The Lab
Global Innovation Lab for Climate Finance

CLIMATE SMART SHRIMP FUND

INSTRUMENT ANALYSIS
SEPTEMBER 2022

Climate Smart Shrimp Fund

LAB INSTRUMENT ANALYSIS
September 2022

DESCRIPTION & GOAL —
A loan fund supported by a technical assistance facility that enables corporate farmers that manage less sophisticated shrimp farms to transition their operations into a sustainable, yield-increasing production system. This transition, combining farm intensification with restoration of mangrove ecosystems, is expected to not only increase profits for farmers but also offer mitigation and adaptation benefits to both the farmers and society.

SECTOR —
Sustainable Agriculture & Food Systems

FINANCE TARGET —
Grants: Development Finance Institutions, foundations
Concessional Investments: Development finance institutions, impact investors
Commercial investments: Institutional investors

GEOGRAPHY —
For pilot phase: Indonesia, Ecuador, and Philippines
For potential future expansion: China, Brazil, and Mexico

The Lab identifies, develops, and launches sustainable finance instruments that can drive billions to a low-carbon economy. The 2022 Lab cycle targets four thematic areas: sustainable food systems, nature-based solutions, zero-carbon buildings, and adaptation, in addition to three geographic regions: Brazil, India and Southern Africa.

AUTHORS AND ACKNOWLEDGEMENTS

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Sida

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CLIMATE POLICY INITIATIVE

SUMMARY

Food security, climate adaptation and climate mitigation will continue to be enormous challenges as the world moves closer to global warming beyond 1.5 degrees above pre-industrial levels. To help address these challenges, Conservation International (CI) has developed an intervention focused on the farmed-shrimp sector that improves production efficiency while simultaneously providing adaptation benefits and sequestering carbon. Known as Climate Smart Shrimp (CSS), the intervention employs a novel green-grey infrastructure approach to upgrade traditional shrimp farms by intensifying production in a specific subset of farm ponds while restoring mangroves in those that remain.

To facilitate adoption of the Climate Smart Shrimp approach, CI has conceived the Climate Smart Shrimp Fund (CSSF). This financial instrument will provide a unique loan bundle including specialized technical assistance to support shrimp farmers in their transition to more efficient and sustainable production systems.

This instrument meets all four lab endorsement criteria:

- **Innovative:** CSSF provides critical support to farmers that otherwise lack the know-how and financing necessary to sustainably intensify shrimp production.
- **Financially Sustainable:** The program's pilot loan stage – although necessarily initially established with the support of philanthropic and/or impact capital – intends to build a track record of successful loan deployment that will attract private funding for the establishment of the full fund.
- **Catalytic:** There is a massive total market opportunity for supporting the transition of traditional shrimp farms to CSS. Internal estimates show the market potential in pilot countries to be around USD6.4 billion.
- **Actionable:** The proponent is well placed to identify and attract the key partners needed to ensure instrument success, including an investment manager and on the ground partners.

As part of their implementation strategy, Conservation International first intends to deploy pilot loans in Indonesia, Ecuador, and the Philippines to test results and to further identify and secure potential future partners. Once this first phase is completed, CI will proceed with the establishment of the formal fund. This fully scaled fund will help deliver a broad range of benefits including improved coastal protection, enhanced biodiversity, improved farm efficiency and rural livelihoods, as well as large scale carbon capture.

As of the writing of this report, CI has already secured partial funding and completed early scoping for loan piloting in the three countries previously mentioned. Key next steps for the deployment of initial pilot loans include (a) prospective farm identification (b) further development of the farm viability tool and (c) supplementary fundraising for pilot loans.

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CONTEXT

As the world moves closer to global warming above 1.5 degrees, further efforts to improve climate mitigation and adaptation are badly needed. Inefficient or polluting food production systems are one area particularly ripe for innovation.

Food security, climate adaptation and climate mitigation will continue to be enormous challenges as the world moves closer to global warming beyond 1.5 degrees above pre-industrial levels. Although precise estimates may vary, experts agree that global food production will need to increase by at least 50 percent by 2050 if it is to meet demand at current levels of consumption (Van Dijk et, al, 2021). At the same time, food systems will need to both adapt to ongoing natural resource pressure and shift to more sustainable methods to help mitigate further climate change. Interventions in the food sector that improve production efficiency, offer adaptation benefits, and sequester existing GHG emissions will therefore be highly valuable in the years to come.

Within this context, the shrimp aquaculture sector is now one of the world's fastest growing protein sources (Moore Foundation, 2020). With an estimated global market value of approximately USD40 billion in 2017, the sector is expected to continue growing at ~6% a year as shrimp becomes an increasingly important source of protein for a growing global population (BCG, 2019). However, as a relatively nascent market, the sector is not without its challenges. Risks related to human and labor rights abuses, as well as viral disease outbreaks like white spot syndrome and yellow head disease, have historically discouraged significant financing from international investors. The environmental reputation of the sector is similarly poor: "since 1940, approximately half of global mangrove cover has been lost. During the 1970's – 1990's, especially high rates of land conversion for shrimp farming may be accountable 30-50% of this habitat loss" (WWF, 2020). These are critical ecosystems that protect coastlines from storm surges and store up to 10 times more carbon per hectare than terrestrial forests. Without these natural coastal barriers, shrimp farms face even greater risk from storm surges that are increasing in frequency and intensity with climate change, making shrimp farming both a driver and victim of climate change.

The sector's transformation towards more efficient and sustainable practices can thus make the sector a part of the solution rather than the problem. By intensifying production in existing extensive shrimp ponds and incentivizing the restoration of surrounding mangrove ecosystems, the Climate Smart Shrimp Fund – proposed by Conservation International – aims to support the sector's essential transition to help decrease farm risk, combat climate change, and improve rural livelihoods.

CONCEPT

1. INSTRUMENT MECHANICS

CSSF will provide a unique loan bundle, including specialized technical assistance, to help shrimp farms intensify existing operations while simultaneously restoring critical mangrove ecosystems.

1.1 THE CLIMATE SMART SHRIMP (CSS) APPROACH

Conservation International (CI) – the proponent of the Climate Smart Shrimp Fund – is an environmental non-governmental organization that combines field work with innovations in science, policy, and finance. Since 1987, it has partnered with communities, worked with governments, and engaged the private sector to protect nature's benefits. It currently has a global reach with offices in over two dozen countries worldwide. Through the lab, CI has successfully accelerated the Cloud Forest Blue Energy Mechanism and RISCO in previous Lab cycles.

