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# Equitable mariculture

A diagnostic framework for equitable mariculture  
development in the Western Indian Ocean

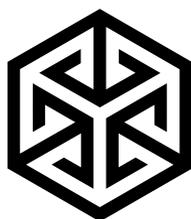




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A diagnostic framework for equitable mariculture  
development in the Western Indian Ocean

Hampus Eriksson, Max Troell, Cecile Brugere,  
Mohan Chadag, Michael Phillips and Neil Andrew



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# Foreword

**As the world looks to the United Nations Agenda 2030 Sustainable Development Goals (SDGs), which provide a new set of targets in the quest to reduce environmental degradation and poverty, it is vital to translate development aspirations into effective practice.**

Guiding the sustainable development of sectors within the blue economy is critical not only to the global goal of thriving life under water (SDG 14), but also across many other goals related to resources, poverty, health, equity and wellbeing. This is especially the case for island and coastal states, where oceans support daily subsistence, livelihoods and economic opportunities, in the face of poverty and food and nutrition insecurity.

In 2009, the Western Indian Ocean Marine Science Association (WIOMSA) and the International Foundation for Science arranged a workshop that sought to explore prospects to improve aquaculture in the Western Indian Ocean region. Subsequently, WIOMSA supported a workshop in 2013 that evaluated community-based aquaculture for the region.

Collaborative work reached a milestone in 2016, when WIOMSA and the Australian Centre for International Agricultural Research (ACIAR) brought together stakeholders from the region for a workshop to focus on mariculture (the farming of aquatic plants and animals in marine and brackish water) and to discuss approaches for guiding the sector towards a more equitable future. From that workshop, held in the Republic of Tanzania, arose the diagnostic framework presented in this publication.

WIOMSA and ACIAR are committed to supporting countries in the Western Indian Ocean region in their ambition to achieve the SDGs and realise the potential of the mariculture sector in achieving these goals.

The diagnostic framework for equitable mariculture development in the Western Indian Ocean will be a useful tool for people involved in coastal management decision-making, as well as mariculture planning and policy. It will help decision-makers in evaluating and guiding future mariculture initiatives towards a more equitable future, in line with mariculture development aspirations of a country or region.



Professor Andrew Campbell  
Chief Executive Officer, ACIAR



Dr Julius Francis  
Executive Secretary, WIOMSA

## Acknowledgments

A workshop was held in Zanzibar, Republic of Tanzania, 9–11 May 2016, to discuss approaches for guiding the mariculture sector towards a more equitable future.

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# Section 1. Overview

## Background

Mariculture is the farming of aquatic plants and animals in marine and brackish water. Mariculture is anticipated to be a new frontier in the sustainable development of national economies of the island and coastal states in the Western Indian Ocean. Traditionally, commercial mariculture has focused mainly on prawn farming in Tanzania, Mozambique and Madagascar and abalone and cobia in South Africa. Small-scale mariculture is also scattered throughout the region producing finfish (mainly milkfish), shellfish, seaweed and sea cucumber in partnership with public, private and non-governmental organisations and academic institutions.

These small-scale mariculture projects have focused on community farming and attracted considerable attention from governments, the private sector, social entrepreneurs and conservation and development agencies. Despite this, major questions remain relating to their scalability and development impact.

Most cultured marine species are commodity species, meaning they are often part of a larger processing and sales industry, mainly destined for export to international markets. These production systems have limited direct potential for local nutrition security but hold opportunity for export revenue and generating employment and income throughout associated value chains (supply industries, processing, value-adding and packaging). Expansion of such systems could play a key role in diversifying coastal livelihoods by stimulating new local employment.

Naturally, there has been a tendency to focus mariculture initiatives on species where suitable technology exists and on species that fetch high market prices. Initiatives have been promoted based on the potential for high-value products, alternative livelihoods for fishers and in some cases as direct remedies for fisheries that have been challenging to manage. These developments have been problematic for the industry because they have not been able to live up to expectations among many stakeholders. Nevertheless, political sentiment remains positive because national policies for development are aligned to such investments.

There is also a gap in evidence about what types of models deliver benefits that are relevant and result in national economic growth and/or in the wellbeing of coastal people. Equitable sharing of the benefits of development is unequivocal in the post-2015 Sustainable Development Goals (SDG). Today ‘benefit sharing’ is both a way of thinking and a practical process to distribute the monetary and non-monetary benefits of resource utilisation across the economy and its stakeholders, generating broad-based growth and progress towards social equity outcomes. From this perspective, benefit sharing is intrinsically connected to SDG propositions on the need to intervene with ‘business as usual’ economic development and move towards environmental sustainability for human wellbeing.

Despite their continued growth, most mariculture initiatives are faced with scientific, technical, financial and institutional challenges that affect their efficiency, environmental sustainability and profitability. A comparable situation exists in the Pacific, where mariculture has not fulfilled policy aspirations of national economic growth or livelihoods to coastal people:

“Based on past experience, there does not seem to be significant potential for marine aquaculture. However, for areas that may still have potential, there needs to be a fundamental change in approaching mariculture development, such as impartial and context specific assessment and planning...” (Hambrey et al. 2012).

