand fish health and are able to act if needed.

Classroom training

- Next to the on-site practical trainings, farmers receive class-room trainings on more theoretical concepts.
- Classroom trainings cover business management practices, basic financials, and sales and distribution.

Supervised production (6 months)

Production

- After having completed the on-site training, farmers start their own production cycle on the demo plot, consisting of a walkway connecting 12 cages, located on CFF property.
- Farmers are required to manage the entire production cycle, purchasing their own inputs and owning the fish at time of harvest.
- Farms are inspected and farmers are coached and guided by CFF personnel.
- CFF monitors the performance of farms and farmers for continuous improvement purposes

Start own production

For the financing of the inputs and equipment, different structures are eligible, all with different pros and cons

To organize the financing of inputs and equipment a farmer on-lending infrastructure should be in place, a combination of an entity managing and providing the working capital, and a legal entity receiving and repaying the loans.

On the short-term the most feasible option is providing working capital funding via CFF. On the long-term, from a sector perspective, ideally a revolving fund is set up. This way SHFs are more independent and SHF involved in aquaculture across the country can access these loans.

Providing loans to VSLAs is the most feasibly option. From a farmer's perspective, they can pool resources and manage the cages collectively and manage financial risks. From an SDM perspective, it does not require setting up costly and prone to fail cooperatives.

	Entity providing working capital			SHF organization receiving working capital	
	CFF	**Commercial banks**	**Revolving Fund**	**Cooperative**	**VSLA**
	Input and equipment loans are pre-financed off CFF's balance sheet	Loans are provided by banks directly to SHF	Loans are provided via a revolving fund designed for investment in SHF aquaculture	Formal, legally registered farmer groups. Small to large scale.	Informal savings and loan associations. Small scale.
Advantages	• Existing entity directly involved in loan provision • Relative ease of accessing capital (due to the size and credibility of the organization)	• Existing financing structures, readily available loan products	• Once set up, can provide finance SHF in broader sector, at interest affordable rates, with tailored products • Direct to SHF financing, independent of other businesses	• Formal registration provides a form of security to lenders • Fully independent SHF organization, increased buy-in and bargaining power	• Low interest rates due to absence of formal lenders • Low default rates due to social cohesion and peer pressure
Barriers	• Accessing capital is expensive due to high interest rates • High exposure due to high amounts of outstanding capital	• Do not lend to these SHFs or VSLAs (high-risk, small scale) • Very high interest rates • No fit for purpose loan products	• Long-term process to design and implement • Requires significant funds from large scale impact investors in aquaculture	• Long-term process and costly to set up • High probability to fail due to organizational and governance issues	• Higher risk of loan defaults due to no formal registration

Opportunities exist to improve the situation for women in the fishery and aquaculture sector in Mozambique

Enabling environment

- Gender disparity in primary education is not significant, although enrolment is **slightly in favor of men**.
- In ownership of a bank account, there is a gender disparity of 0.65. This is **close to the global average**.
- Only 49% of women state they have an opinion or ability to take part in decision-making; an **area of improvement** that could be focused on.

Primary education enrollment * [1]	**0.90**
Owner of a bank account or used a mobile money service in the past year * [2]	**0.65**
% of married women who participate in decision-making ** [3]	**49%**

Legend

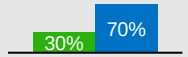
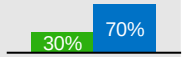
Men

Women

Gender ratio (Female/Male)[1]

Comparison of Chicoa Fish Farm to the national context

- Chicoa aims to be **gender intentional** in their future operations
- Chicoa is currently working on a **gender analysis** and creating policies such as a sexual harassment policy.
- Female employees perform intensive manual labor, which is usually **perceived to be suited for males** only.
- Most women in the region have **limited or no access to educational opportunities**. As a result, most are illiterate.
- Women in the region are **limited in decision making** (e.g. they need permission from their husbands to work).

	Mozambique	CFF***
How does CFF's ratio of female to male employees compare with the country labor force participation? * [1]	**0.98**	**0.26**
How does CFF's proportion of female to male farmers compare with the country-wide farmer distribution? [4]	 2018	 2018
How do the incomes earned by CFF's employees compare with the incomes earned by women and men in the country? * [1]	**0.56**	**1.00**
How does the yield of CFF's male and female farmers compare with the country average?	**N/A**	**N/A**

* Divide female indicator by male indicator to get ratio. A ratio of 1 indicates parity between the sexes; a ratio between 0 and 1 typically means a disparity in favor of males; whereas a ratio greater than 1 indicates a disparity in favor of females.
** Concerning own health care, major household purchases, and visits to family or relatives
*** Chicoa's is currently not yet working with outgrowers. Therefore, numbers concerning employees are based on their own operations and numbers concerning farmers are based on targets.

Sources: 1) World Economic Forum: Global Gender Gap report (2020); 2) World Bank: Global Findex (2017); 3) USAID: Demographic and Health Survey (2011); 4) FAO Sector overview (2018)

4. SDM performance

Assessing Chicoa's financial performance and opportunities for improvement

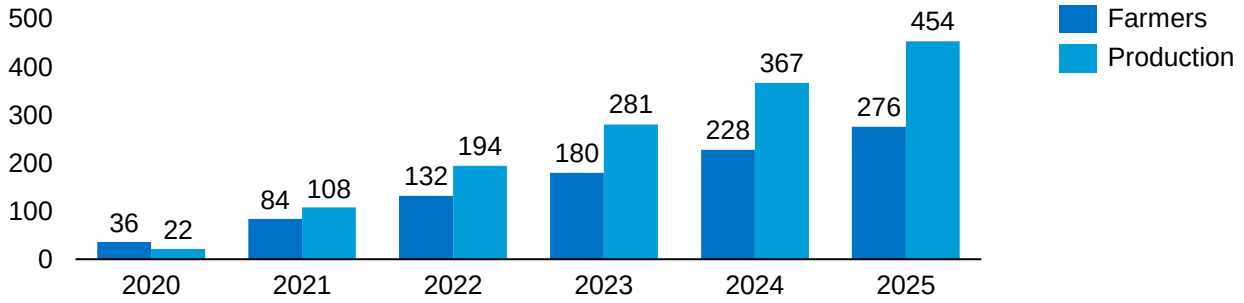
Following the baseline setup, the CFF SDM can reach 276 farmers and produce 454 MT tilapia per year by 2025 at a total cost of $4.9 million.

Growth drivers

Current farmer and production targets are driven by a set of key design principles:

- **Training:** CFF's training facilities and 12-cage demo plot can support training of 24 farmers per production cycle (6 months)
- **Cage size:** Cages are constructed in such a way that they are easily harvestable, containing 2,000 fish per cage at time of harvest
- **Cage setup:** Each cage setup, including walkway, nets and harvesting equipment is designed to accommodate 12 cages. Each cage is managed by 2 farmers.

SDM scale (# of farmers, MT tilapia per year)

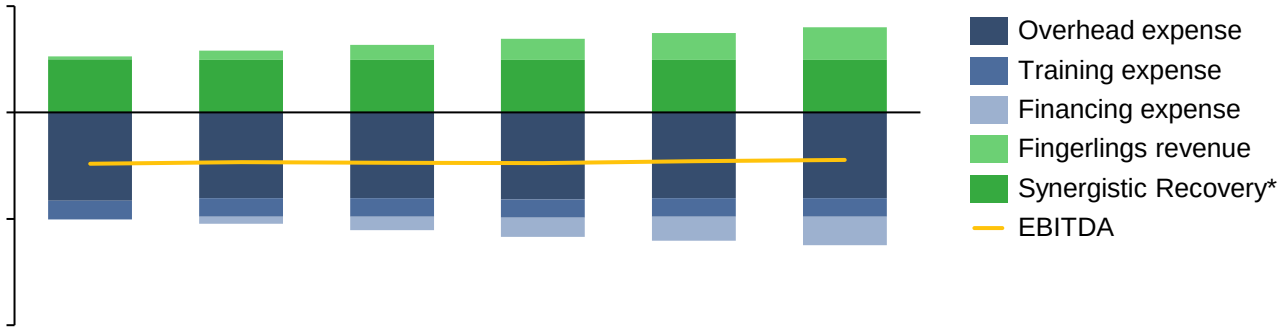


SDM P&L

- Given above assumptions the CFF SDM is projected to incur consistent annual losses at least until 2025.
- Costs include a training facility, one demo-plot, provision of fingerlings, feed and cages, costs of finance and staff and overheads.
- Average cost of capital is assumed to be 12% per year, interests charged to farmers 0% and farmers default rate 0%. More realistic figures are explored in the optimal scenario, under which sufficient value is created to be able to charged higher fees to cover cost.

Assumptions are based on initial discussion with CFF, where no interests are charged to famers, not are default rates assumed. Alternative scenarios have been explored later in this report.

SDM P&L



** Synergistic Recoveries are benefits that come with the time invested by the CFF's core team, such as community support, living up to a certain investment ethos, etc.). 50% overhead and training expenses are counted as revenues counted towards Synergistic Recoveries, based on the matching finance principle following previous IDH engagements.*

Financing

A cumulative financing gap by 2025 still needs to be covered:

- Service revenues cover 15% of total annual operating costs by 2025. While a fee is charged on fingerlings, training and cages are provided at cost, and no interests are charged on farmer loans.
- Synergistic Recoveries cover another 44% of total expenses
- The Zambezi Valley Development Agency (ZVDA) is granting the training centre, and providing loans to cover training centre operation expenses and the demo plot.
- No other financiers are known to contribute to the costs of the SDM.

CFF would need to draw in additional funding or charge higher fees on the service offering. However, higher fees would put further pressure on farmers' incomes.