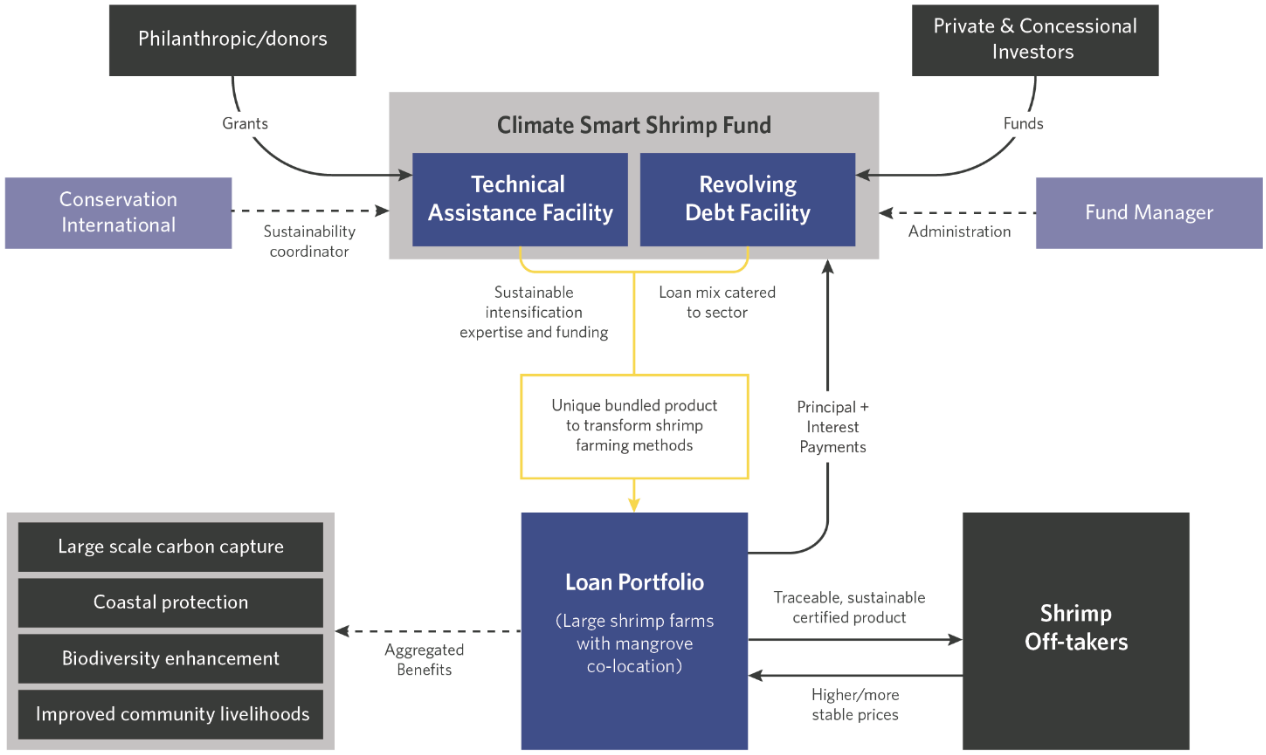
Climate Smart Shrimp (CSS) is an approach to responsible shrimp farm intensification developed by CI. It employs a mix of nature conservation and restoration with conventional infrastructure approaches to help both active and abandoned extensive shrimp farms – farms that practice the most basic form of shrimp farming, largely relying on tides for water circulation and natural in-pond organisms for feed – to intensify production in certain ponds while restoring mangroves in others.

While the restored mangroves provide an important filtering service for farm effluents and increase the climate resilience of the shrimp farm itself (as well as the entire coastline as a whole), intensification in the remaining ponds more than makes up for the loss of production from ponds where mangroves are restored. By combining restoration and intensification, CSS provides a unique value-add in which coastlines are made more resilient, healthy, and biodiverse. At the same time, shrimp farms enjoy increased production and efficiency while simultaneously decreasing climate and disease risk.

Figure 1: Land Use Comparison between Extensive and CSS Approaches

INSTRUMENT MECHANICS

Figure 2: Instrument Mechanics Diagram



To facilitate adoption of the Climate Smart Shrimp approach by extensive farmers looking to intensify their operations, CI has conceived the financial instrument that is the focus of this report – the Climate Smart Shrimp Fund (CSSF).

CSSF consists of two separate sleeves. The first is a technical assistance facility managed by the idea's proponent, Conservation International, and the second is a revolving debt facility that originates and services loans to corporate shrimp farmers to fund intensification in a subset of the production area in line with the CSS model described above.

More specifically, the TA facility – funded largely through grants – will fund the provision of specialized support needed for effective adoption of the CSS model. This includes training to help farmers implement 'best management practices' regarding both intensification and usage of relevant equipment as well as the monitoring of mangrove restoration efforts. Moreover, the TA facility will coordinate the acquisition of environmental engineers to assist with pond grading (needed to elevate production ponds above the intertidal zone), as well as local nursery teams to support with the mangrove restoration. These improvements will allow projects to obtain sustainable aquaculture certifications for their farms, such as those provided by Best Aquaculture Practices (BAP) and the Aquaculture Stewardship Council (ASC), with whom CI already has strong relationships. Among their various benefits, such certifications will help address environmental concerns around unsustainable feed sources, while also enabling price premiums for the sale of sustainably certified shrimp. CI will act as sustainability coordinator for the TA facility with aggregators and/or contracted third parties working on-site, and will use conservation use agreements or easements – frequently employed throughout CI's work around the world – to ensure the long-term protection of mangroves restored through the program.

Meanwhile, loans provided through the debt facility provide farmers with the means to make all other relevant upgrades to existing farm equipment and infrastructure. While this will vary on a farm-to-farm basis, such upgrades may include the provisioning of new aerators (known as "paddle wheels"), pumping equipment, auto-feeders, disease monitoring and management equipment as well as sensors for monitoring dissolved oxygen content, water temperature, and other indicators. Other improvements, like off-grid solar arrays, could also be provided to farms on a case-by-case basis.

Together, these two sleeves provide a unique loan bundle to eligible shrimp farms, either directly or through aggregator partners, thereby providing farmers with the funds and technical know-how to sustainably intensify their operations in line with the CSS model.

2. INNOVATION

By combining intensification with mangrove restoration, CSSF enables broad benefits to both farmers and surrounding coastal communities by decreasing pollution and disease risks while improving farm efficiency and broader climate resilience.

2.1 BARRIERS ADDRESSED: MANGROVE RESTORATION TO MITIGATE DOWNSIDES OF TRADITIONAL APPROACHES

In order to incentivize mangrove restoration, the Climate Smart Shrimp Fund is unique in its approach to a number of key barriers.

Table 1: Barriers Addressed

Barrier	Description	Solution
Access to Finance	In Indonesia and many other shrimp farming jurisdictions, shrimp producers often have difficulty accessing external bank financing, due in large part to a lack of collateral and the perceived operating risks associated with the sector.	While the land restoration aspect of CSS requires the need to prioritize farmers with adequate long-term land rights (either through direct ownership or long-term leases), CSSF seeks to provide farmers with flexible loan products adapted to the operating needs of shrimp farmers in emerging market contexts. Further, CSSF investments, alongside technical assistance support, are intended to improve farm-level operating performance and improve farmer eligibility to access commercial debt financing in the future.
Technical capacities	Despite an ambition to modernize – many extensive shrimp farmers often lack the technical know-how to effectively implement intensification that does not result in even greater environmental pollution and disease risk, let alone to restore complex mangrove ecosystems.	CSSF's technical assistance facility – organized and coordinated by Conservational International with the support existing technology partners and professional farm managers – will provide specialized training and oversight in the adoption of new technologies and the achievement of conditional aquaculture certifications. Meanwhile, environmental engineering and nursery teams will be sourced to assist with mangroves restoration.
Restoration on commercial properties	Commercially utilized land is often a challenging (if not impossible) place to incentivize restoration or other conservation improvements.	Through CSSF, mangrove ecosystems can be restored to the benefit of private land holders as well as surrounding coastal communities. While the farms benefit from increased productivity and decreased disease risk,

		nearby communities also share in the benefits of improved coastal resilience.
Disease risk	The farmed shrimp sector is infamous for its market volatility, largely due to the potential for large disease outbreaks that can destroy entire harvests, such as White Spot Syndrome.	Cement-lined ponds - a keystone of intensification, serve as a simple and effective barrier against external disease transfer. Other technologies, such as aerators and water filters, further limit the potential for diseases to thrive, while access to improved feeds also helps promote further resistance to infection (CREO, 2022).
Environmental risk	The farmed shrimp sector has a similarly poor environmental reputation, due to polluting effluents from untreated pond water entering surrounding ecosystems and the destruction of mangroves that has historically preceded the establishment of extensive shrimp farms.	While traditional shrimp farm intensification (if done sustainably) might help address the polluting runoff, it does little to mitigate the historic destruction of mangrove ecosystems. CSSF addresses both barriers by restoring mangroves on sight where the mangroves provide additional filtering services pond effluent.

2.2 INNOVATION: THE ONLY SHRIMP-EXCLUSIVE FUND COMBINING INTENSIFICATION WITH RESTORATION

Thanks to renewed appreciation for the essential nature of aquaculture farming – due to overfishing of wild populations and improvements in aquaculture technology – the sector is currently enjoying a significant increase in attention and investment (CREO, 2022). As a result, there are several new aquaculture focused funding facilities – some already active, and some still under development – that might be compared to the Climate Smart Shrimp Fund.

Only one of these, the Blue Revolution Fund – also being developed in partnership with Conservation International - shares the Climate Smart Shrimp Fund's exclusive focus on the shrimp sector. The idea, however, is still under development, and has compulsory input and equipment technology providers, making it somewhat less flexible than the CSSF in terms of implementation. Additionally, mangrove restoration is not a focus for the Blue Revolution Fund, which instead focuses more heavily on technology improvements.