The simple diagnostic framework presented in this publication is designed to assist decision-making for assessment and planning around sustainable and equitable mariculture. It draws on lessons from earlier and existing mariculture initiatives to support and guide an industry with practice that better aligns with aspirations for equitable growth and the Sustainable Development Goals.

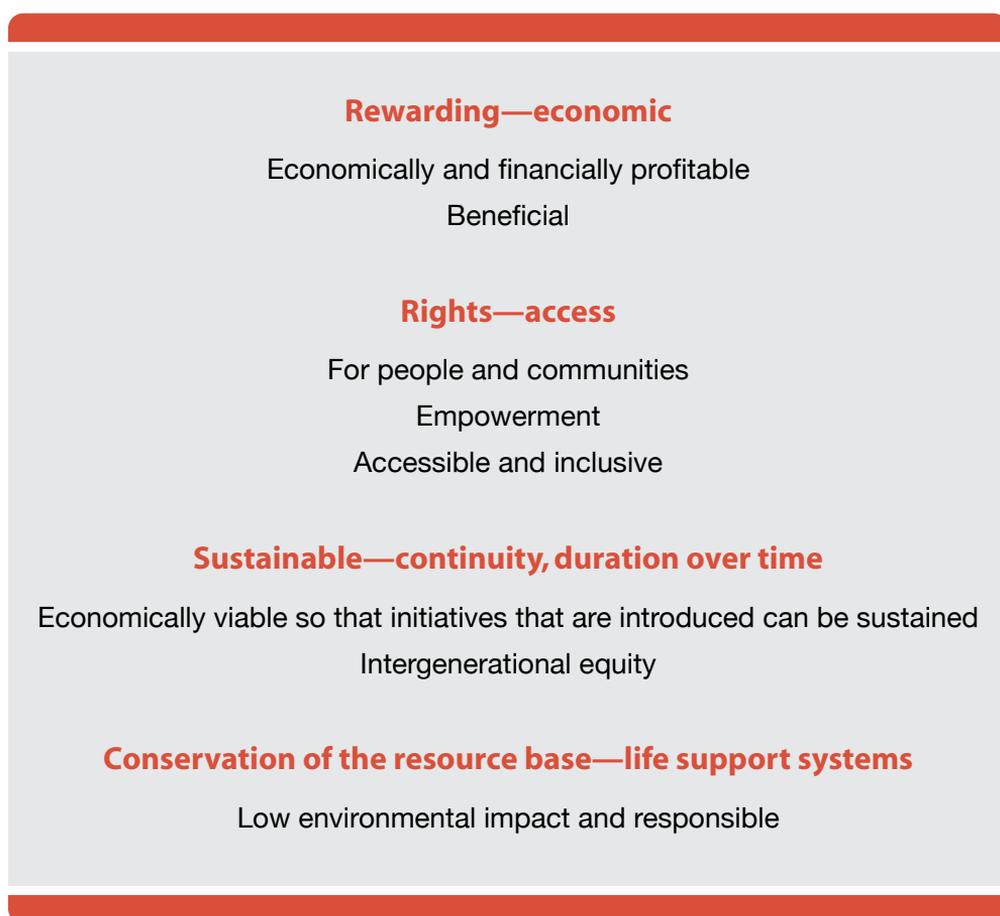
## **Principles for equitable mariculture**

Globally, from a whole of production perspective, there has been an uneven distribution of the benefits from mariculture among stakeholders. In parallel there is a disconnect between what those involved in mariculture want and the way these desires are captured at policy level. This ‘people–policy gap’ (Krause et al. 2015) must be closed if mariculture is to fulfil the ambitions of sustained and inclusive economic growth from the sector.

The term ‘equitable mariculture’ does not yet have its own definition but it is recognised that to fulfil its role in sustainable development, mariculture must be equitable as it grows. Equitable mariculture is therefore easier to characterise according to the principles and associated dimensions it encapsulates.

This was done by mariculture stakeholders of the Western Indian Ocean, who gathered in Zanzibar, 9–11 May 2016, to discuss sustainable and equitable mariculture development in the region. This workshop identified four principles upon which equitable mariculture should be based, as outlined in Figure 1.

‘Equitable’ here does not mean that all the benefits of mariculture should be equally distributed, but it implies that they should be shared fairly and that any negative impact on people and their livelihoods, now or in the future, should be considered and mitigated. This is especially important for the Western Indian Ocean region where many people are tightly connected to coastal resources and depend on ecological services for their wellbeing.



**Figure 1.** Four principles and associated dimensions for equitable mariculture development in the Western Indian Ocean. These principles were identified and further defined by Western Indian Ocean mariculture stakeholders participating in a workshop held in Zanzibar, 9–11 May 2016.

## A diagnostic approach

The idealised aspirations of equitable mariculture development for economic growth are difficult to operationalise. There is a clear need for more objective and informed project planning and assessment. The way mariculture is planned to deliver benefits across different stakeholder groups (direct and indirect beneficiaries) needs to account for the negative and positive impacts of mariculture across time and spatial scales. Planning and assessment needs to better capture and, if necessary, influence the underlying processes that share benefits by mariculture among the stakeholders of entire value chains. It also needs to include how revenues from export earnings trickle down and contribute to socially responsible national economic growth.