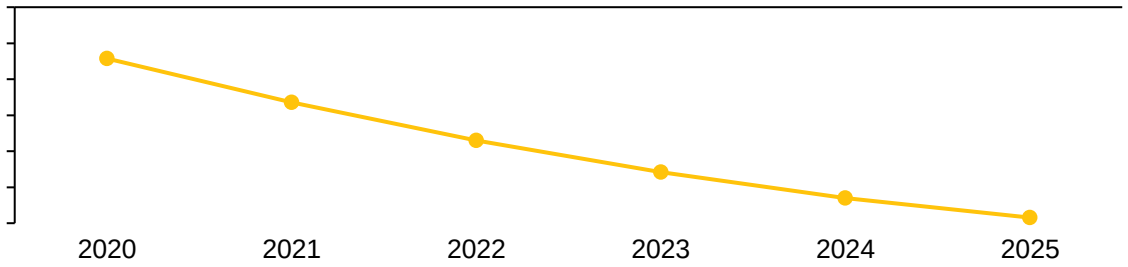
Working capital

The CFF SDM has a working capital need consisting of short- and long-term loans:

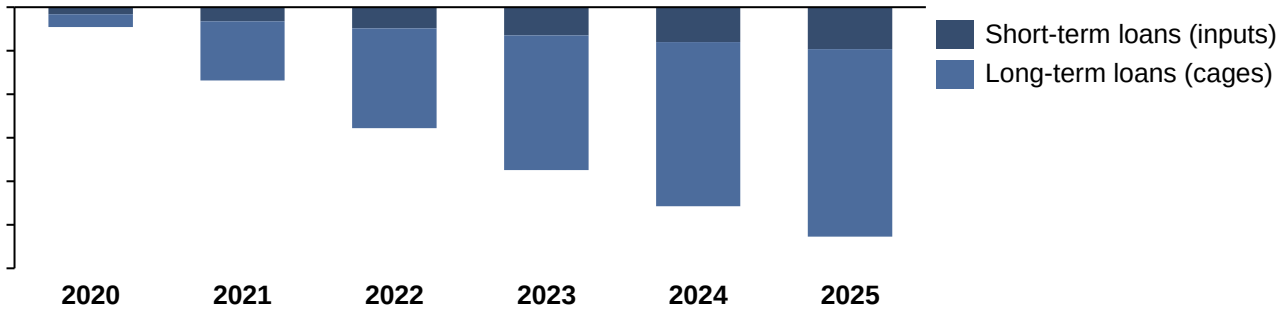
- Short-term loans covering feed and fingerlings are repaid in full, including a fee on fingerlings, at time of harvest.
- Long-term loans including cages, walkways, nets, and boats are repaid linearly over the assets useful life assuming $0 rest value, starting from the first harvest.

A financing structure and vehicle needs to be designed and implemented before investors can provide working capital loans to farmers.

Funding needs to cover operating expenses



Working capital outstanding



Expanding training capacity and cage size are important in reaching farmer numbers (450) and farmer production targets (3,000 MT) by 2025

Growing the number of smallholders to 450 is key in boosting Chicoa's own feed and fingerling sales, increasing fish production and generating incomes. Multiple (potential) barriers to scale have been identified:

Barrier	Type	Description
Training capacity	Operational	Training capacity is currently limited at 24 farmers per production cycle as this is the maximum number of people that can be supervised on Chicoa's production site without disturbing operations, and trainees must manage their own cages on the 12-cage demo-farm for a full production cycle (6 months). Adding another 12-cage demo-farm would allow training 48 farmers per production cycle.
Farmer literacy	Operational	Illiteracy and lack of business skills will require significant investments in time and resources to provide proper training. The effectiveness of training will determine the farmer's ability to adopt best practices, their success in farming, and ultimately their motivation to keep farming and draw in others.
Farmer population	Demographic	The number of people willing to farm is not expected to be a bottleneck as many people are looking for jobs and willing to travel long distances for their incomes.
Suitable cultivation sites	Geographical	The number of suitable sites for smallholder farms should be plentiful.
Permittable production volumes	Legal	Expected smallholder production volumes are not expected to approximate the lake's carrying capacity and is therefore not expected to have harmful effects on the lake's ecosystem.
Production site capacity	Operational	The maximum number of farmers per production site is mainly dependent on input and equipment production capacity. This should be scaled up in time to meet demand of a growing number of farmers.
Maximum service delivery distance	Operational	The maximum distance between Chicoa's production site and smallholders is difficult to assess. A decision on when to build an entirely new production site to supply a new smallholder cluster is dependent on many factors, including proximity of a feed mill, a community, infrastructure (roads, electricity) and suitability of the lake.
Average cage size	Operational	The average cage size determines the volumes produced for any given number of farmers. However the size is limited in that harvesting should be easily manageable with a group of smallholders.

Apart from availability of working capital, no major service production and provision constraints are foreseen in meeting the most ambitious scenario

Meeting the required impact and production targets requires timely delivery and sufficient production capacity of services (fingerlings, feed and cages). Risks and barriers to the current and future capacity have been identified:

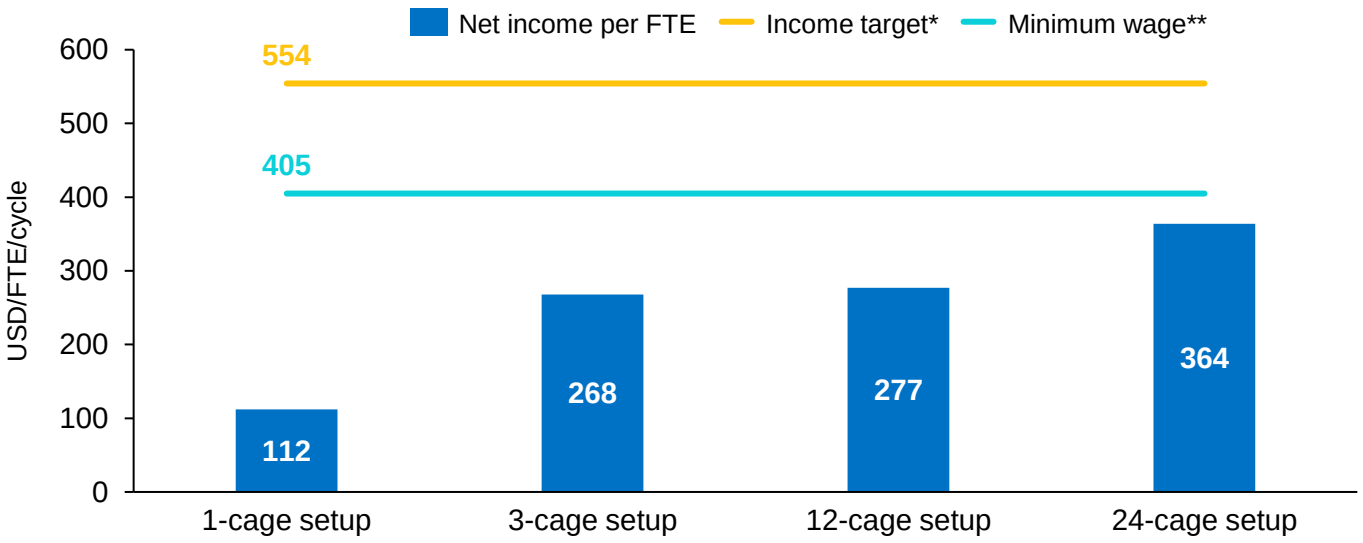
SHF service	Sourced from	Current capacity	Future plans	Time until delivery	Risk and barriers
Fingerlings (#/year) 384,000 (2020) 4,224,000 (2025)	Own hatchery at CFF's main production site	Breeding facilities are sufficient to meet current CFF and smallholder demand.	Scaleup of facilities to accommodate CFF and smallholder production growth targets is already included in CFF's strategy and investment plans.	Production of fingerlings should start 2 months before delivering to farmers.	Shortage of fingerlings due to lack of adequate planning Lower quality fingerlings as a result of external impact (disease, climate)
Feed (MT/year) 181 (2020) 1,996 (2025)	Aquafeed, imported from Zimbabwe	Production meets CFF and smallholder demand. Supplies can be stored at CFF's production site.	Keep as is in the short-term. Shift away from import to sourcing from own feed mill (see below).	Approximately one week from the feed order to delivery. Can be stored up to six months.	Delays in delivery Closing borders Import taxes and permit issues
	Own feed mill	None	Plans to construct in-country feed mill to avoid 17% IVA and contribute to broader development of local aquaculture sector. Increased cost of raw materials are expected to balance out reduced transportation costs.	Approximately a week from the feed order to delivery. Can be stored up to six months.	Start of construction depends on investors' willingness to invest Completion depends on local buy-in of authorities and import of construction materials
Cages (#/year) 72 (2020) 96 (2025)	Aquazur, located next to CFF's main production site	People, factory, materials and finance are sufficient to meet current demand	Production capacity (construction materials and workers), is planned to be scaled up with smallholder demand for cages	Delivery of materials takes between 3-4 months. Pace of production is 2-3 cages per day.	Production depends on import of construction materials and capital to finance pre-orders Expertise lies with one person at Aquazur

5. Farmer performance

Assessing the farmer's financial performance and opportunities for improvement

Given baseline assumptions, different setups provide a good income, but less than CFF's income target or minimum wage

Comparing income per FTE, living income proxy and minimum wage
Shown for each cage setup, in USD/SHF/cycle



* The living income proxy set by CFF, stating that an individual should make a minimum of 6,000 MZN per month
** The minimum wage in the fishery sector is equal to 4,390 MZN per month

The 1-cage setup merely functions as a reference point to get an understanding of the economics of a single cage. The 3-cage setup is chosen because it seems like a setup that is easily managed by a single household. The 12-cage setup is chosen to allow for a better organization of the farmers into groups and to exploit economies of scale. The 24-cage setup was chosen to explore the limits of the economies of scale.