In the aquaculture sector more generally, there are many new aquaculture-focused private equity funds primarily focused on aquaculture technology, but relatively few that focus on providing financing to farmers. Those that do, such as the Asia Aquaculture Facility and the eco.business Fund, vary in their approaches, utilizing either revenue based lending models or working indirectly through local financial actors. Again, however, none of these funds are specific to shrimp aquaculture.

Looking beyond aquaculture, the Sustainable Agriculture Finance Facility, endorsed by the Lab in 2020, might also be considered a similar approach, in that it provides customized loan bundles to farmers as an incentive to adopt specific models of agricultural production known as Integrated Crop Livestock Forest (ICLF) systems. Beyond its general approach, however, there are few other relevant similarities, as it is focused on land-based agriculture rather than aquaculture.

Given the overall lack of directly comparable, shrimp-focused initiatives, CSSF appears to be truly unique in its market positioning, not only in its focus on the shrimp sector but also in its novel combination with mangrove restoration.

2.3 ADDITIONAL ROOM FOR INNOVATION: BLUE CARBON PROJECT

Going forward, CSSF's client base may further benefit from participation in blue carbon offset markets. Initial estimates using indicative farm attributes described later in this report suggest that a $100M fund could sequester approximately ~300,000 tons of CO2e through mangrove restoration over a 5-year period. Furthermore, Conservation International, having an established blue carbon program, is well placed to implement such a project as a program developer. To do so, CI should assess the feasibility of signing legal agreements with farmers to aggregate the carbon sequestered through mangrove restoration across multiple farms as a single project, or where appropriate (IE, where farms are large enough) to develop projects on a per-farm basis.

The signing of such agreements would further strengthen the program's position in meeting the two core requirements for quality offsets: additionality and permanence. While there is a risk that some lands being restored through the activities of CSSF may not meet additionality requirements since restoration may otherwise be mandated by the government, there is simultaneously a competing and much more concerning risk that farmers will simply replace restored mangroves with further intensified shrimp ponds once the lending program is complete. Along with the use of aforementioned conservation easements and land use agreements, the signing of blue carbon agreements can further guarantee that re-deforestation will not occur.

2.4 CHALLENGES TO INSTRUMENT SUCCESS

The instrument may come across challenges outside the proponent's control that might impede the successful launch and operation of the CSSF. These are highlighted below.

- <u>Shrimp Farmer Buy-In:</u> Some extensive shrimp farmers may practice far more passive forms of farming than initially expected, known in the industry as "Set it and forget it" approaches. These farmers will be less inclined to spend significant time and resources improving such production systems, which currently allow them to simply stock existing ponds with larvae and return some months later to harvest. As such, incentivizing the adoption of approaches like CSS will remain an important challenge, particularly in cases of more complex land rights issues where a farmer operating on leased land may not have the appetite to take on debt for properties they do not own.
- <u>Attracting an appropriate investment manager</u>: One key success factor for this instrument is the ability of the proponent to find and successfully partner with an investment manager that is aligned to their vision and ethos. To achieve this, the business case for the investment manager needs to be compelling. In other words, the bottom line would need to be sufficient to attract reputable candidates.
- <u>Developing a scaled loan pipeline</u>: The catalytic potential of the instrument is clear from a research point of view. However, developing an actual list of interested potential clients will require further on the ground networking with producers, supply chain participants, and other relevant stakeholders.
- <u>Technical assistance implementors</u>: As on-the-ground implementation will need to be sub-contracted; the idea assumes that there are enough on the ground personnel to cover the significant bandwidth of work envisioned by the proponents. Fortunately,

the CI has significant experience in formulating and coordinating strategies and workplans amongst various on-the-ground partners.

A key solution to all these challenges is the deployment of pilot loans in several different target regions. The results of this initial piloting – which will provide critical data on loan repayments and help highlight implementation issues that arise in a real-life context - will in turn inform how best to address the challenges described above.

Furthermore, the practical experience provided by the pilot loans will allow the proponent to understand more clearly the instrument's profit potential as well as the key management and technical expertise needed to effectively proceed with the investment manager selection process. The stepped piloting approach is an opportunity for deeper engagement with on the ground actors at all levels including identifying and developing relationship with potential implementation partners. Pipeline development would then be an output of the pilot loan stage and will be influenced considerably by the onboarding of the selected investment manager.

MARKET TEST AND BEYOND

3. IMPLEMENTATION PATHWAY AND REPLICATION

The Climate Smart Shrimp Fund is intended to have a demonstration effect and show local funders that if they promote these farm's transformations, the result will be a less risky and improved client base, allowing them to untap an overlooked market.

As the developer of CSSF, Conservation International's first priority is to consolidate and solidify its partnerships that are necessary to execute the proposed implementation plan as illustrated in Figure 3 below.

Phase 1 – Pilot Loan Deployment: CI has already secured the majority of funding required to scope and test the CSS approach in Indonesia, Ecuador and the Philippines, details of which can be found in Annex 3. CI has worked in Indonesia since 1991 and has experience designing and implementing shrimp aquaculture improvement projects and developing multi-faceted engineering restoration projects. Similarly, the proponent has close ties to the shrimp sector in both Ecuador and the Philippines. Phase 1 is critical, as the work of executing the CSS approach and deploying pilot loans will serve to prove the concept and gather lessons learned, as described in the previous section. It is envisioned this phase will have a 2-year duration with key milestones highlighted in Figure 3.

Phase 2 – Fund Formation: As mentioned in section 2.4 above, information will be gathered through the pilot loans in order to kickstart Phase 2. Once these loans have resulted in successful farm transformations that can be observed and reported, CI plans to partner with a reputable investment manager (to be identified) and formally setup the fund. It is at this stage that commercial capital is first injected into the initiative. The fund is projected to run for 10 – 12 years having target loan deployments of over $100M. The fund may also expand the target geography from the three pilot loan countries to the six shown in Figure 4.