A diagnostic framework has been designed to help those in charge of overseeing the development of mariculture account for these factors and steer the development trajectory of the sector towards enhanced sustainability and equity. The framework has been designed to reflect the desired outcomes of mariculture initiatives (Figure 2).

The objectives and benefits of diagnostic approaches have been articulated across disciplines to move beyond an 'ideological' approach that advocates a singular application or model to all situations. The science and application of diagnostic approaches have gained considerable ground, and increasingly feature in international development policy. This framework should not be seen as replacing other modes of assessment that are already in place, but as a complement to these, to make sure that equity considerations are satisfied in the proposed mariculture activity.



**Figure 2.** Six outcomes on which the diagnostic framework to guide sustainable and equitable development of mariculture has been based.

## How to use the diagnostic framework

The thematic outcomes on which the diagnostic framework is based, emerged as prioritised areas in the sustainable development of mariculture, where the workshop participants agreed that there was a strong connection to the four equity principles outlined in Figure 1. In the diagnostic framework the outcomes are aspirational outcomes—a theorised benchmark of what an initiative should seek to achieve. Each outcome is linked to a diagnostic question to help gauge to what extent an initiative holds potential to deliver this outcome. The framework provides further guidance on how to answer the question and suggests a minimum set of actions if the answer to the diagnostic question is no. Each outcome is accompanied by a suggested set of indicators for its monitoring and evaluation.

The word ‘initiative’ is used to encompass both small and large projects as well as proposals, led by business enterprises, governments or communities. These can differ in their objective and size. It is important to note that this diagnostic framework will not solve all the potential problems or capture all the opportunities that may come with mariculture development, but it will help guide and structure how to carry out assessments of such activities.

The diagnostic framework is set out in Section 2.

Section 3 provides a template to record the response to each diagnostic question.

### **Who is the diagnostic framework for?**

The framework is primarily aimed at people involved in coastal management decision-making, as well as mariculture planning and policy making. Target users of the diagnostic framework are the officers within fisheries and aquaculture ministries, or other agencies, who deal with mariculture development applications and licensing. The framework provides a reference to assess applications and ensures that the proposed or existing developments comply with a number of equity and sustainability criteria that are in line with the country’s and region’s mariculture development aspirations.

### **References**

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## Section 2. Diagnosis: How equitable is the mariculture initiative?



PHOTO: M. Troell

## Outcome 1. Space



Space appropriated for mariculture maintains environments that support livelihoods

### Relevance

Mariculture can encroach on space already used for other livelihoods and such space can have diverse ownership structures. This concern includes the direct effect of displacement of existing activities and limiting access to space for other users. In hypothetical scenarios, this can impact negatively on livelihood opportunities for resident people, cause conflict over contested spaces and marginalise those not able to capitalise on mariculture growth.

Mariculture initiatives ought to consider the space they are proposing to use in the context of access rights and existing, and potentially future, livelihood activities. Larger-scale initiatives may have greater evaluation requirements, while small-scale businesses may be better assessed at the area level, or through zoning.

### Diagnostic question

*Will the proposed mariculture activity operate and grow without blocking access to space for other users or disrupting areas supporting existing, and potentially future, livelihoods?*

Answer	Description
	<b>Yes</b> Mariculture is small-scale or proposed in areas where very few people source food and income.
	<b>No</b> Mariculture will use space where people frequently source food and income, potentially blocking their access and livelihood opportunities.
	<b>Unknown</b> It is not possible to answer the question with the current information.

## Finding the answer

- Examine the initiative's proposal documentation to see if it defines the space it is proposing to use and impact upon, while assessing the potential for user conflicts. Request this information if these issues are not addressed.
- Request applicants of large-scale initiatives to commission third-party ecological and social impact assessments that evaluate the spatial appropriation for mariculture.
- Consult national coastal zoning plans and consider other sectors' involvement within that space (tourism, fishing, maritime infrastructure etc.).
- Consult the literature on lessons learned from similar mariculture activities.

## Actions if the answer is no or unknown

If there are indications that the proposed mariculture development will block access to space, then mitigating actions must be considered. In consultation with stakeholders mitigation actions may include identification of alternative sites and consideration of other employment opportunities. Development of spatial planning and zoning can assist in evaluating sites that are appropriate to mariculture without encroaching on used space.

## Indicators for M&E

The following indicators have been identified for monitoring and evaluation.

Outcome 1	Indicators
Space appropriated for mariculture maintains environments that support livelihoods	Size and location of area appropriated for mariculture
	Number of people reporting altered (better or worse) livelihood activities due to mariculture
	Number of people reporting change in access to space due to mariculture
	Number of people reporting conflicts over space used by mariculture

## Outcome 2. Habitats



### Mariculture sustainably uses coastal habitats that support ecosystem services

#### Relevance

Mariculture operations can drive modification of coastal habitats and functioning of ecosystems through physical alteration, pollution and broader ecological flow-on effects, for example from feed production, fry collection and disease spread. Degradation of coastal ecosystems can threaten their resilience and productivity, with both direct and indirect effects on ecosystem services that coastal people benefit from. Therefore, ecological effects caused by mariculture must be considered in the planning stages.