Impact on farmer incomes

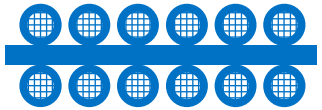
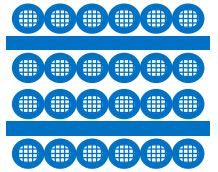
- All the explored cage setups provide a **positive net income per full-time equivalent (FTE)**, although they vary widely. A breakdown of the costs and revenues is shown in the profit and loss statement (P&L).
- **The larger setups are more profitable** due to economies of scale, especially in terms of fixed labor needs for sales and guarding.
- Given that unemployment in the region is extremely high, cage farming might be considered as an interesting activity for the people in the area.
- However, all of the setups provide an income that is **lower than the living income proxy of USD 554 per 6 months**, which is set as a target by CFF.
- When we compare the outcomes with the minimum wage for Kapenta fisher in the area, we can see that the **income from all setups is lower than this minimum wage**.

All the explored cage setups yield a positive net income, but larger setups are more profitable due to economies of scale

The base setup consists of 12 cages connected to a floatable walkway from which farmers can harvest their cages. Nets, boats and harvesting equipment are included. For a 24-cage setup it is assumed the equipment can be shared among two sets of 12 cages.

Setup for sensitivity analysis



Organizational setup	Single cage	3 cages	12 cages + walkway	24 cages + 2 walkways
Managed by	N/A (for reference only)	Household	Association	Association
Number of cages	1	3	12	24
FTE's needed	4	5	11	18
Labor needs*				
Cultivation & harvesting (Days)	93	278	1,110	2,220
Sales & guarding (Days)	460	460	460	460
Economics*				
Yield (kg/farm)	900	2,700	10,800	21,600
Market price (USD/kg)	$2.31	$2.31	$2.31	$2.31
Revenue (USD/farm)	$2,077	$6,231	$24,923	$49,846
Input expenses (USD)	-$1,547	-$4,642	-$18,569	-$37,139
Capital costs (USD)**	-$83	-$250	-$2,845	-$5,690
Net income per farm (USD/farm)	**$446**	**$1,338**	**$3,509**	**$7,017**
Net income per FTE (USD/FTE)	**$112**	**$268**	**$319**	**$390**

* This analysis is based on one production cycle, which takes approximately 6 months
** Capital costs are equal to depreciation costs for all required equipment, thus assuming exact repayment over the lifetime of the setup (10 years)

Go to farmer assumptions

By optimizing the cage size, fish weight and feed costs the SDM should enable SHFs to earn up to the living income proxy

Key farmer production and income drivers

The most effective measures CFF can influence are the cage size, fish weight and prices charged for feed (excl. IVA). Combined changes should enable CFF to generate a living income for farmers that are part of the SDM:

- Cages can be manufactured to hold 3,000 fish with relative ease and at low marginal cost.
- Larger cages might enable growing slightly larger (i.e. heavier) fish of around 500 grams.
- Feed costs can be reduced by charging a lower fee or building an in-country feed mill to avoid paying a 17% IVA (Impuesto al Valor Agregado) charge.

Note that not all variables can easily be influenced by CFF. For example, market price and IVA are important drivers since they require a small percentage change to push income to the desired level, but they are determined externally. Furthermore, both FCR and survival rate are already approaching their upper limits and are therefore difficult to improve further.

Go to farmer assumptions

Outcomes sensitivity analysis, solving for no income and meeting the income target

To identify the key drivers of the farm P&L, a sensitivity analysis is done for the 12-cage setup. It tests to what extent a single variable must change for the net income per SHF to reach a certain value ($0 or $554), all else equal.

Driver	Baseline value	No income ($0)		LI proxy ($554)	
Fish per cage (#)	2,000	1,041	-48%	3,034	+52%
Average fish weight (Kg)	0.45	0.26	-42%	0.63	+40%
Survival rate (%)	75%	19%	-75%	100%*	(+33%)*
FCR (Kg/kg)	1.4	1.64	+17%	1.16	-17%
Market price (USD/kg)	[redacted]	$2.03	-12%	$2.59	+12%
Fingerling price (USD/unit)	[redacted]	$0.128	+288%	$0*	(-100%)*
Feed price ex IVA (USD/kg)	[redacted]	$1.16	+17%	$0.82	-17%
IVA (%)	[redacted]	37%	+120%	0%*	(-100%)*

* Survival rate, fingerling price and IVA values would need to in-/decrease beyond feasible limits:
- At the maximum survival rate of 100% (an increase of 33%), the income per FTE would be USD 301 which is a 9% increase.
- At the minimum fingerling price of USD 0.00 (a decrease of 100%) the income per FTE would be USD 373, which is a 35% increase.
- At the minimum IVA percentage of 0% (a decrease of 100%) the income per FTE would be USD 508, which is an 83% increase.

6. Recommendations

Quantifying the identified opportunities for improvement

CFF should consider faster growth rates, larger cages and setups for increased scale, efficiency and value capture…

	Faster growth	Increased production	Increased efficiency	Improved cage setup and value capture
Current situation	Farmers are planned to spend 2 months on-site before being transferred to the demo plot to manage their own cages for 4 months. This demo plot can support 24 farmers.	The current cage size at 2,000 fish (1MT), depends on standard sizes of construction materials (i.e., the tubes) and designed to be easily harvestable for SHFs.	Following the current design, 12 cages are connected to a walkway and harvesting platform.	Cage design is further optimized, increasing capacity, affordability and reusability Takes into account 15% farmers defaulting
SDM design change and expected operational impact	**Adding a second demo plot** allows faster throughput of 2 times 24 farmers per production cycle.	**Expanding the cage size to 3,000 fish** (1.5 MT) would allow reaching larger production volumes, should be feasible and still manageable in terms of harvesting. This will also allow the SDM to charge interest rates on the input and equipment loans while improving farmer incomes.	By **extending the setup to 24 cages**, harvesting equipment and boats can be shared among more cages, reducing capital costs.	Increased cage size **increased farmer incomes**, allowing CFF to charge fees on feed and interests on loans, making their **business model commercially viable**.
Expected social impact	Training more farmers will double the total value generated in the area. Potential spillover effects will further expand economic aquaculture related activities	While interest cost rise, average cage yields and profitability increases; leading to higher income per farmer.	Larger setups can be managed by relatively fewer farmers (18 farmers per 24 cages, versus 11 farmers per 12 cages), increasing incomes per farmer	Significantly larger and slightly more affordable cages further increase farmer incomes. Cages are modular making it easy to rearrange for optimal setup and reuse over time.

**Key growth drivers have been identified in discussions with CFF.*

…reducing net loss per farmer by 55% and lifting farmer incomes above the living income benchmark (102% vs 50%)

Showing key assumptions and outcomes for different scenarios. More ambitions assumptions stack up per scenario from left to right

Scenario assumptions	Baseline	Faster growth	Increased production	Increased efficiency	Value capture
	Cumulative				
Farmers	24 per production cycle	48 per production cycle			
Cage size	2,000 fish per cage		3,000 fish per cage		7,200 fish per cage
Organizational model	12 cages per group			24 cages per group	12 cages per group
Interest rate charged to SHFs	0%		8%		12%

Outcomes by 2025

Outcomes of scenario analysis are only available in private version of the report.

With faster growth and larger cage sizes, CFF can charge higher interest rates reaching break-even post 2025

An improved production setup for increased efficiency

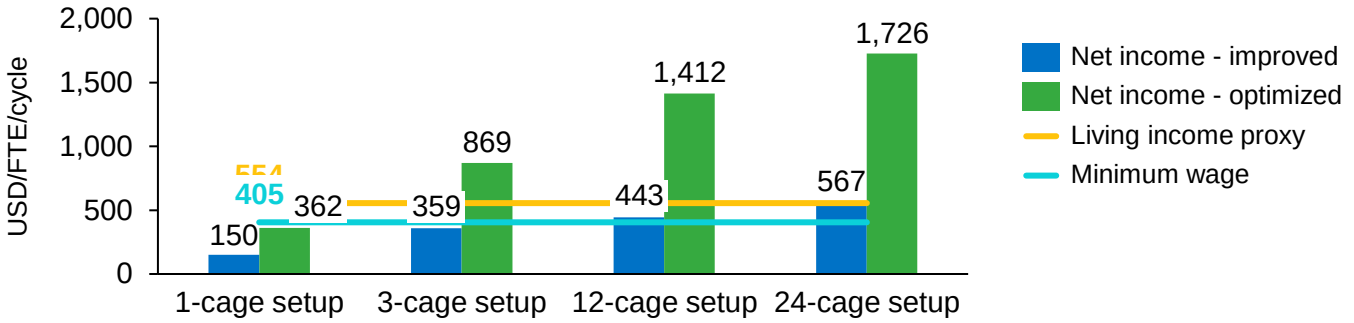
- Following the third scenario on previous slide, changing key parameters of the business model allows the SDM to push farmer incomes to $567 per SHF per cycle (up from $277), while still resulting in a negative EBITDA by 2025. This includes charging farmers subsidized interest rates (8% versus 12% assumed cost of capital).
- At the same time working capital needs expand to -$4.1 M per year outstanding by Q4 2025. On the short-term this increased amount should probably be carried by CFF's balance sheet. On the long-term, alternatives should be explored where farmer financing can be provided to farmers through different channels.