Figure 3: Climate Smart Shrimp Fund Proposed Implementation Plan

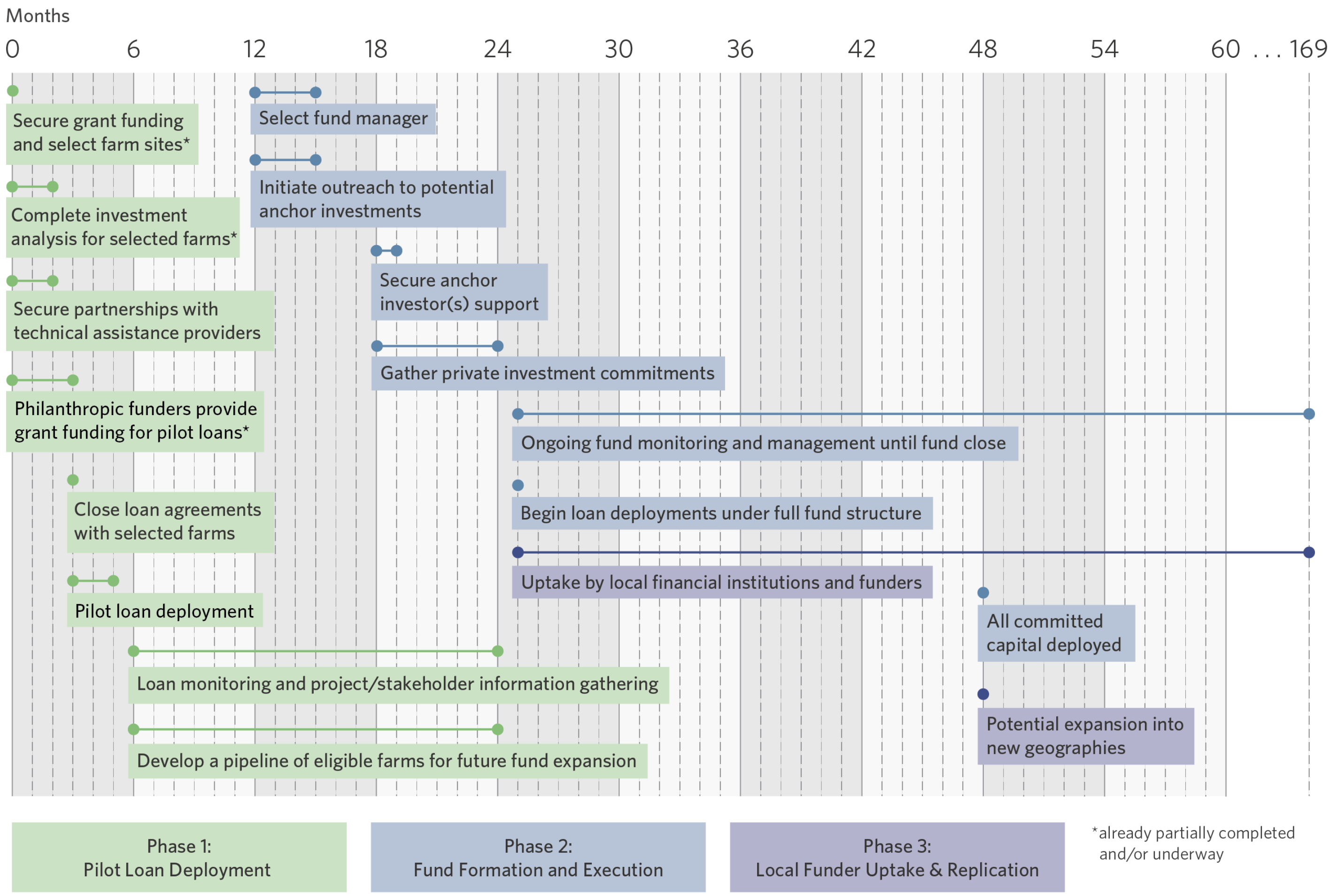


Figure 4. Estimated Investment Potential for Priority Countries

Note: Pilot countries in dark green, potential additional target countries for fund in light green.

Phase 3 – Local Funder Uptake: In the long term, CSSF is intended to have a demonstration effect, and aims to prove to local funders that the financing of sustainable farm transformations in line with the CSS approach will result in a less risky and improved client base. Before the fund winds down, CSSF will work to engage with local financial institutions to share farm and program level results to further promote the opportunity for financing the farmed shrimp sector's transition to sustainable intensification, thereby allowing these local funders to untap a previously overlooked market.

4. FINANCIAL IMPACT AND SUSTAINABILITY

4.1 QUANTITATIVE MODELING

In order to meet the Lab's financial sustainability criteria, the Lab focused our analysis on the following key topics fundamental to attracting both clients and investors:

1. **The Borrower's Incentive to Transition:** Is the "climate smart approach" actually preferential to the alternative approaches available? Will farmers be interested in the first place?
2. **Viability of Loan Repayment and Reasonable Returns**: Will farmers be able to repay the loans at terms acceptable to investors?

In order to gauge the above at this point in the instrument's development stage, illustrative calculations were performed on an indicative 40-hectare shrimp farm assumed to be representative of the average target client.

4.1.1 THE BORROWER'S INCENTIVE TO TRANSITION:

The table below illustrates the fundamental differences between operations on an indicative, 40-hectare farm utilizing the three approaches to shrimp farming: extensive, conventional intensive, and the climate smart shrimp approach proposed here. Note that these three examples are representative of approaches that exist on a spectrum dependent on both farmer and geography. Although the target clients of CSSF are farmers whose current production practices can be broadly categorized as "extensive," some aspects of intensification (such as the use of pumping systems or feed) may be present depending on context.[1] As such, the values below are intended as best estimates to most clearly illustrate the fundamental differences between the three production methods.

Table 2: Illustrative Assumptions at Farm-Level

Item	Extensive (BAU)	Conventional Intensive	Climate Smart
Farm Size	40	40	40
Production Area (Ha)	36	24.8	8
Mangrove Area (Ha)	0	0	24
Settling ponds and other land use	4	15.2	8.0
Restoration Scale Factor	0	0	3
Cycles per Year	1	2	2
Total Project Capital Expenditures	-	1,784,211	717,952
Total Working Capital Required	203,515	1,994,429	643,364
Total Capital Required	203,515	3,778,640	1,361,316

[1] Our interviews and research showed that the on the ground reality for corporate farmers can vary significantly. For example, in Central America, farmers have large areas that they are transforming from extensive or semi-intensive towards intensive production. On the other hand, in Indonesia, some corporate farms might already be fully intensified, but are interested in the opportunity to buy nearby active or abandoned extensive farms to transform them.

Key details are as follows:

1. Restoration Scale Factor: The "Restoration Scale Factor" is the ratio between restored mangrove to intensified shrimp prediction and could range between 1.5:1 to as high as 4:1 depending on farm design and intensification patterns. In the base case scenario, we assign a Restoration Scale Factor value of 3:1. Between the scenarios presented, the Climate Smart approach is the only scenario that contemplates any form of mangrove restoration.
2. Production Cycles: Most extensive farms typically realize a single harvest per year due to generally lower productivity levels. In contrast, intensified ponds – either conventional or climate smart – are often capable of producing up to 3 harvests per year. For purposes of our modeling exercise, we assume 1 production cycle per annum for extensive farms and 2 cycles per annum in both the conventional and climate smart scenarios.
3. Total Capital Required: As indicated in Table 1., the capital required to transition a farm from extensive to conventional intensification are more than three times higher than for climate smart shrimp. This is due in part to [brief explanation]. While transitioning to a CSS model will still require a relatively significant up-front capital investment, the increase in farm-level operating income coupled with potential long-run operation and maintenance cost advantages associated with nature-based wastewater treatment (relative to engineered solutions) is expected to deliver preferential economic performance while also providing additional environmental and socio-economic benefits. More detailed analyses of potential cost and benefits of mangrove restoration relative to engineered solutions for wastewater treatment will be undertaken in future periods.

Table 3: BAU vs Climate Smart Financing Requirements and Outcomes

Item	Extensive (BAU)	Climate Smart
Total Capital Required	203,515	1,361,316
Equity Provided by farmer	203,515	240,095
AVG EBT (Annual)	96,842	366,918

For both the conventional and climate smart scenarios, we assume that CSSF loans cover 80% and 85% of total project investment and working capital requirements, respectively, with the remaining amount provided in the form of borrower equity (cash). Through the use of CSSF leverage, farm-level profits (measured in Earnings Before Taxes) are expected to experience 4x growth relative to the extensive ("business-as-usual") scenario. The Climate Smart approach also offers additional protection against climate-related shocks, therefore making it the more risk averse intensification option.

Finally, farmers implementing the CSS approach would also stand to benefit from the future development of blue carbon program, as mentioned previously in this report. Initial modelling suggests that such a program – assuming a $100 million fund focused solely on farms in Indonesia – could result in offsets worth approximately $1.2 million. Furthermore, this is likely a conservative estimate, as it relies on average carbon offset values from 2020, which are expected to increase significantly in the coming years.

The above leads the Lab to conclude that target farmers would be sufficiently incentivized to consider the CSS approach supported with CSSF support over the BAU and conventional intensification alternatives. The full quantitative analysis including a broader set of results is laid out in Annex 2.

4.1.2 VIABILITY OF LOAN REPAYMENT AND REASONABLE RETURNS

As indicated in this report, there is a significant unmet demand for financing solutions adapted to the needs of the shrimp aquaculture industry. Preliminary market testing undertaken as part of the Lab process indicates farmer interest in CSS where the model can demonstrate increased economic value and the terms of commercial financing can be adapted to farmer needs.

The loan package provided to the indicative target farmer has the following characteristics:

Table 4: Indicative loan package characteristics

Loan Type	Amount	Interest	Term	Other
Long term	574,362	12.00%	5- year	One year grace period, payable semi-annually
Working Capital	546,860	8.00%	6 months	Revolving credit facility on per cycle basis
Total	1,121,221			

Modelling shows that the indicative client target would have a minimum debt service coverage ratio of 1.99x using these loan assumptions.

The investment manager would naturally need to understand the flexibility it would have in order to offer different interest rates to clients dependent on the perceived risk of each individual operation. At the same time, the manager would need to take into account how variations in operations could affect payback. The table below demonstrates how differing interest rates and a reduction in the total amount of KG harvested would affect the loan's debt service coverage ratio.