#### Diagnostic question

*Will mariculture operate without impact on habitats and in a way that safeguards ecosystem services?*

Answer	Description
	<b>Yes</b> Mariculture will operate in environments that provide a limited range of ecosystem services, or with negligible habitat impact, and will not risk undermining current and future ecosystem services.
	<b>No</b> Mariculture will use or modify environments that supply an important stream of ecosystem services and are of high ecological value, potentially disrupting life-supporting ecosystem services.
	<b>Unknown</b> It is not possible to answer the question with the current information.

## Finding the answer

- Review current knowledge of ecosystem services provision, or potential provision in the area targeted for development and future threats, for example climate change.
- Examine the initiative's documentation. Check it includes assessment of socio-ecological risks and request the information if it doesn't.
- Request applicants for large-scale initiatives to seek third party ecological and social impact assessments.
- Consult the literature on lessons learned from similar mariculture activities.

## Actions if the answer is no or unknown

If there are uncertainties associated with how mariculture will be carried out in the natural environment, then strong adaptive management structures and regulations must accompany implementation. Mitigating activities, when possible, or restoration of degraded areas should be requested of the applicant. Mariculture cannot be considered sustainable or equitable if there are indications of severe, or irreversible, effects on habitats and adjacent communities.

## Indicators for M&E

The following indicators have been identified for monitoring and evaluation.

Outcome 2	Indicators
Mariculture sustainably uses coastal habitats that support ecosystem services	Level of biodiversity change against a baseline
	Measure of ecological community structure change against a baseline
	Measure of water quality against standard reference values and a baseline
	Measure of pollutants of concern against standard reference values and a baseline
	Number of people in adjacent areas reporting habitat deterioration compared to a baseline

## Outcome 3. Biosecurity



Functional integrity of ecosystems is not compromised by invasive species or pathogen introduction from mariculture

### Relevance

Unwanted effects from unintentionally or intentionally introducing alien species through mariculture may be of broad ecological concern. While introduced species may not have direct negative impacts on people in the coastal zone and their livelihoods, potential indirect effects through alteration of the ecological integrity and functionality of ecosystems must be considered. The introduction of pathogens (infectious agents responsible for disease epizootics) to the ecosystem from culture of native or exotic species is also of concern. Intensive farming operations could amplify pathogens and put the surrounding ecosystem and wild fish population at risk. In addition, large-scale monoculture of native species may impact negatively on genetic composition of wild species if large-scale escape or spread is happening.

### Diagnostic question

*Will there be negligible risk of mariculture introducing invasive species or pathogens that could undermine current or future livelihoods?*

Answer	Description
	<b>Yes</b> Necessary risk management measures have been considered (based on risk analysis) and will be implemented to minimise the impact of the proposed mariculture species on native wildlife and risk of disease transmission and spread.
	<b>No</b> There is not sufficient evidence that the proposed mariculture species will be farmed in a biosecure way that minimises risks to the native local wildlife and ecosystem. Serious diseases (e.g. OIE-listed diseases) are known to occur for the proposed mariculture species and pose risks to endemic populations.
	<b>Unknown</b> It is not possible to answer the question with the current information.

## Finding the answer

- Check compliance with legislation on the introduction and management of non-indigenous species.
- Check compliance with legislation on the introduction of genetically improved strains.
- Review the history of past introductions of the proposed species, including its sensitivity to pathogens and role in documented disease outbreaks.
- Review the extent of current farming of the proposed species in the proposed area, and the extent to which the proposed initiative contributes (or not) to the diversity of farmed species.
- Proposal documentation should include assessment of potential ecological risks and detail all the risk management options that will be put in place.
- Request applicants for large-scale initiatives to commission a third-party ecological impact assessment.
- Consult the literature on lessons learned from similar mariculture activities.
- Gain an understanding about how impacts from mariculture are positioned in a broader suite of factors impacting on biosecurity (i.e. climate driven or linked to other activities).

## Actions if the answer is no or unknown

It is essential that the proposed initiative complies with better management practices (BMPs), biosecurity guidelines and codes of conduct (irrespective of the type of species farmed), as well as with legislation and guidelines on the use and management of introduced species in mariculture.

## Indicators for M&E

The following indicators have been identified for monitoring and evaluation.

Outcome 3	Indicators
Functional integrity of ecosystems is not compromised by invasive species or pathogen introductions from mariculture	Changes in biodiversity in the vicinity of the mariculture operation against a baseline
	Changes in ecological community
	Abundance of farmed species in the natural environment (if non-native mariculture species are used)
	Frequency of disease incidence on farms
	Presence of pathogens from the mariculture species in the wild environment

## Outcome 4. Incomes and livelihoods



Livelihood opportunities and benefits for people living in the coastal zone are increased through mariculture

### Relevance

Mariculture initiatives are often justified by wanting to deliver increased benefits to people. Such initiatives may be resource intensive and commonly require considerable external inputs. As a consequence, many initiatives focused on community farming have been unsustainable beyond project lifetimes. Mariculture production systems that focus on commodity species have limited direct local nutrition security potential but hold potential for supporting employment and income generation throughout value chains, for example supply industries, processing and packaging.