An optimized production setup for value capture

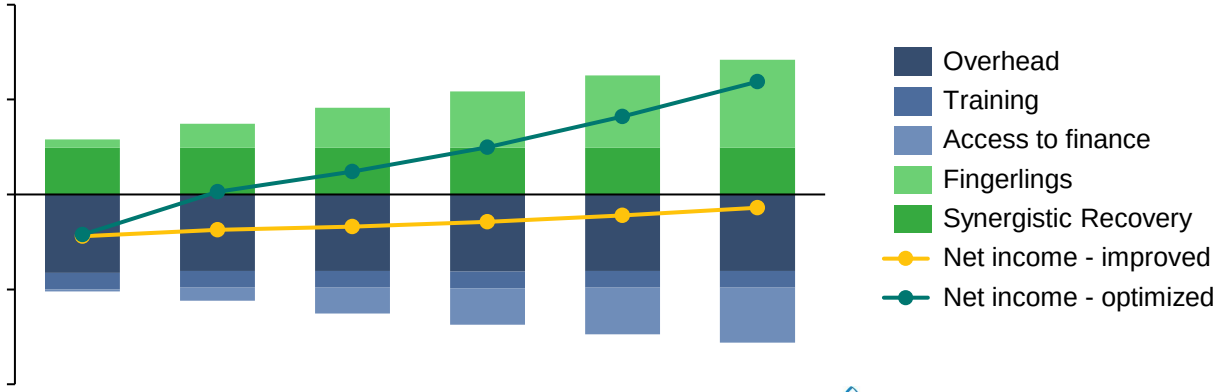
- Following the fourth scenario on previous slide, changing key parameters of the business model allows the SDM to push farmer incomes to $1,412 per SHF per cycle (up from $277) for a 12-cage setup.
- At the same working capital needs expand to -$6.0 M per year outstanding by Q4 2025.

Farmer income per cage setup ($/cycle)

Shown for each cage setup, in USD/SHF/cycle



SDM P&L



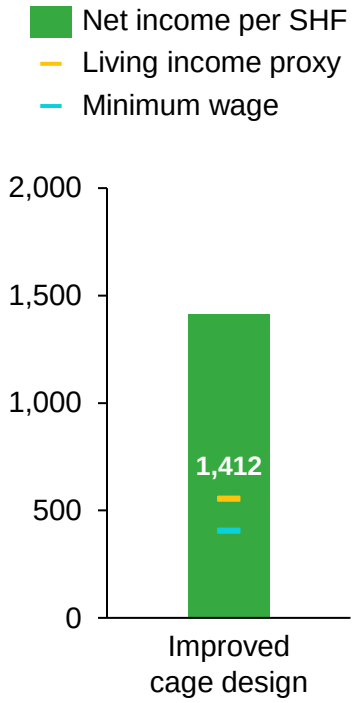
Based on the outcome of the analysis, Chicoa has explored a new cage design, with significantly better results

Improved cage design

- Based on the preliminary results of the analysis, Chicoa (in collaboration with Aquazur) has revised the design of the cages for the smallholders.
- They explored different cage designs from a technical and financial perspective.
- For a comparison between the different designs they mainly focused on the **cost per cubic meter** and the **depreciation cost per kg of fish**.
- The preferred improved design consists of cubical cages that you can walk in between and which are easy to increase/decrease in size.
- This design has a cost per cubic meter of $33.79 (compared to $81.50 for the original design) and a depreciation cost per kg of fish of $0.17 (compared to $0.41 for the original design)
- This design leads to significant better financial results for the farmers, due to increased volumes.
- However, due to these larger volumes two main concerns arise:
  - Farmers must still be able to harvest the cages
  - Farmers must be able to sell the increased volumes of fish

Farmer income ($/cycle)

In USD/SHF/cycle



Organizational setup	Improved cage design
Managed by	Association
Number of cages	24
FTE's needed	18
Labor needs*	
Cultivation & harvesting (Days)	2,220
Sales & guarding (Days)	460
Economics*	
Yield (kg/farm)	77,760
Market price (USD/kg)	$2.31
Revenue (USD/farm)	$179,446
Input expenses (USD)	-$133,700
Capital costs (USD)**	-$8,098
Interest expenses	-$6,239
Net income per farm (USD/farm)	**$31,408**
Net income per FTE (USD/FTE)	**1,745**

Go to farmer assumptions

* This analysis is based on one production cycle, which takes approximately 6 months
** Capital costs are equal to depreciation costs for all required equipment, thus assuming exact repayment over the lifetime of the setup (10 years)

CFF is well-positioned to strongly contribute to the development of the sector

Development of the aquaculture sector

- Mozambique's aquaculture sector is nascent, especially in comparison with neighbouring countries.
- Aquaculture is the most efficient animal protein production method with a relatively low environmental impact. However, it is capital intensive, and its expansion in Mozambique has been hampered by bureaucratic hurdles, weak infrastructure, lack of inputs and local technical expertise[1,2], so additional investments are needed.
- The development of aquaculture plays an important role in the socio-economic development of a country by [3,4]:
  - Providing affordable protein
  - Improving the population's diet
  - Contributing to food security
  - Creating jobs and generating income (Chicoa's trainings specifically address and promote business skills and entrepreneurship)
  - Promoting regional development
  - Reducing pressure on wild stocks
- Chicoa's smallholder program provides a promising entry point to add sustainable value to the sector.

Additional benefits*

Outcomes of the analysis that show a benefit for the sector/region, beyond the effects for the farmers and Chicoa

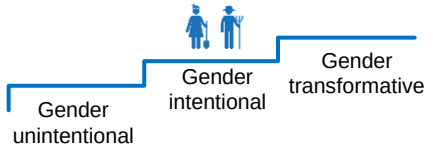
Total value generated	$ 704,000
Total value generated per dollar invested	$ 0.25
Number of farmers reached	552
% of living income achieved	102%
Annual smallholder production	1,361 MT/year

* Based on the optimal scenario

Sources: 1) FAO: The state of world fisheries (2018); 2) Chicoa Project Proposal (2018); 3) FAO NASO (2019) ; 4) FAO Sector Overview (2018)

CFF should roll-out gender sensitive policies, and collect gender disaggregated data to inform service provision

Where is CFF on its gender journey?



Current: gender intentional

CFF has taken steps to at least understand the different needs and constraints of women and men in its internal process, strategy, or service design with the goal of ensuring both women and men have access to resources

Next: gender transformative

CFF takes a data-driven approach to understand the different needs and constraints of women and men, tailoring services to ensure either that men and women have access to resources, control over the benefits of those resources or are working in an inclusive workplace

Gender-related business opportunities

Internal Processes

- Develop and enforce human resources policies on sexual harassment, anti-discrimination, fair compensation, parental leave, fair recruitment and/or fair hiring, to support the development of a safe and motivated work environment.
- Develop and protect safe reporting procedures for victims of violence (e.g., trusted advisors, emergency hotlines); ensure employees involved in these procedures are trained to handle different potential cases
- Regularly review and update disciplinary procedures, and conduct organization-wide training on violence or sexual harassment at the workplace

Data Collection

- Where data / information has been collected about how women and men's needs and preferences may be different, incorporate these in overall approach
- Where data / information has been collected about how women's and men's needs and preferences may be different (e.g., cash flows, expenditure types), ensure staff involved in design and delivery are aware of these lessons so that they can incorporate them into their work
- Develop options for men and women who need to access products/services and information remotely (e.g., through field visits, mobile phones) to allow those needing more flexibility

Service Provision

- Ensure meetings are held in spaces that are safe and socially acceptable for both men and women.
- Facilitate child-care arrangements during the time of the meeting
- Ensure trainings, relevant documents (e.g., contracts), and mobile technologies can be understood by farmers with different levels of literacy (e.g., use audio and visual tools, simple language)
- Recruit and train both women and men to serve as leaders of marketing groups, out grower schemes, and contract committees

Risks addressed

- Building an unsafe workplace
- Losing potential partners (reputational risk)
- Losing potential talent

- Missing an opportunity for business growth

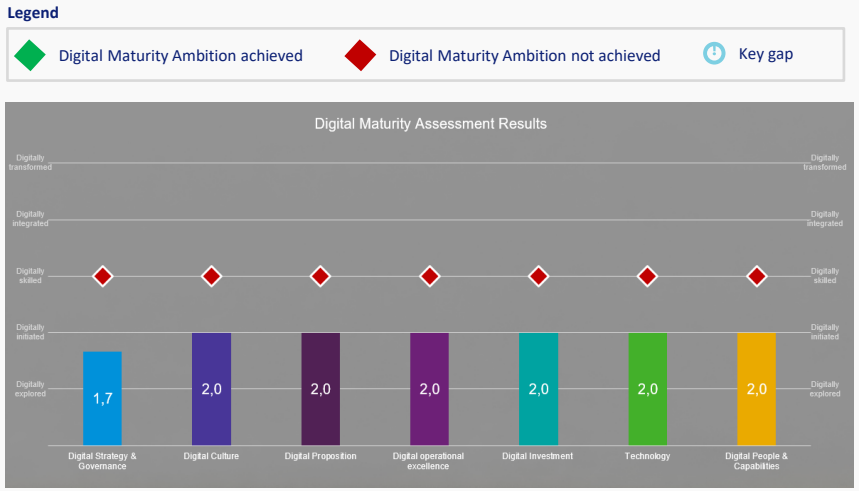
- Missing an opportunity for business growth

Further efficiency gains can be obtained by implementing a digital strategy and supporting training and systems

Results of the Digital Maturity Assessment (DMA)

The digital maturity assessment for Chicoa shows an average score of **level 2**:

- Chicoa is aware of digitalization and started some ad hoc initiatives but did not yet integrate these in a digital strategy/planning.
- The next step is to successfully scale innovative ideas to applications for different customers and employees, both internal and external.
- The most important building blocks for the digital transformation include increasing digital knowledge and competences as well as developing an organization structure suitable for quickly changing circumstances.
- The interviewees indicated that customer engagement is an important topic to improve and focus on.
- The key gap is in the field of digital strategy and governance. Mainly because no formal (digital) organizational structure is available to suit the needs for using new technologies (including roles assigned).