Table 5: Debt Service Coverage Ratio (DSCR) behavior adjusted for increase in interest rate and reduction in KG harvested.

	Reduction in total KG harvested		
LT loan @ interest of	Base	10%	20%
8%	2.14	1.58	1.02
10%	2.07	1.53	0.98
Base (12%)	1.99	1.47	0.95
15%	1.89	1.40	0.90
18%	1.80	1.33	0.85

The results show that the investment manager would have options available in order to gauge the correct pricing for its loans taking into consideration the potential risk of a reduction in projected harvested amounts. On the other hand, although the indicative client could potentially afford to pay higher interest rates, any fall in the operations productivity would put the loan payback at risk.

The Lab deems that illustrative figures demonstrate that the underlying loan product would offer sufficient payback characteristics to entice interest from potential managers.

4.2 PRIVATE FINANCE MOBILIZATION AND REPLICATION POTENTIAL

As previously mentioned, Conservation International has 5 pilots across 3 countries already under development (2 in Indonesia, 2 in Philippines and 1 in Ecuador) in order to test the CSS approach. Once these projects are complete, CI will pivot funding for CSS farm transitions to be sourced from the USD100M Climate Smart Shrimp Fund (CSSF).

The table below shows the estimated capital required for both pilot completion and the fully scaled fund. When it comes to the full fund, initial modelling suggests a partnership IRR of approximately 12.34%, therefore indicating that catalytic capital could be employed to make the proposition more attractive to commercial capital providers. It is also worth noting that in order to allocate all available debt funding, CSSF would only need to target around 85 projects.

Table 6: Estimated Capital Requirements

Investor type	Amount (USD)	Role of capital
Grants/Concessional debt	~$2-5M	To finalize support of ongoing pilot programs in Indonesia, Ecuador, and the Philippines
Grants	~$5M	To fund the TA facility for the fully scaled fund
Concessional equity	~$25M	Catalytic capital for the fully scaled debt fund
Commercial equity	~$70M	Completing the funding required for the fully scaled fund

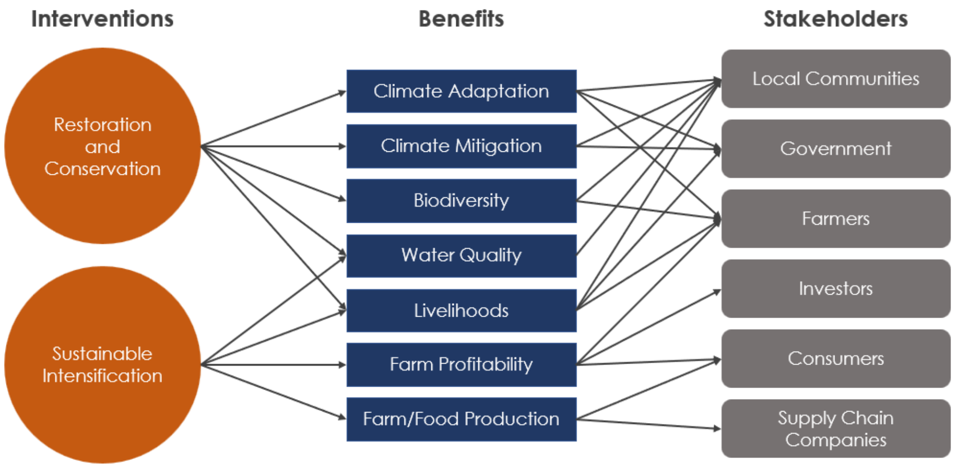
Globally, estimated total investable catalytic potential is approximately $25 billion. More realistically, the six initial target geographies proposed in the sections above have a total potential of $16.3 billion. In fact, Indonesia, Ecuador, and the Philippines alone (current pilot countries) have a total catalytic potential of $6.4 billion. As this potential market cannot be met by CSSF alone, CI's long-term intention is then to use this initiative as a catalyst to promote uptake from widespread local financial actors. It is worth noting that, although the total potential estimates are certainly significant, data in the shrimp sector is admittedly difficult to attain, and it is therefore unclear precisely how much of this potential lies with farms that are both in close proximity to mangrove areas and have sufficient land rights for participation in the program. To address these concerns, CI together with Thinking Machines Corp. are developing a satellite-based farm selection tool called the "Climate Smart Shrimp Farm Viability Tool", with previews available in Annex 4. As of the writing of this report, the tool has been developed only for application in Indonesia and the Philippines but is intended to be expanded to other relevant geographies.

5. ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACT

Incentivizing shrimp aquaculture farms to restore mangroves on part of their land, in exchange for access to capital and resources to sustainably intensify production on the remainder, dramatically increases the available area for restoration of mangroves.

The main feature of the CSS approach is the substitution of shrimp production area for mangrove restoration area in existing farms. It is estimated that after transformation the ratio of mangrove to production area will be greater than 1.5x. This land-use change, along with the intensification of the farms, has the potential to deliver positive impacts on many fronts, including environmental, social/economic, and sectoral impacts. Figure 5 illustrates the relationship between the CSS approach interventions and their benefits to different stakeholders.

Figure 5: CSS Benefits diagram



5.1 ENVIRONMENTAL IMPACT

The CSSF confers multiple environmental benefits through mangrove restoration, including carbon sequestration, enhanced biodiversity and ecosystem integrity, and improved water quality.

Carbon sequestration: Mangroves sequester carbon on a rate 10x that of terrestrial forests per hectare. An average ha of mangroves can capture 30 tons of CO2 per year in some regions. Carbon sequestration estimates are detailed in the chart below.

Enhanced biodiversity and ecosystem integrity: Mangroves serve as the foundation for complex marine ecosystems. Their root systems provide habitat and nurseries for a variety of species, including shrimp, crabs, finfish, turtles, and marine mammals, while their branches provide important habitats for resident and migratory birds. Overall, mangrove restoration contributes to the enhancement of species abundance, including that of economically important fisheries species. Additionally, as previously noted, relevant certification requirements regarding the use of sustainable feed sources helps to further reduce negative impacts on ocean systems often associated with the production of lower quality feed types previously used.

Improved water quality: Restored mangroves also help to mitigate the otherwise harmful effects of the added nutrients and accumulated solids normally present in shrimp farm effluents. The nutrient remediation processes in mangrove wetlands include sedimentation, decomposition of organic matter, assimilation of nutrients by plants, bacteria nitrification and dentification, and ion absorption by soil compounds. Recent studies suggest that the effluent from a hectare of standard intensive shrimp culture can be effectively treated by at least 1.5 hectares of restored mangroves (Goto et al. Under review). This filtering service provided by mangrove ecosystems in turn prevents sediment and nutrients from negatively impacting nearby aquatic ecosystems, such as coral reefs and seagrass meadows.

Table 7: Five Year Socio-Environmental Impact Estimates

	CSSF
Restored Mangroves Area (Ha)	~2,000

CO_2 Abated (tons)	~240,000
Jobs Created Above Extensive BAU	~3,500

5.2 SOCIAL AND ECONOMIC IMPACT

The implementation of CSSF would also provide multiple social and economic benefits through improvement of the shrimp sector, climate adaptation and resilience, and additional income generation for communities.

Climate adaptation: Restoration of mangrove forests provides climate adaptation benefits through protection against sea level rise and storm surges. The root systems of mangroves form protective barriers against wave agitation and trap natural sediments, which protect and reinforce shorelines against erosion. Mangroves have been shown to be a cost effective means of protecting vulnerable coastlines from flood and erosion risks, with currently existing mangroves conferring upwards of $65 billion USD per year in flood protection benefits.

Additional income generation for communities: Restored mangroves, when responsibly managed, provide additional livelihoods benefits to nearby communities through the collection of fuelwood, timber, honey, medicinal plants, fish, shrimp, and crab. Furthermore, restored mangroves – increasingly managed around the world as ecotourism attractions - also help to increase commercial fishery yields in surrounding waters, as they provide critical nursery habitats for many commercially caught fish.