### Diagnostic question

*Does the mariculture initiative outline a realistic plan for viability of the business, and long-term economic sustainability that delivers benefits and opportunities to people?*

Answer	Description
	<b>Yes</b> The initiative is economically viable, and outlines a realistic impact pathway that promises to deliver benefits (e.g. food or income) to people beyond the project lifetime. Risks and assumptions (e.g. governance) that may inhibit these benefits are clearly indicated and addressed to the best of the proposal's ability.
	<b>No</b> The initiative is not considering how mariculture will be sustained past its lifetime, and assumes benefits without describing how they will be achieved and without ensuring that the necessary measures are in place to ensure sustainability.
	<b>Unknown</b> It is not possible to answer the question with the current information.

## Finding the answer

- Check that the initiative’s proposal documentation outlines a plan for the economic sustainability of the mariculture enterprise and an explanation of the chain logic to achieve this.
- Request applicants for large-scale initiatives to commission a third-party socio-economic assessment.
- Consult the literature on lessons learned from similar mariculture activities.

## Actions if the answer is no or unknown

Consult with the proposing party and request a plan that promises to deliver benefits to people. If such a pathway cannot be developed, then consider what benefits the mariculture initiative will actually have for those living in the coastal zone. In some cases this may require further studies or participatory appraisals of how the activity will interact with people’s lives to fill the gaps before moving on. For some initiatives it might not be possible to answer the question—for instance when the mariculture initiative is an experiment—in other cases it might be justifiable if risks to people and environments are demonstrated as being low.

## Indicators for M&E

The following indicators have been identified for monitoring and evaluation.

Outcome 4	Indicators
Livelihood opportunities and benefits for people living in the coastal zone are increased through mariculture	Number of people employed or otherwise engaged in new mariculture activities (including the entire value chain)
	Level of income in communities engaged in mariculture
	Number of alternative income-generating opportunities created in the community

## Outcome 5. Economic growth



Mariculture is financially viable and contributing to socially responsible national economic growth

### Relevance

Mariculture offers large potential for economic growth through delivery of revenue from production and from growth in national supply industries. However, as growth is realised there must be benefit-sharing mechanisms in place to ensure that revenue is contributing to the achievement of national development objectives. The private sector has an important role to play in bolstering the presence and productivity of mariculture, and all mariculture initiatives can ensure they fulfil their responsibilities to society.

Most species produced in mariculture are commodity species, meaning they are often part of a larger processing and sales industry destined for export to international markets, with scope for national revenue from exports. The social responsibility of mariculture producers can be achieved in many ways. These include the creation of local employment, provision of decent work conditions, investment in local infrastructure and participation of employees in the enterprise capital regardless of the commodity produced. This outcome is perhaps best suited to evaluate medium to larger enterprises, as they are more likely to have the financial and corporate capacity to undertake such activities.

### Diagnostic question

*Does the enterprise outline socially responsible business strategies and productive stakeholder relationships for creating lasting national value?*

Answer	Description
	<b>Yes</b> The initiative is explicit about how it will contribute to economic growth and will put in place business processes for transparency and social responsibility.
	<b>No</b> The initiative does not present a credible corporate structure or a process through which to deliver lasting national value and socially responsible development.
	<b>Unknown</b> It is not possible to answer the question with the current information.

## Finding the answer

- Check that the initiative’s proposal documentation outlines a plan for socially responsible business strategies and productive stakeholder relationships for creating lasting national value, commonly referred to as a corporate social responsibility plan.
- Assess past experiences from similar initiatives and identify past corporate practices among involved operators.
- Request applicants for large-scale initiatives to commission a third-party business model assessment.
- Consult the literature on lessons learned from similar mariculture activities.

## Actions if the answer is no or unknown

Consult with the proposing party to request a detailed corporate social responsibility plan. Check the history of the proposer’s practices. Set clear criteria for corporate practices that outline requirements for transparency and social responsibility. If the proposer cannot outline how the initiative can contribute to national growth and living standards then consider what benefit the mariculture initiative will actually have to the creation of lasting national value and local welfare. In some cases filling this knowledge gap may require further studies before moving on. For some initiatives it might not be possible to answer the question—for instance when the mariculture initiative is an experiment—in other cases it might be justifiable if risks to people and environments are demonstrated as being low.

## Indicators for M&E

The following indicators have been identified for project or enterprise monitoring and evaluation.

Outcome 5	Indicators
Mariculture is financially viable and contributing to socially responsible national economic growth	Number of social actions and contributions to the local community
	Measures of living standards in mariculture communities
	National revenue from mariculture
	Business viable through time (number of years in operation)

## Outcome 6. Gender and youth



Access to opportunities and benefits from mariculture is equitable

### Relevance

Working towards gender equality is justified both from the ethical consideration that equal opportunity for men and women is a human right, and from the fact that progress towards poverty reduction and food security is faster when women are empowered. Men and women access information and benefits differently and this influences their ability to harness opportunities. In addition, the involvement of youth in development is commonly prioritised in national development strategies. Therefore, mariculture development ought to consider how it can best assure that women and youth are accessing opportunities from mariculture production and value chains.

### Diagnostic question

*Will the mariculture initiative deliberately engage women and youth so that they can access opportunities?*

Answer	Description
	<b>Yes</b> The initiative is actively considering gender in production and/or value chains, and has a strategy for how to consider equitable involvement and access to benefits for women and youth.
	<b>No</b> The initiative is not considering gender as part of the implementation and is not addressing imbalances that promote gender inequity (access to information and benefits).
	<b>Unknown</b> It is not possible to answer the question with the current information.