- *To assess the digital maturity, interviews were conducted with Zerene Haddad, Damien Legros, Gerry McCollum and Rory Goddard.*
- *After the interviews, the DMA was sent in excel to the interviewees to receive their input and validate our findings.*
- *For all questions, the average score is shown in the dashboard. Recommendations were then formulated to increase Digital Maturity.*

Risks & key barriers

- A connection to the internet/wifi is not yet widely available for every location of Chicoa. Moreover, an Information Technology (IT) landscape is not developed for employees with access to internet.
- Scaling Chicoa's business is a challenge considering the environment operating in and lack of structure and role including responsibilities around digital.
- Focus on (digital initiatives) is limited and in the current situation a lot of small activities are conducted however significant results lack. Workload to be executed requires prioritization; less is more in that respect.
- Employees of Chicoa lack digital literacy hence using digital solutions is a challenge.
- Finances are tight and a (fixed) innovation budget is not readily available.

Recommendations

- Develop the current basic building blocks (Internet) to start using digital within the organization and research the possibilities of bringing these to the next level.
- Research end-to-end software to use within the organization (i.e. an Enterprise Resource Planning (ERP) system) when a solid IT landscape is designed and developed. Connect multiple applications to make sure that personnel has access to data/applications required for daily business.
- Develop a formal organizational structure including policies and guidelines applicable to everyone in the organization. Create a role within the company that includes the responsibilities around using digital within organizational processes for optimization.
- Empower and stimulate employees to research initiatives and relevant technology and/or aquaculture trends for Chicoa and bring focus to defined topics for digital initiatives.
- Offer a training curriculum on digital and alphabetic skills for staff to increase digital literacy and improve efficiency and effectiveness.
- Involve and engage customers in the process by talking to them about their desires and find (digital) channels to reach customers and sell the products.

The transferability of the SDM's strengths needs to be understood to be able to effectively replicate it in other African locations

Building block	Description	Replicability	Elaboration
Location	This SDM is located on lake Cahora Bassa, which has very favorable conditions for aquaculture. The outgrowers can take advantage of the small protective bays, absence of diseases and the proximity to the input supplier (CFF). Due to proximity of villages, plenty small protective bays and calm waters, there should be sufficient locations for SHFs to grow their fish.	Low	When location of the farm has strategically been picked due to its exceptionally favorable conditions. A lake with similar conditions (see previous analyses) is probably hard to find. Replicating a similar farm on the same lake is probably be easier.
Experience and expertise	One of the two founders of CFF is an engineer with over 20 years experience in aquaculture in Africa, including building fish feed plants and fish processing facilities. The other is an aquaculturalist who has set up multiple tilapia farms in Africa and around the world for over 30 years.	Low	The years of relevant expertise and experience in aquaculture in the African context of the two founders is critical for CFF's success and quite unique. While it is difficult to find similar people, teams can be created where some of these skills come together. These could then need to draw from CFF's experience and foundation in the form of regular trainings.
Production facilities	The outgrower cages are manufactured with low cost, high quality materials and are durable (expected to last at least 10 years). The producer is in close contact with CFF and is located nearby.	High	The combined expertise of CFF and the cage manufacturer and their close collaboration is important, but not unique. The hatchery and cages are made from relatively simple, imported materials and this is therefore relatively easy to replicate.
Fingerling quality	The high-quality fingerlings that will be provided to the outgrowers are bred on CFF's main production site. This process is closely monitored by CFF's experts and has been optimized over the years.	Average	CFF's fingerling production has been optimized over the years by combining different breeds and closely monitoring the process. Although specific knowledge and expertise are required, it is possible to transfer best practices over to other locations.
Feed quality	The feed that will be supplied to the outgrowers is imported from a feed company from Zimbabwe. This company is owned by one of CFF's founders and is specialized in fish feed. Going forward CFF aims to construct a feed mill and produce feed of similar quality themselves, thereby avoiding IVA charges.	High	Since the feed is currently being imported, and different feed providers exist, it is easy to replicate this elsewhere. A feed mill will sufficient capital, good supply of raw materials, and relatively available technical expertise.

Contact details

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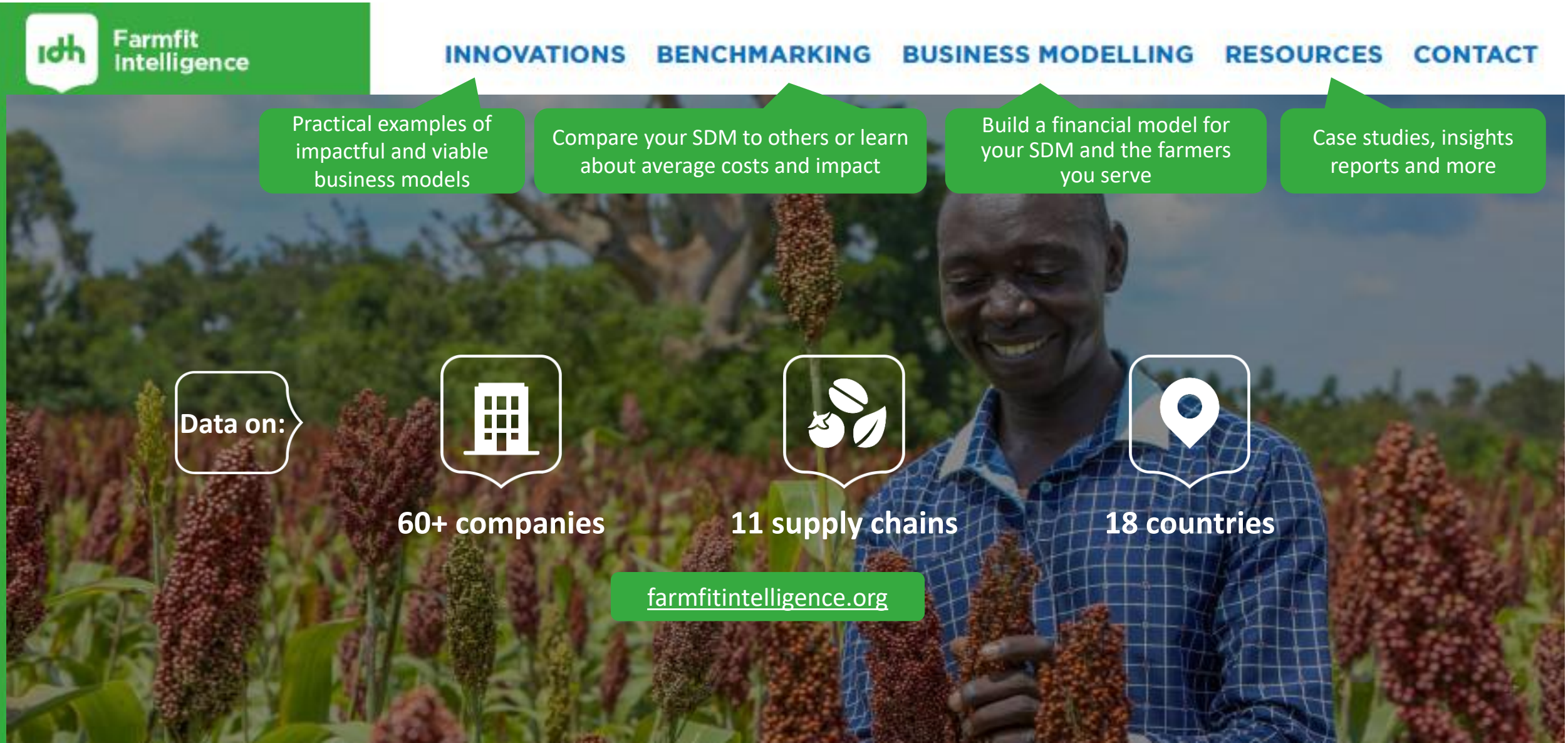
Farmfit Intelligence portal: designed to support you in serving smallholders – profitably, inclusively



7. Annex

Key assumptions and background data and analyses

Annex content

1. Glossary
2. Farmer P&L assumptions
3. Markets
4. Risks and opportunities mapping – economic, social and environmental
5. Value Chain Digital Transformation Tool explanation and detailed results
6. Sources

Glossary

Abbreviation	Meaning
CFF	Chicoa Fish Farm
DMA	Digital Maturity Assessment
EBIT	Earnings Before Interest and Taxes
ERP	Enterprise Resource Planning
FCR	Food Conversion Ratio
FTE	Full-time equivalent
GDP	Gross Domestic Product
GDP pc	Gross Domestic Product per capita
IT	Information Technology
IVA	Impuesto al Valor Agregado (Value-Added Tax)
IVR	Interactive Voice Response
MT	Metric Ton (1,000 kg)
MZN	Mozambican Metical (currency)

Abbreviation	Meaning
NGO	Non-governmental organization
P&L	Profit and Loss Statement
pH	pondus Hydrogenium (a measure of the acidity of water)
SSA	Sub-Saharan Africa
SDM	Service Delivery Model
SHF	Smallholder farmer
SMS	Short Message Service
USD	United States Dollar (currency)
USSD	Unstructured Supplementary Service Data
VCDTT	Value Chain Digital Transformation Tool
VSLA	Village Savings and Loan Association
ZVDA	Zambezi Valley Development Agency