Sustainable Development Goals

Through the benefits described above, CSSF contributes to the achievement of 9 of the United Nation's Sustainable Development Goals. Specifically, these include:

- *SDG 2 - Zero Hunger*: CSSF will support increases in the global supply of shrimp.
- *SDG 5 - Gender Equality*: Increased production translates to increase job opportunities for women in CSSF regions, such as in value-add processing facilities.
- It is worth noting that as farms become modernized, the need to be able to observe and monitor water quality, shrimp growth and mortality rates is essential. These tasks are usually undertaken through Lab analysis that is conducted on site at most larger farms. As such, increasing demand for lab technicians is expected, and in Indonesia, an estimated 70% of lab technician graduates are female.
- *SDG 8 - Decent Work and Economic Growth*: CSSF will bring increased wealth to regions where it is implemented as well as new restoration and monitoring jobs.
- *SDG 9 - Industry Innovation and Infrastructure*: CSSF intends to transform the farmed-shrimp industry by incentivizing more sustainable and efficient production systems.
- *SDG 13 - Climate Action*: Mangrove restoration and conservation will bring both mitigation and adaptation benefits.
- *SDG 14 - Life Below Water*: Filtering services provided by restored mangroves helps to mitigate harmful farm effluents, thereby improving the health of surrounding coastal waters and ecosystems.

5.3 SECTORAL IMPACT: SUSTAINABLE FOOD SYSTEMS

The main goal of the Lab's Sustainable Food Systems stream is to identify innovative solutions to catalyze private investment to improve the sustainability and resilience of global food systems while supporting a green, resilient recovery from the COVID-19 pandemic. The challenge is daunting: in 2021, the Food and Agriculture Organization of the United Nations (FAO) estimated that the total amount of undernourished people globally was over 700 million.

By supporting the transition to climate smart production, the Climate Smart Shrimp Fund will improve the resilience and economic outcomes of shrimp farmers across the globe. In turn, consumers will receive a higher quality product while the shrimp sector itself will be further incentivized to hasten its transition to more sustainable methods of production.

NEXT STEPS

Conservation International has already completed early scoping as part of Phase I of the CSSF implementation strategy. The additional actions highlighted below represent the remaining key steps for initial pilot implementation in Indonesia, Ecuador, and the Philippines:

Identification of Prospective Farms for Pilot Loans

Conservation International is finalizing the execution of a grant provided by the Caterpillar Foundation and David and Lucille Packard Foundation to identify sites in Indonesia to implement the CSS approach. Additionally, they have secured half the funding required to execute a similar program in Ecuador and have begun site and partner selection. Finally, CI is currently using grant funds from the Ocean Risk and Resilience Action Alliance (ORRAA) and the UK Blue Planet Fund to scope additional project sites in the Philippines, the final country identified for program piloting.

Development of Farm Viability Tool

In parallel, Conservation International, together with Thinking Machines Data Science, Inc. will continue to develop a machine-learning-based scoping tool that identifies viable areas for CSS implementation worldwide, as part of a grant provided by Climate Change AI, underwritten by Quadrature Climate Foundation and Schmidt Futures. Please see Annex 4 for details.

Pilot Fundraising and Loan Deployment

Once pilot loan locations are identified and investment analysis and due diligence are completed, Conservation International will deploy the pilot loans. As described above, learnings and data gathered from these initial loans will be essential inputs for the eventual establishment of the fully scaled Climate Smart Shrimp Fund.

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ANNEXES – TABLE OF CONTENTS

ANNEX 1- QUANTITATIVE MODELLING-FARM LEVEL

Shrimp production approach comparison at farm level: Analysts modelled an illustrative comparison of three different production approaches using and indicative 40-hectare farm. This process allowed the team to estimate the capital required and financial results for each. The results are outlined in the tables below.

- Initial Investment:

Extensive

		Ha	USD/Ha	Total (USD)
Land value		40	0	-
Settling ponds	0%	0	0	0
Other land use	10%	4	0	0
Restoration scale factor	0			
Production Area		36	0	0
Restoration Area		0	0	0
Sub total land value				-
Infrastructure				
Grading		36	-	-
Construction		36	-	-
Lining pipes		36	-	-
Mechanical Filtration		36	-	-
Sub total infrastructure				-
Equipment				
Aerators (USD/Unit)	506	36	-	
Units required per Ha	0			
Aerator total				-
Water pump (USD/Unit)	200	36	-	
Units required per Ha	0			
Water pump total				-
Sub-total equipment				-
Restoration		0	5,000	-
Total Project				-

Conventional Intensive

		Ha	USD/Ha	Total (USD)
Land value		40	0	-
Settling ponds	10%	4	0	0
Other land use	28%	11.2	0	0
Restoration scale factor	0			
Production Area		24.8	0	0
Restoration Area		0	0	0
Sub total land value				-
Infrastructure				
Grading		24.8	21,300	528,240
Construction		24.8	16,667	413,342
Lining pipes		24.8	14,429	357,839
Mechanical Filtration		24.8	2,250	55,800
Sub total infrastructure				**1,355,221**
Equipment				
Aerators (USD/Unit)	506	24.8	16,698	
Units required per Ha	33			
Aerator total				414,110.40
Water pump (USD/Unit)	200	24.8	600	
Units required per Ha	3			
Water pump total				14,880.00
Sub-total equipment				**428,990.40**
Restoration		0	5,000	-
Total Project				**1,784,211**

Climate Smart

		Ha	USD/Ha	Total (USD)
Land value		40	0	-
Settling ponds	10%	4	0	0
Other land use	10%	4	0	0
Restoration scale factor	3			
Production Area		8	0	0
Restoration Area		24	0	0
Sub total land value				-
Infrastructure				
Grading		8	21,300	170,400
Construction		8	16,667	133,336
Lining pipes		8	14,429	115,432
Mechanical Filtration		8	2,250	18,000
Sub total infrastructure				**437,168**
Equipment				
Aerators (USD/Unit)	506	8	16,698	
Units required per Ha	33			
Aerator total				133,584.00
Water pump (USD/Unit)	200	8	600	
Units required per Ha	3			
Water pump total				4,800.00
Sub-total equipment				**138,384.00**
Restoration		24	5,000	**120,000.00**
Total Project				**695,552**

- Profit/Loss:

Extensive Cycle Length: 12 Months

	1	
Revenue	Annualized (one cycle)	
Total Area (Ha)	36.0	
Revenue per Ha	8,965	
Total Revenue	**322,757**	**100%**
Cost of Production		
Post Larvae (PL)	(11,484)	-4%
Feed	(114,764)	-36%
Amendments	(35,712)	-11%
Electricity	-	0%
Labor	(35,194)	-11%
Total Cost of Production	**(197,154)**	**-61%**
Gross Profit	**125,603**	**38.92%**
Operating Expense		
Farm Management	(6,361)	-2%
Annual Lease/Rent Costs	(20,000)	-6%
Insurance	(2,400)	-1%
Producer Certification	-	0%
Total Operating Expense	**(28,761)**	**-9%**
EBIT	**96,842**	**30.00%**
Interest		
Taxes		
Net Income (Loss)		

Conventional Intensification Cycle length: 5 months

		Cycles per year 2	
Revenue	per cycle	Annualized	
Total Area (Ha)	24.8	24.8	
Revenue per Ha	107,586	215,171	
Total Revenue	**2,668,125**	**5,336,250**	**100%**
Cost of Production			
Post Larvae (PL)	(94,934)	(189,869)	-4%
Feed	(948,712)	(1,897,423)	-36%
Amendments	(131,465)	(262,930)	-5%
Electricity	(255,064)	(510,129)	-10%
Labor	(290,938)	(581,876)	-11%
Total Cost of Production	**(1,721,113)**	**(3,442,227)**	**-65%**
Gross Profit	**947,012**	**1,894,024**	**35.49%**
Operating Expense			
Farm Management	(273,316)	(546,631)	-10%
Lease/Rent Costs	(10,000)	(20,000)	0%
Insurance	(1,200)	(2,400)	0%
Producer Certification	-	-	0%
Total Operating Expense	**(284,516)**	**(569,031)**	**-11%**
EBIT	**662,496**	**1,324,992**	**24.83%**
Interest			
Taxes			
Net Income (Loss)			