## Finding the answer

- Ensure that the initiative's proposal documentation addresses gender issues and contains a strategy for engaging with women and youth.
- Request applicants for large-scale initiatives to commission a third-party socio-economic assessment.
- Consult women and youth in the proposed area to gauge their level of interest and whether they see opportunities or barriers from the mariculture initiative.
- Consult the literature on lessons learned from similar mariculture activities.

## Actions if the answer is no or unknown

Ensure the proposer has access to relevant literature and policies that articulate the need and desirability of including gender-based opportunities in their initiative. Ensure compliance with gender-specific legal or regulatory requirements that may be relevant to the initiative.

## Indicators for M&E

The following indicators have been identified for monitoring and evaluation.

Outcome 6	Indicators
Access to opportunities and benefits from mariculture is gender equitable	Participation (number) of women and youth employed in mariculture activities
	Salary levels and types of positions occupied by women in mariculture activities in comparison to the male workforce
	Number of young trainees recruited and in-house training sessions



## Section 3. Diagnosis summary and actions

**What do the answers from the six diagnostic questions indicate about how the initiative is aligned with equitable outcomes? The matrix on the next page can be used to summarise the assessment for each outcome. The objective is to provide a simple overview summary and assist in the evaluation.**

Each diagnostic question from Section 2 should be evaluated and interpreted in consultation with the supporting text under each outcome. Counting the ticks and crosses is an overview assessment but the details of the evaluation and its implications are to be found under each outcome.

The decision must be arrived at by the decision-maker(s) based on the details provided in the initiative proposal and interactions with the proposer. Further validation of the decision (based on the size/value/area of the initiative) can come from an independent third party. The role of third-party assessment or certification has also been highlighted as a potential source of information under each of the outcomes.

## Diagnostic summary

			
			
			
			
			
			
			
Summary			

Summary evaluation	Action
	<p><b>All ticks = mariculture initiative is aligned with equitable outcomes</b></p> <p><i>Move to Section 4 to consider a monitoring and evaluation plan for implementation of the initiative.</i></p>
 	<p><b>Mostly ticks = mariculture initiative has potential for alignment with equitable outcomes</b></p> <p><i>Move to Section 4 to consider a monitoring and evaluation plan for implementation of the initiative but consider how the initiative can be improved to increase its alignment with outcomes that are not met.</i></p>
	<p><b>All or mostly crosses = mariculture initiative is not aligned with equitable outcomes</b></p> <p><i>The initiative does not meet the expectations of a sustainable and equitable mariculture activity and should not be permitted to go ahead as it stands.</i></p>
	<p><b>All or mostly question marks = insufficient information to evaluate if initiative is aligned with equitable outcomes</b></p> <p><i>There are information gaps in the initiative that needs to be filled before an evaluation can be completed and decision made.</i></p>



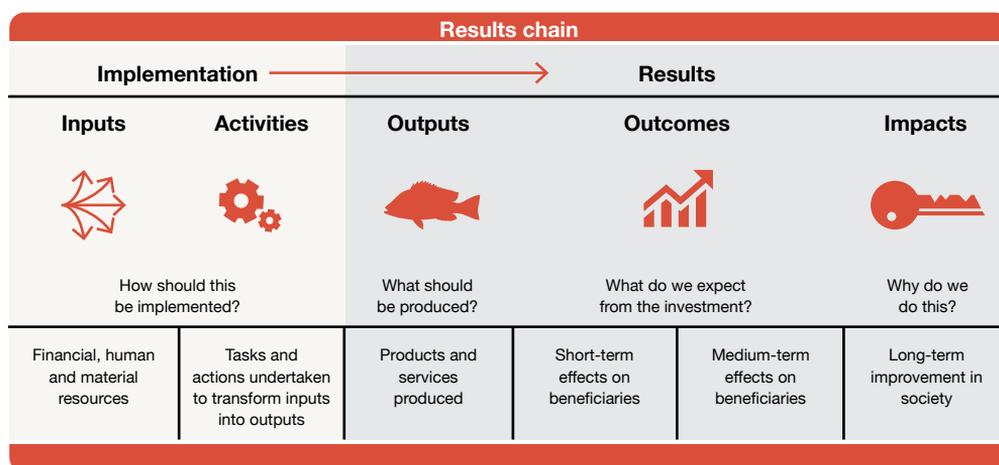
PHOTO: H. Eriksson

## Section 4.

# Monitoring and evaluation

**Monitoring and evaluation of mariculture initiatives is important for accountability and to build an evidence base to track how outcomes are achieved. Monitoring and evaluation plans broadly incorporate indicators along a results chain (Figure 3).**

In-depth analytical frameworks and planning tools exist to support development of monitoring and evaluation plans and impact assessments, see Section 5. The plans should build on result chains that illustrate the theoretical causal chain between the implementation dimensions, inputs and activities and their intended results that include outputs, outcomes and impacts. The use of results chain logic is well established and frequently features in impact evaluation literature. Using this logic will assist in evaluating appropriate outcomes and sustainability of mariculture initiatives. Rigorous evaluations will help build better mariculture programs based on evidence from past initiatives.