Baseline assumptions for farmer analysis

Go to farmer P&L

Go to sensitivity analysis

Variable	Value
Fish per cage	2,000
Own consumption	0%
Post-harvest losses	0%
Share sold to Chicoa	100%
Cultivation labor needs	92 days per cage per cycle (0.5 day per cage)
Harvesting labor needs	1 day per cage per cycle (3 to 4 people simultaneously for 1 hour per MT)
Sales labor needs	4 days per cycle (assuming constant workload, independent of volume)
Guarding labor needs	456 days per cycle (Assuming 2 guards per setup for 10 hours a day)
Percentage hired labor	0%
Average fish weight	0.45 kg
Survival rate	75%

Variable	Value
FCR	1.4
Length of production cycle	6 months
Production cycles per year	2
Cost per cage	$800
Lifespan per cage	10 years
Cost per net	$200
Lifespan per net	3 years
Cost per bird net	$20
Lifespan per bird net	1 year
Cost per walkway + harvesting platform	$36,900
Lifespan per walkway + harvesting platform	10 years

Improved cage design assumptions for farmer analysis

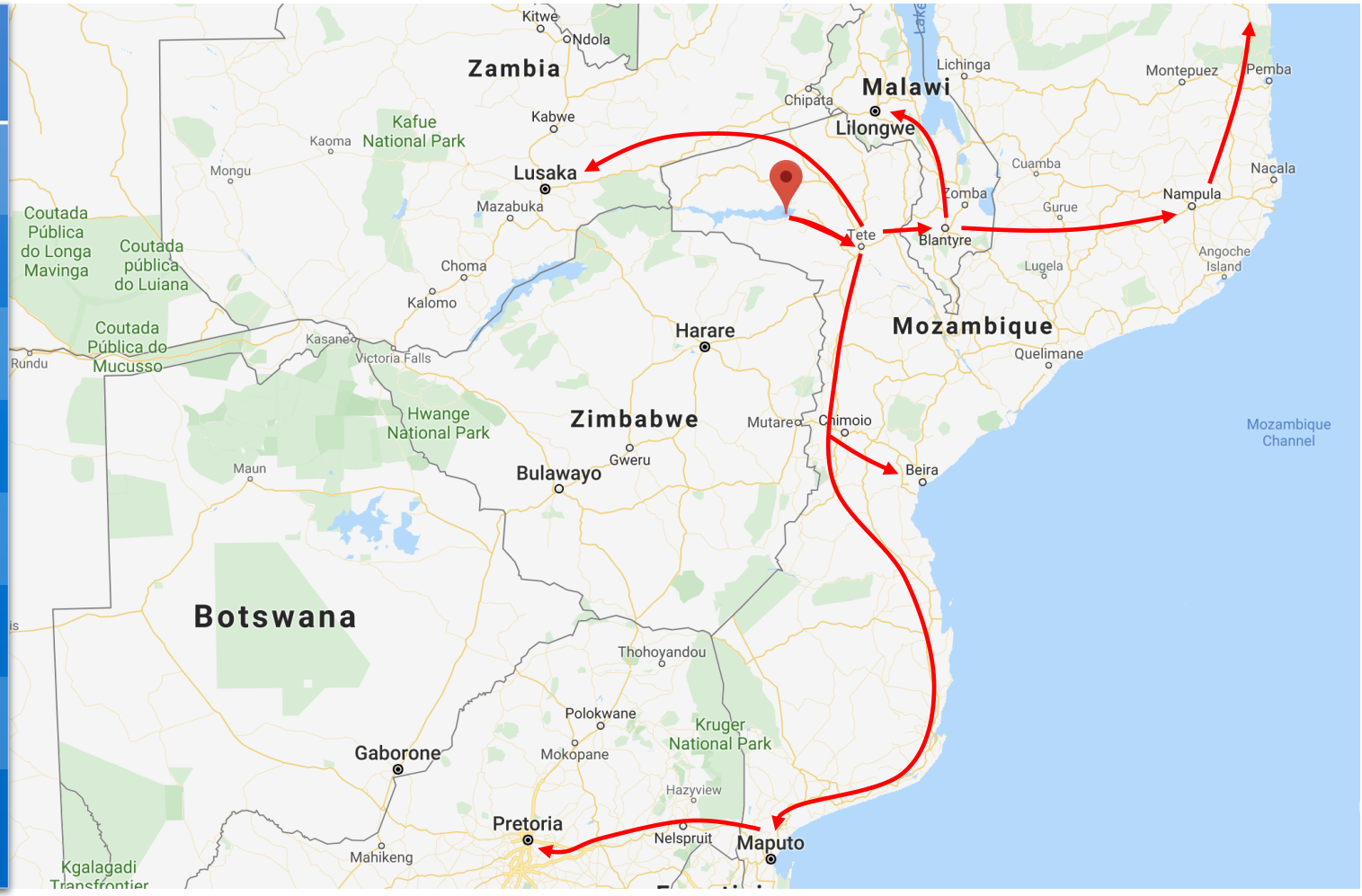
Go to farmer P&L

Variable	Value
Fish per cage	7,200
Own consumption	0%
Post-harvest losses	0%
Share sold to Chicoa	100%
Cultivation labor needs	92 days per cage per cycle (0.5 day per cage)
Harvesting labor needs	1 day per cage per cycle (3 to 4 people simultaneously for 1 hour per MT)
Sales labor needs	4 days per cycle (assuming constant workload, independent of volume)
Guarding labor needs	456 days per cycle (Assuming 2 guards per setup for 10 hours a day)
Percentage hired labor	0%
Average fish weight	0.45 kg
Survival rate	75%

Variable	Value
FCR	1.4
Length of production cycle	6 months
Production cycles per year	2
Cost per cage	$3,290
Lifespan per cage	10 years
Cost per net	$200
Lifespan per net	3 years
Cost per bird net	$20
Lifespan per bird net	1 year
Cost per walkway + harvesting platform	$31,101
Lifespan per walkway + harvesting platform	10 years

Current regional markets

From:	To:	Distance
Farm	Tete, Mozambique	194 km
Tete	Lusaka, Zambia	812 km
Tete	Beira, Mozambique	603 km
Tete	Blantyre, Malawi	228 km
Tete	Nampula, Mozambique	899 km
Tete	Palma, Mozambique	1,349 km
Tete	Maputo, Mozambique	1,548 km
Tete	Pretoria, South Africa	2,093 km



Economic risks and opportunities

Theme	Risk and opportunities	Measures taken by CFF
Competition	• On the lake there is one other organization and a few independent entrepreneurs, that also farm tilapia. • As a result there is barely any competition, but the sector and markets are also underdeveloped.	• Chicoa puts a lot of effort in the development of aquaculture in the region, as well as the market for tilapia. • If done correctly this will give them a significant first-mover advantage.
Market	• The population of this region is among the fastest growing in the world[1], and GDP is increasing.[2] • Based on the African average, the potential demand for fish in the region is 400,000 tons per annum.[3]	• Chicoa has established markets for tilapia in Tete, Nampula, Palma, Maputo and Beira.
Pricing	• Pricing is an important aspect to end buyers. Chicoa's tilapia therefore needs to be able to compete on price.	• Chicoa has been experimenting with their feeding in order to achieve the most efficient FCR. This allows them to keep their costs as low as possible.[4]
Operations	• Operations are still heavily dependent on its owner's experience and expertise • Theft of produce is a serious issue in the region.	• Chicoa is building a management capable team and transferring knowledge • Chicoa will train outgrowers on the importance of security and the need for security guards to guard their cages.
Legislation	• By Mozambican tax law, primary producers are exempted from charging IVA. Traders and importers are required to charge 17% IVA to their consumers.[3]	• When selling nonlocal inputs (like feed), Chicoa cannot avoid passing these costs on to their client groups. • In terms of local inputs (fingerlings and cages), this law gives them an advantage.
Infrastructure	• Tilapia perishes quickly when it is not cooled, therefore supplying markets is challenging. It requires investment in just-in-time distribution and retail outlets.[3]	• Chicoa has invested in and established cold chain storage facilities in Maputo, Tete and Blantyre. • Chicoa coordinates with other producers who rely on cold chain storage infrastructure to optimize efficiency.

Sources: 1) World Bank population indicator (2019); 2) World Bank GDP growth indicator (2018); 3) Chicoa investor deck (2019); 4) Chicoa Project Proposal (2018)

Social risks and opportunities[1]

Theme	Risks and opportunities	Measures taken by CFF
Education	• There is one primary school in Emboque, but the nearest secondary school is an hour away by car, resulting in children dropping out after primary school. • Literacy is low among all adults, but even more among women.	• Chicoa has contributed to the refurbishment of the local school. • Chicoa's (unschooled) employees are trained to become skilled farm workers.
Health	• Healthcare facilities in Emboque are inadequate. The local clinic does not have a proper nurse or medical professional on site, and does not administer proper medicine.	• Chicoa contributed towards a clean water source in the village. • All Chicoa employees (and their families) have access to a private clinic, for which costs are covered.
Food security and nutrition	• Overall food security is low in Emboque, due to low incomes. • Due to a protein deficit, most protein is being imported.	• Chicoa's tilapia is a relative cheap, local source of protein, and it is enriched with Omega 3 which makes it more nutritious than wild fish. • Chicoa employees receive a daily meal at work.[1]
Equality & empowerment	• Married women that are seeking employment need approval from their spouse, which forms a barrier. • Literacy rates and the ability to speak English or Portuguese are lower for women than for men.	• Chicoa specifically aims to employ women and they strive for gender parity in the workplace. • Women get 3 months of paid maternity leave (which is 1 month more than the national standard).
Wage and income	• Unemployment in the region is high and still increasing due to shrinking businesses. • The area around Cahora Basa is poor and mainly consists of subsistence-based agrarian land.	• Around 100 people living in or near Emboque are employed by Chicoa. • Chicoa commits to paying a living wage to all of their employees.
Infrastructure	• Chicoa Fish Farm is located in a remote area, with very limited existing infrastructure.	• Chicoa has contributed to shared infrastructure, including (among others) a village borehole, access roads, electricity, ablutions, septic tanks and aquaculture facilities. • Chicoa employees receive a housing allowance.