Climate Smart Cycle length: 5 Months

		Cycles per year 2	
Revenue	per cycle	Annualized	
Total Area (Ha)	8.0	8.0	
Revenue per Ha	107,586	215,171	
Total Revenue	**860,686**	**1,721,371**	**100%**
Cost of Production			
Post Larvae (PL)	(30,624)	(61,248)	-4%
Feed	(306,036)	(612,072)	-36%
Amendments	(42,408)	(84,816)	-5%
Electricity	(82,279)	(164,558)	-10%
Labor	(93,851)	(187,702)	-11%
Total Cost of Production	**(555,198)**	**(1,110,396)**	**-65%**
Gross Profit	**305,488**	**610,975**	**35.49%**
Operating Expense			
Farm Management	(88,166)	(176,333)	-10%
Annual Lease/Rent Costs	(10,000)	(20,000)	-1%
Insurance	(1,200)	(2,400)	0%
Producer Certification	-	-	0%
Total Operating Expense	**(99,366)**	**(198,733)**	**-12%**
EBIT	**206,121**	**412,243**	**23.95%**
Interest			
Taxes			
Net Income (Loss)			

ANNEX 2- QUANTITATIVE MODELLING- INDICITIVE LOAN

Indicative loan on CSS Farm Level Project: Using the CSS figures a model was created in order to stress-test the project's ability to service an indicative loan. Base case results are demonstrated below.

CLIMATE SMART INTENSIFICATION
Forecasted Farm Financing & Cash Flow Analysis (Annual)

Model Key Assumptions

Financing Sources	USD$	%
Senior Loan (Long-Term Debt)	574,362	43.19%
Credit Facility	520,016	39.11%
Owner Equity (Cash)	235,358	17.70%
Total	**1,329,736**	**100.00%**

Financing Uses	USD$	%
Project Capital Expenditures	695,552	52.31%
Capitalized Operating Expenses	22,400	1.68%
Working Capital	611,784	46.01%
Total	**1,329,736**	**100.00%**

Long-Term Financing Assumptions			
Total Long-Term Financing Requirements	USD$	717,952	
Max Long-Term Debt-to-Cost Ratio	%	80.00%	
Max Long-Term Debt Financing	USD$	574,362	x
Loan Term	years	5.00	
Payment Periods	periods yr^{-1}	2	
Grace Period	years	1.00	
Interest Rate	APR%	12.00%	

Credit Facility			
Total Working Capital Financing Requiremer	USD$	611,784	
Max Working Capital Financing Ratio	%	85.00%	
Max Credit Facility	USD$	520,016	x
Interest Rate	APR%	8.00%	
[Commitment Fee]	%Facility	0.50%	

Farm-Level Income Statement

	0	1	2	3	4	5	6	7	8	9	10
Gross Revenue	-	1,549,234	1,549,234	1,549,234	1,549,234	1,549,234	1,549,234	1,549,234	1,549,234	1,549,234	1,549,234
Cost of Production	-	(1,093,940)	(1,093,940)	(1,093,940)	(1,093,940)	(1,093,940)	(1,093,940)	(1,093,940)	(1,093,940)	(1,093,940)	(1,093,940)
Gross Profit	-	**455,294**	**455,294**	**455,294**	**455,294**	**455,294**	**455,294**	**455,294**	**455,294**	**455,294**	**455,294**
Farm Operating Expense											
Farm Management	-	129,628	129,628	129,628	129,628	129,628	129,628	129,628	129,628	129,628	129,628
Lease / Rent Costs	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Insurance	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400
Farm Certification	-	-	-	-	-	-	-	-	-	-	-
Total Farm Operating Expense	**22,400**	**152,028**	**152,028**	**152,028**	**152,028**	**152,028**	**152,028**	**152,028**	**152,028**	**152,028**	**152,028**
Farm EBITDA	**(22,400)**	**303,266**	**303,266**	**303,266**	**303,266**	**303,266**	**303,266**	**303,266**	**303,266**	**303,266**	**303,266**
Less: D&A Expense [Future Model Iteration]	-	-	-	-	-	-	-	-	-	-	-
Farm EBIT	**(22,400)**	**303,266**	**303,266**	**303,266**	**303,266**	**303,266**	**303,266**	**303,266**	**303,266**	**303,266**	**303,266**
Interest on Debt	-	(89,724)	(86,242)	(71,467)	(54,865)	(36,211)	-	-	-	-	-
Farm EBT	**(22,400)**	**213,542**	**217,024**	**231,799**	**248,401**	**267,055**	**303,266**	**303,266**	**303,266**	**303,266**	**303,266**
Corporate Taxes	-	(23,490)	(23,873)	(25,498)	(27,324)	(29,376)	(33,359)	(33,359)	(33,359)	(33,359)	(33,359)
Less: TLC Adjustment	-	(22,400)	-	-	-	-	-	-	-	-	-
Farm Net Income (Loss)	**(22,400)**	**167,652**	**193,151**	**206,301**	**221,077**	**237,679**	**269,907**	**269,907**	**269,907**	**269,907**	**269,907**

Debt Service Coverage

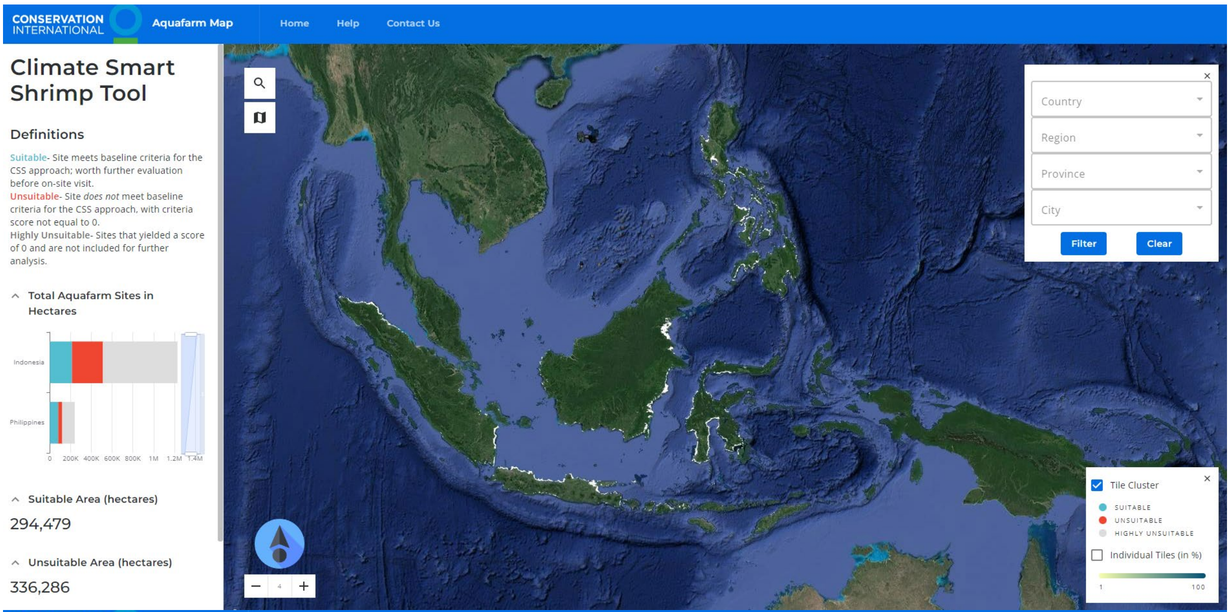
	0	1	2	3	4	5	6	7	8	9	10
Farm EBIT	**(22,400)**	**412,243**	**412,243**	**412,243**	**412,243**	**412,243**	**412,243**	**412,243**	**412,243**	**412,243**	**412,243**
Long-Term Debt											
Proceeds from Borrowing	574,362	-	-	-	-	-	-	-	-	-	-
Mandatory Interest Payments	-	90,798	87,316	72,540	55,938	37,284	-	-	-	-	-
Mandatory Principal Repayment	-	-	119,544	134,320	150,922	169,576	-	-	-	-	-
Total Debt Service	-	**90,798**	**206,860**	**206,860**	**206,860**	**206,860**	-	-	-	-	-
Interest Coverage	-	4.54	4.72	5.68	7.37	11.06	-	-	-	-	-
DSCR	-	4.54	1.99	1.99	1.99	1.99	-	-	-	-	-