**Figure 3.** Monitoring and evaluation incorporates the assessment of indicators along a results chain.

Adapted from ADB 2006. An introduction to results management: principles, implications and applications. Manila: Asian Development Bank. <<http://beta.adb.org/documents/introduction-results-management-principles-implications-and-applications>>

The emphasis in this diagnostic framework has been on outcomes—what the initiative is meant to achieve. How to achieve the outcomes depends on the scope of the initiative. The suggested indicators under each outcome in this diagnostic framework are summarised in the table below.

## Suggested indicators for each outcome in the diagnostic framework

Outcomes	Indicators
Space appropriated for mariculture maintains environments that support livelihoods (Space)	Size and location of area appropriated for mariculture
	Number of people reporting altered (better or worse) livelihood activities due to mariculture
	Number of people reporting change in access to space due of mariculture
	Number of people reporting conflicts over space used by mariculture
Mariculture sustainably uses coastal habitats that support ecosystem services (Habitats)	Level of biodiversity change against a baseline
	Measure of ecological community structure change against a baseline
	Measure of water quality against standard reference values and a baseline
	Measure of pollutants of concern against standard reference values and a baseline
Functional integrity of ecosystems is not compromised by invasive species or pathogen introductions from mariculture (Biosecurity)	Changes in biodiversity in the vicinity of the mariculture operation against a baseline
	Changes in ecological community
	Abundance of farmed species in the natural environment (if non-native mariculture species are used)
	Frequency of disease incidence on farms
Livelihood opportunities and benefits for people living in the coastal zone are increased through mariculture (Income and livelihoods)	Number of people employed or otherwise engaged in new mariculture activities (including the entire value chain)
	Level of income in communities engaged in mariculture
	Number of alternative income-generating opportunities created in the community

Outcomes	Indicators
Mariculture is financially viable and contributing to socially responsible national economic growth (Economic growth)	Number of social actions and contributions to the local community
	Measures of living standards in mariculture communities
	National revenue from mariculture
	Business viable through time (number of years in operation)
Access to opportunities and benefits from mariculture is gender equitable (Gender and youth)	Participation (number) of women and youth employed in mariculture activities
	Salary levels and types of positions occupied by women in mariculture activities in comparison to the male workforce
	Number of young trainees recruited and in-house training sessions

Initiatives will have different requirements for monitoring and evaluation depending on their objectives, scale, species, environment and mode of implementation. The six outcomes that this framework centres on represent long-term challenges for future mariculture initiatives to overcome. Monitoring and evaluating mariculture initiatives is important to facilitate learning, for example, to guide policy and build better mariculture programs. The framework in this guide gives a structure for how to map indicators that help evaluate outcomes associated to generic mariculture initiatives. It is understood that initiatives will have requirements for monitoring and evaluation that must be considered on a case-by-case basis. However, it should be a requirement for good practice of a mariculture initiative to commit to monitoring and evaluating relevant indicators against all six outcomes.



## Section 5. Resources

### Assessment and planning for mariculture development

#### **The code of conduct for responsible fisheries:**

FAO (Food and Agriculture Organization of the UN) 1995. Code of conduct for responsible fisheries. FAO: Rome. Accessible at <[www.fao.org/docrep/005/v9878e/v9878e00.htm](http://www.fao.org/docrep/005/v9878e/v9878e00.htm)>

#### **Ecosystem approach to aquaculture:**

FAO 2010. Aquaculture development 4. Ecosystem approach to aquaculture. FAO technical guidelines for responsible fisheries, 5 Suppl. 4. FAO: Rome. Accessible at <[www.fao.org/docrep/013/i1750e/i1750e00.htm](http://www.fao.org/docrep/013/i1750e/i1750e00.htm)>

#### **An assessment of impacts from small-scale aquaculture in Southeast Asia, with whole-of-production system analyses relevant for WIO mariculture:**

Belton B. 2013. Small-scale aquaculture, development and poverty: a reassessment. Pp. 93–108 in 'Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development', ed. by M.G. Bondad-Reantaso and R.P. Subasinghe. FAO Fisheries and Aquaculture Proceedings No. 31. FAO: Rome. Accessible at <[http://pubs.iclarm.net/resource\\_centre/WF-3717.pdf](http://pubs.iclarm.net/resource_centre/WF-3717.pdf)>

#### **A workshop report where practitioners and stakeholders review community-based aquaculture in WIO:**

Ateweberhan M., Hudson J., Rougier A., Harris A., Jiddawi N. and Msuya F.E. 2014. Community based aquaculture in the Western Indian Ocean: Challenges faced and lessons learned. Zanzibar, December 9–11, 2013. Blue Ventures Conservation: London. Accessible at: <[www.wiomsa.org/download/reports/CBAWIO\\_WorkshopReport.pdf](http://www.wiomsa.org/download/reports/CBAWIO_WorkshopReport.pdf)>

#### **A reference work for responsible-approach practices for when mariculture initiatives contains objectives of stock enhancement:**

Blankenship H.L. and Leber K.M. 1995. A responsible approach to marine stock enhancement. American Fisheries Society Symposium 15, 167–175. Accessible at: <[http://www.stockenhancement.org/pdf/responsible\\_approach\\_1995.pdf](http://www.stockenhancement.org/pdf/responsible_approach_1995.pdf)>