Sources: 1) Chicoa Social Impact report (2019), based on findings from informal focus groups done by Chicoa with the community

Environmental risks and opportunities

Theme	Risk and opportunities	Measures taken by CFF
Water	• High water quality, large water exchange and high oxygen levels are favourable for fish production.[1] • Due to the location of the lake, CFF's operations are not affected by droughts and rising water levels. • Temperature fluctuations during winter affect fry production.[2]	• Based on their expertise, Chicoa has deliberately chosen their current location to set up their fish farm. • Fry production is prioritized during warmer months and during the brief winter period it will be done on land in greenhouses.
Nutrients	• Lake Cahora Bassa can be classified as mesotrophic.	• We have to feed the fish, cannot rely on the natural production of the lake.
Diseases	• Chicoa is located on a natural water body, that can be exposed to pathology risks.	• Chicoa monitor and test our fish regularly for any diseases. • Chicoa takes sanitary precautions to avoid contamination from external sources. • Chicoa avoids introducing other tilapia strains to the lake • Farmers will be taught how to identify and control diseases.
Climate	• Aquaculture is a relatively climate resilient practice.	• A low food conversion ratio of 1.3 (vegetable to animal protein) leads to lower transport costs and reduced waste per ton of fish.[3] • Ingredients for feed are sourced in southern Africa, reducing costs and carbon emissions compared to importing from further abroad.[3]
Terrain	• The steep land around the farm provides shelter from wind and waves. • The gorge of Cahora Bassa Lake is very deep.	• Chicoa site was chosen specifically because of the terrain around the peninsula, in order to capitalise on these ideal aquaculture conditions. • Chicoa is situated at the beginning of the gorge, allowing for production cages to be relatively close to shore, improving management and security, while saving on fuel.[4]

Sources: 1) Chicoa investor deck (2019); 2) Chicoa production report (Oct 2019); 3) Chicoa Social Impact report (2019); 4) Chicoa website (2020)

Explaining the methodology of the Value Chain Digital Transformation Tool and Digital Maturity Assessment

Value Chain Digital Transformation Tool (VCDTT)

- Through the VCDTT a wide range of partners from IDH are supported to identify and invest in technology
- This tool includes a database of high potential technology use-cases, linked to key challenges of clients, that can be implemented.
- As part of this tool, a methodology in place to select the most relevant and applicable use-cases for a client.
- Based on challenges, different digital solutions are suggested to optimize the business.
- The advisory goal is to provide insight into the most prominent applicable technology use-cases and CFF's digital maturity.
- The VCDTT consists of 4 steps:
    1. **Identification** – Performing the first step of the methodology in the online VCDTT on the use case database
    2. **Prioritization** – Prioritize the earlier identified use cases from the database based on desirability and feasibility
    3. **Digital Maturity Assessment** – Conduct the Digital Maturity Assessment to distinguish strengths and opportunities for improvement
    4. **Results** – The results include identified and prioritized use cases and DMA analysis with improvement areas

Digital Maturity Assessment (DMA)

- The DMA is performed to distinguish Chicoa's strengths and weaknesses for implementing a digital solution (use-case)
- The DMA consists of 13 high level questions and will be conducted by means of several interviews with stakeholders and employees of Chicoa.
- This assessment is used to determine the categories that require additional attention for the use case implementation
- The case of CFF will be used as a pilot to understand the complications of applying this assessment to an organization within the agri-sector

Piloting of approach and detailed results

- CFF has been one of the first SDM cases where the methodology of the VCDTT and DMA has been piloted.
- The KPMG and IDH team have worked on several iterations to effectively integrate the outcomes of the analysis into the standard SDM report. The idea is to make this methodology easy-to-use by SDM teams and integrate into future cases.
- Due to the corona outbreak the interviews have been conducted remotely
- The identified use cases and the outcomes of the DMA are found on slide 46-48 and 49-52 respectively.

Of the 8 identified use cases, 4 are prioritized to ensure efficiency and current relevance for Chicoa

Farmer information services provide clients with relatively general agricultural information and advice on agronomic best practices (e.g., planting, harvesting, pest and disease management), farming inputs, the weather, and market information (e.g., prices for key inputs and commodities), typically via Short Message Service (SMS), Unstructured Supplementary Service Data (USSD), and Interactive Voice Response (IVR), and occasionally with call center support.

Traceability of product includes the means to track products along the value chain in order to capture information (e.g. origin) of the product and provide transparency). It can serve different purposes, e.g. to ensure quality of the product, to allow for monitoring of certification produce throughout the different value chain steps, to ensure identity preservation or segregation throughout the value chain, secure quality of inputs etc.

Farm management includes the digital management and monitoring of on-farm processes and data in order to allow a more professional and integrated way of managing farms. Solutions offered usually help to collect data about farm performance, allowing for better decision making.

Real time water condition monitoring provides the ability to accurately assess the quality of the water (in a specific pond) and decide on treatment in order to identify pollution and prevent diseases e.g. via sensors and by measuring pH, dissolved oxygen, salinity, temperature, transparency, nitrogen etc.

Detailed description of use cases 1/2

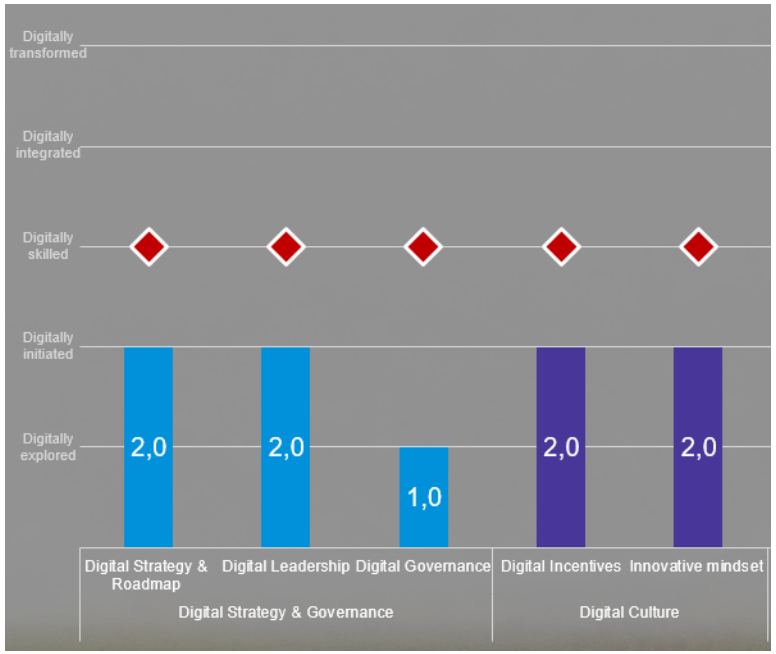
Identified use cases					
	Challenge	**Use case**	**Use case description**	**Desired benefits**	**Example**
1	Information when to sell at what price (information asymmetry) is present. Often low farm gate prices are received due to highly intermediated value chains with multiple layers of actors between producer and end-consumer.	**Bundled solution providers**	Bundled solution provides solutions that bundle multiple digital agricultural services (e.g. market linkages, digital finance and digital advisory services) and deliver a fully integrated digital value proposition to smallholder farmers and other agricultural value chain intermediaries. The idea is that the services that are bundled together have some type of complementarity which will increase the added value to the people and organizations using them, also allowing for less complexity in dealing with different service providers.	• Cost reduction • Increased transparency • Quality improvement of provided services • Improved financial stability • Increasing scale or replication	• Twiga • Mezzanine
2	Information when to sell at what price (information asymmetry) is present. Often low farm gate prices are received due to highly intermediated value chains with multiple layers of actors between producer and end-consumer.	**Access to e-market/e-commerce services**	Access to e-market/e-commerce services enables the clients to access online virtual trading marketplaces, where buyers and sellers are present, with little to no human intermediation helping them to reach customers more easily or access produce from different suppliers in a single e-marketplace.	• Cost reduction • Quality improvement of provided services • Improved financial stability • Increasing scale or replication	• Usomi • Farmster
3	Agricultural best practices are not necessarily known, followed and/or researched and skills lack. Access to agro-related information, educational resources etc. is not present.	**Farmer information services**	Farmer information services provide clients with relatively general agricultural information and advice on agronomic best practices (e.g., planting, harvesting, pest and disease management), farming inputs, the weather, and market information (e.g., prices for key inputs and commodities), typically via SMS, USSD, and IVR, and occasionally with call center support.	• Cost reduction • Quality improvement of provided services • Improved financial stability	• Icow • Farmer hotline
4	Agricultural best practices are not necessarily known, followed and/or researched and skills lack. Access to agro-related information, educational resources etc. is not present.	**Online learning tools**	Online learning tools include access to trainings for clients to acquire general information on planning, acquisition, using digital tools, harvesting, best practices.	• Cost reduction • Increased yield/productivity • Quality improvement of provided services • Improved financial stability	• Coursera • EDX