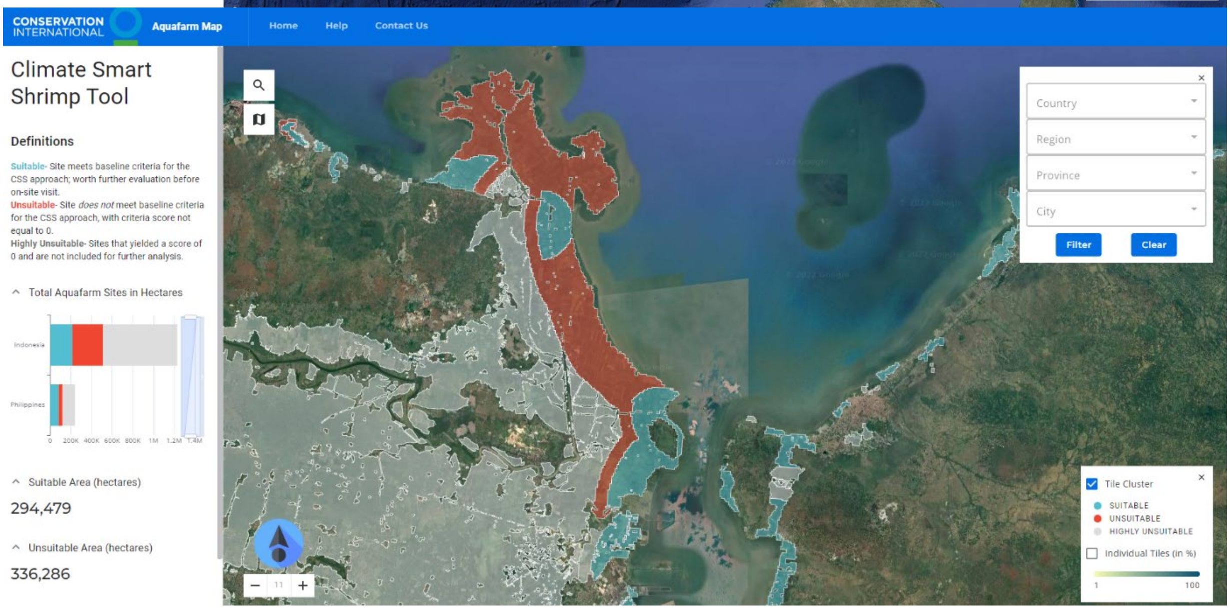
ANNEX 3: ONGOING PILOT EFFORTS

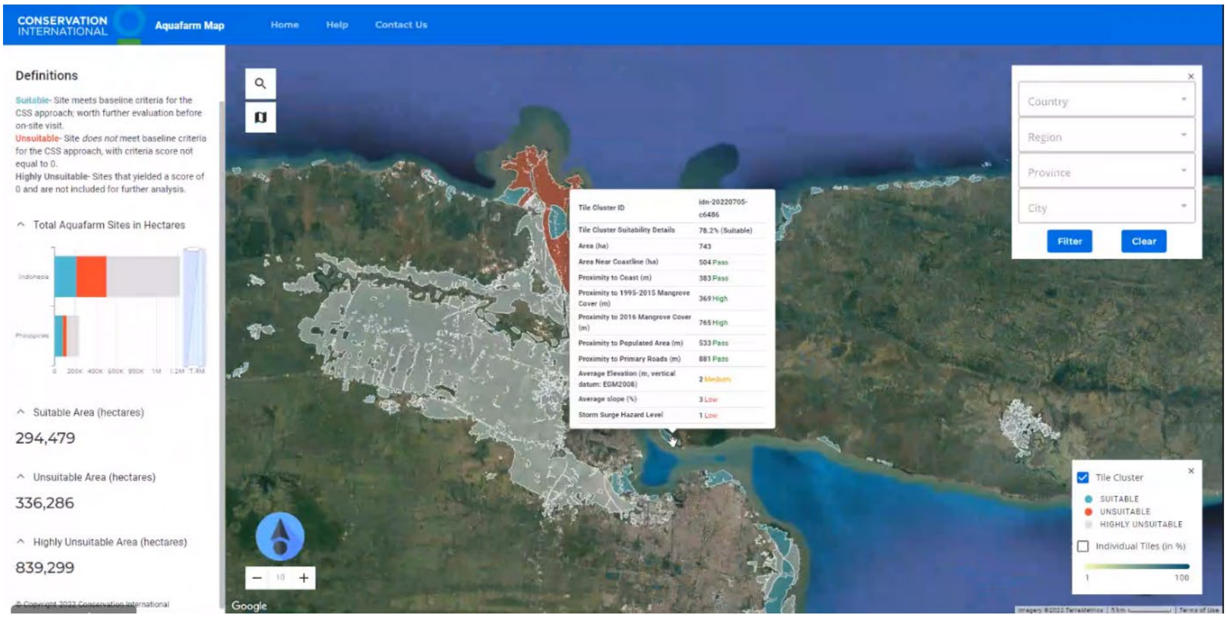
Region(s)	Funder	Implementing Partners	Stage	Next steps	Probability of pilot execution
Indonesia - Central Kalimantan, Sukamaru	Caterpillar Foundation (restoration), ADM capital ACLF (intensification) - *tentative*	Alune	Finalizing site selection, fundraising for intensification	Conduct bathymetry survey, investor site visit	Moderate (depends on finding intensification investor)
Indonesia - Central Sulawesi	Caterpillar Foundation (restoration), CI-V and JALA (intensification)	JALA	Formalizing partnership w/ JALA and farmer	Sign partnership agreement	High
Philippines	ORRAA / UK Blue Planet Fund (UK DFID)	Tambuyog, Jack Morales	Scoping is complete (Many opportunities for CSSF pilot).	Developing concept note for pilot funders/investors	Low (depends on finding grant funding, investor, and intensification partner)
Philippines	Investor (under NDA)	AECOM	Site visits and selection	Ongoing site visits and selection	Moderate (early-stage negotiations)
Ecuador	Private Individual (restoration and intensification) – need $500k match	XpertSea	Partnership discovery phase	Meetings with farmers	High (strong partnerships and 50% of required funding)

ANNEX 4: CI CSS FARM VIABILITY TOOL

Thinking Machines Corp. together with Conservation International are currently developing a platform that applies computer vision to satellite imagery that will enable the proponents (and other interested organizations) to locate and categorize shrimp ponds that have potential for Climate Smart Shrimp approach transformation. The system uses criteria such as proximity to current or historical mangroves, roads, coastlines, populated areas, and exposure to climate hazards like sea level rise and coastal flooding in order to generate results for the platform users. The images below demonstrate the platform's user interface.







CONSERVATION INTERNATIONAL
Aquafarm Map
Home
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Definitions
Suitable- Site meets baseline criteria for the CSS approach; worth further evaluation before on-site visit.
Unsuitable- Site does not meet baseline criteria for the CSS approach, with criteria score not equal to 0.
Highly Unsuitable- Sites that yielded a score of 0 and are not included for further analysis.
Total Aquafarm Sites in Hectares
Indonesia
Philippines
0 200K 400K 600K 800K 1M 1.2M 1.4M
Suitable Area (hectares)
294,479
Unsuitable Area (hectares)
336,286
Highly Unsuitable Area (hectares)
839,299
Tile Cluster ID idn-20220705-c6486
Tile Cluster Suitability Details 78.2% (Suitable)
Area (ha) 743
Area Near Coastline (ha) 504 Pass
Proximity to Coast (m) 383 Pass
Proximity to 1995-2015 Mangrove Cover (m) 369 High
Proximity to 2016 Mangrove Cover (m) 765 High
Proximity to Populated Area (m) 533 Pass
Proximity to Primary Roads (m) 881 Pass
Average Elevation (m, vertical datum: EGM2008) 2 Medium
Average slope (%) 3 Low
Storm Surge Hazard Level 1 Low
Country
Region
Province
City
Filter
Clear
Tile Cluster
SUITABLE
UNSUITABLE
HIGHLY UNSUITABLE
Individual Tiles (in %)
1
100
Google