#### **A review of impacts and sustainability of mariculture initiatives in the Pacific with lessons and policy guidance that is relevant for the WIO:**

Hambrey Consulting and Nautilus Consultants. 2011. Opportunities for the development of the Pacific islands' mariculture sector: Report to the Secretariat of the Pacific Community. SPC: New Caledonia. Accessible at: <<http://bit.ly/wn6MTK>>

#### **Insight to the science of diagnosis using an interdisciplinary framework:**

Hinkel J., Cox M.E., Schlüter M., Binder C.R. and Falk T. 2015. A diagnostic procedure for applying the social-ecological systems framework in diverse cases. Ecology and Society 20(1), 32. <<http://dx.doi.org/10.5751/ES-07023-200132>>

#### **A diagnostic framing for economic policy in the World Bank's 'growth diagnostics' approach:**

Hausman R., Rodrik D. and Velasco A. 2005. Growth diagnostics. John F. Kennedy School of Government, Harvard University (Cambridge, Massachusetts) 35pp. Accessible at: <<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.446.2212&rep=rep1&type=pdf>>

### **A scientific investigation of the connections between people and policy in aquaculture development:**

Krause G., Brugere C., Diedrich A., Ebeling M.W., Ferse S.C.A., Mikkelsen E. et al. 2015. A revolution without people? Closing the people–policy gap in aquaculture development. *Aquaculture* 447, 44–55. Accessible at: <[www.sciencedirect.com/science/article/pii/S0044848615000800](http://www.sciencedirect.com/science/article/pii/S0044848615000800)>

### **A review of mariculture prospects and challenges in the Western Indian Ocean:**

Troell M., Hecht T., Beveridge M., Stead S., Bryceson I., Kautsky N. et al. (eds) 2011. *Mariculture in the WIO region—Challenges and Prospects*. WIOMSA Book Series No. 11. Accessible at: <[www.beijer.kva.se/ftp/max/Mariculture.pdf](http://www.beijer.kva.se/ftp/max/Mariculture.pdf)>

### **A literature review on measuring gender transformative change:**

Hillenbrand E., Karim N., Mohanraj P. and Wu D. 2015. Measuring gender transformative change: A review of literature and promising practices. Working Paper. CARE USA. Accessible at: <[http://pubs.iclarm.net/resource\\_centre/AAS-Working-Paper-Measuring-Gender-Transformative-Change.pdf](http://pubs.iclarm.net/resource_centre/AAS-Working-Paper-Measuring-Gender-Transformative-Change.pdf)>

### **The instructional guide on the Abbreviated Women’s Empowerment in Agriculture Index (A-WEAI):**

Malapit H.J., Kovarik C., Sproule K., Meinzen-Dick R.S. and Quisumbing A.R. 2015. Instructional guide on the abbreviated Women’s Empowerment in Agriculture Index (A-WEAI). IFPRI: Washington, DC. Accessible at: <<https://www.ifpri.org/publication/instructional-guide-abbreviated-womens-empowerment-agriculture-index-weai>>

### **A guide for agricultural policy and research with indicators of gendered control over agricultural resources:**

Rao S. 2016. Indicators of gendered control over agricultural resources: A guide for agricultural policy and research. Working paper. CGIAR Gender and Agriculture Research Network. Accessible at: <[https://cgspace.cgiar.org/bitstream/handle/10568/75779/Indicators%20of%20gendered%20control%20over%20agricultural%20resources\\_Workingpaper1.pdf?sequence=5&isAllowed=y](https://cgspace.cgiar.org/bitstream/handle/10568/75779/Indicators%20of%20gendered%20control%20over%20agricultural%20resources_Workingpaper1.pdf?sequence=5&isAllowed=y)>

## **Monitoring and evaluation and impact assessment**

### **An in-depth guide to planning and conducting ex-ante impact evaluation for aquaculture and fisheries initiatives:**

Crissman C.C., Abernethy K., Delaporte A. and Timmers B. 2013. A practical guide for ex-ante impact evaluation in fisheries and aquaculture. CGIAR Research Program on Aquatic Agricultural Systems, Guidelines: AAS-2013-04. WorldFish: Penang, Malaysia. Accessible at: <[http://pubs.iclarm.net/resource\\_centre/WF\\_3464.pdf](http://pubs.iclarm.net/resource_centre/WF_3464.pdf)>

### **A technical report on environmental impact assessment and monitoring in aquaculture that emphasises relevant regulatory requirements:**

FAO 2009. Environmental impact assessment and monitoring in aquaculture. *FAO Fisheries and Aquaculture Technical Paper*. No. 527. Rome, FAO. 2009. 57p. <[www.fao.org/docrep/012/i0970e/i0970e00.htm](http://www.fao.org/docrep/012/i0970e/i0970e00.htm)>

### **A broader view on impact evaluation in natural resource management research programs that can assist in both the ex-ante and ex-post phase of initiative evaluation (by ACIAR):**

Mayne J. and Stern E. 2013. Impact evaluation of natural resource management research programs: a broader view. ACIAR Impact Assessment Series Report No. 84. ACIAR: Canberra. Accessible at: <http://aciarc.gov.au/files/ias84.pdf>





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