Detailed description of use cases 2/2

Identified use cases					
	Challenge	**Use case**	**Use case description**	**Desired benefits**	**Example**
5	Relevant knowledge and access to farm specific content is not present. Therefore reliance is on inaccurate manual systems where data is not captured and leveraged upon.	**Farm management**	Farm management includes the digital management and monitoring of on-farm processes and data in order to allow a more professional and integrated way of managing farms. Solutions offered usually help to collect data about farm performance, allowing for better decision making.	• Cost reduction • Increased yield • Quality improvement of provided services • Reduced crop/commodity losses • Increasing scale or replication	• Infosys • SAP
6	Relevant knowledge and access to farm specific content is not present. Therefore reliance is on inaccurate manual systems where data is not captured and leveraged upon.	**Yield forecasting**	Yield forecasting enables to accurately predict production across time, based on combination of information inputs.	• Cost reduction • Increased yield/productivity • Quality improvement of provided services • Reduced crop/commodity losses • Improved financial stability	• AfricultuRes • Nadira
7	Relevant knowledge and access to farm specific content is not present. Therefore reliance is on inaccurate manual systems where data is not captured and leveraged upon.	**Water condition monitoring**	Real time water condition monitoring provides the ability to accurately assess the quality of the water (in a specific pond) and decide on treatment in order to identify pollution and prevent diseases e.g. via sensors and by measuring pH, dissolved oxygen, salinity, temperature, transparency, nitrogen etc.	• Cost reduction • Increased yield/productivity • Quality improvement of provided services • Reduced crop/commodity losses • Reduced environmental damage	• SigFox • EnviraIoT
8	There is often a poor quality of produce relative to market requirements or difficulty in meeting the high hurdles of food safety standards and traceability required by agribusiness buyers and processors in more commercial value chains.	**Traceability solutions**	Traceability of product includes the means to track products along the value chain in order to capture information (e.g. origin) of the product and provide transparency). It can serve different purposes, e.g. to ensure quality of the product, to allow for monitoring of certification produce throughout the different value chain steps, to ensure identity preservation or segregation throughout the value chain, secure quality of inputs etc.	• Increased transparency • Quality improvement of provided services	• Chainpoint • QualiTrace

Results per theme (1 of 4)

Results per question for Digital Strategy & Governance and Digital Culture



Results per theme

1. Digital Strategy & Governance

Results

Several ad hoc initiatives are planned for, that account for potential impact, and the role, of digital for the future. Besides that, employees acknowledge the importance of digital, however do not always have the opportunity to drive digital within Chicoa due to some elementary 'restrictions'. Formal policies and rules around organizational structure are limited and a specific role with digital responsibilities is nonexistent.

Recommendations:

- Create an action plan (digital agenda) for the digital initiatives and identify priority areas.
- Create a communication plan across the organization to research digital trends.
- Draft formal policies and rules to ensure a formal organization structure flexible to respond to quickly changing environments.

2. Digital Culture

Results

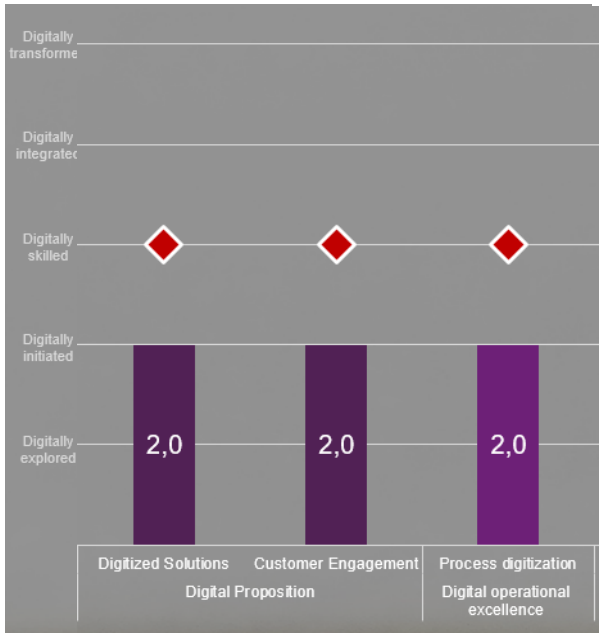
There is no identified formal structure or central focus on incentivizing employees of Chicoa to start digital initiatives. Employees do come up with some digital initiatives and solutions and are supported to some extent. Digital is fragmented within the culture: employees working on the farm have little to do with digital solutions and digital illiteracy is high, whereas employees in the office use digital solution in their daily work somewhat more. Digital culture is challenging from this point of view.

Recommendations:

- Create a formal structure to engage employees with the digital agenda.
- Provide employees with time dedicated to work on digital initiatives and solutions.
- Support employees throughout the organization on developing digital initiatives.
- Engage all employees in the organization in the digital agenda.

Results per theme (2 of 4)

Results per question for Digital Propositions and Digital Operational Excellence



Results per theme

3. Digital Propositions

Results

To some extent digital technologies are used to incrementally improve existing products and service. Digital is not structurally used to engage customers in the process and customer segmentation does not take place to personalize the experience. Chicoa does have the ambition to engage customers more and to start using different marketing channels.

Recommendations:

- Prioritize the use of digital to create new services for customers around the selling of fish.
- Use digital channels to engage customers with the company. Draft a planning and vision to get to know Chicoa's customers and desires. Use your customer segmentation for selling the product based on a customer's specific needs.

4. Digital Operational Excellence

Results

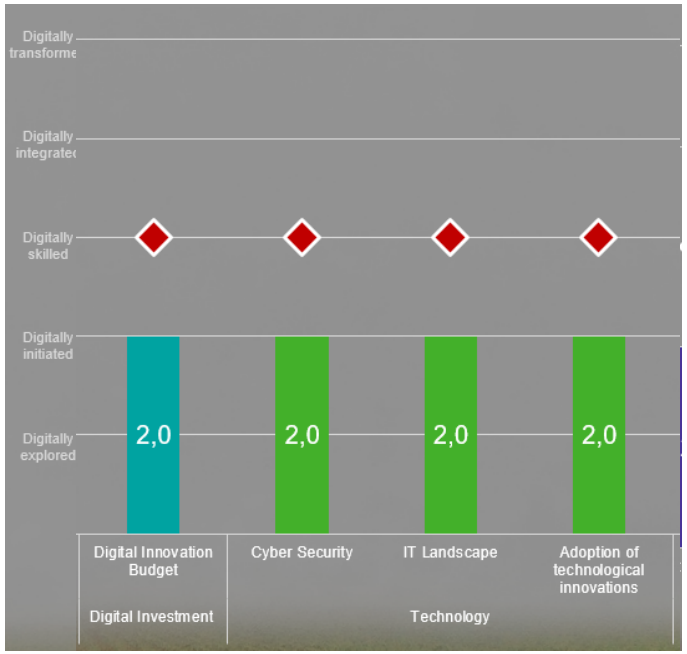
Chicoa mostly uses paper for certain parts within the business (on farm level), however there is a shift in the use of some applications (i.e. excel) for loose parts of the value chain processes like reporting. Again the use of digital solutions is fragmented between the employees on the farm and employees in the office, however steps are taken to improve usage of computers and applications throughout entire Chicoa.

Recommendations:

- Start using digital technologies in multiple parts of the organizational processes and value chain to achieve efficiencies.
- Research optimization methods to be used.
- Establish links between different systems.

Results per theme (3 of 4)

Results per question for Digital Investment budget and Technology



Results per theme

5. Digital Investment budget

Results

A small budget is available, however throughout the organization it is not clear that this is assigned to be invested in innovation/digital solutions. Some digital initiatives are supported after engagement with all stakeholders is realized.

Recommendations:

- Make sure that a fixed budget is available to support digital initiatives. As a start Chicoa could reserve a budget for market exploration/development.
- Organize stakeholder meetings on a structural basis to receive commitment from all.

6. Technology

Results

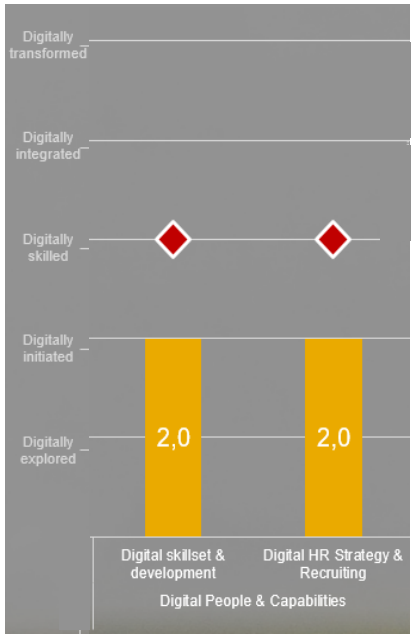
In the interviews it is indicated that there is large room for improvement in Technology but that small steps need to be taken in order to achieve and initiate a digital transformation. Cyber security or risk management practices are not identified in the interviews. Internet connection is barely present on farm level, and if present it is not of high quality. The adoption of technological innovations is difficult, for people on the farm it is even harder considering circumstances as described before. Others, such as interviewees, are familiar with technological innovations and conduct research individually.

Recommendations:

- Make sure internet connection is readily available and of higher quality if possible.
- Be aware of the accompanying risks and consequences of using digital: create risk management processes and cyber security measures.
- Research improvements for current computer systems and find available solutions on the market.

Results per theme (4 of 4)

Results per question for Digital People & Capabilities



Results per theme

7. Digital People & Capabilities

Results

All input received via the interviewees provided with a different score on these questions (3,2,1). This shows that there is not one view on this category. Average shows that the organization is looking into the need for digital roles and some employees extend their current role towards a more digital role. Funding for this seems to be rather low, hence Chicoa might face some problems with their capacity and available resources.

Recommendations

- Small steps can be taken to define a skillset for all relevant roles related to digital.
- Provide opportunities for training to employees on basic digital skills.
- Create a planning document that includes future goals of the organization including the capacity requirements.

Sources

Source	Link (if publicly available)
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