dakshin

# Island Sustainability Pathways

## FISHERIES CO-MANAGEMENT IN THE LAKSHADWEEP ISLANDS

SUPPORTED BY TATA TRUSTS

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# 1. Introduction

### *1.1 Background and Context*

Fisheries provide nutritional and livelihood security to millions of people across the world. Globally, the fisheries sector employs over 59 million people (FAO, 2020). Fishing is one of the oldest forms of human-environment interactions and human society has coexisted with oceans and other aquatic systems for thousands of years, sustainably harvesting resources to fulfil their food needs. Fishing is, in fact, one of the last remaining examples of a commercial food production system that is classified under 'hunting and gathering.' In India, nearly 15 million people depend on fisheries for their livelihood. In the case of marine fisheries, there are nearly 3432 fishing villages scattered along India's vast coastline of more than 7500 km. Socio-economically and culturally, the fisheries sector is extremely significant.

However, the past 4-5 decades have seen a massive transformation in the scale of fishing operations due to technological advances leading to mechanisation of fisheries and a strong market demand for seafood from a growing population in a highly globalised economy, leading to intensive extraction of fish resources and increased pressure on the world's oceans. The dominant fisheries developmental paradigms tend to be myopic, with a narrow focus on augmenting fisheries production and boosting national revenue. This approach, however, has proven to be disastrous for the world's marine ecosystems. There have been a host of studies documenting the ecosystem impacts of industrial-scale fisheries (Jennings and Kaiser, 1998). Considering the tremendous role that oceans play in regulating the earth's climate and buffering the impacts of anthropogenic climate change by absorbing atmospheric carbon, ensuring healthy oceans is crucial for human survival. Since fishing is one of the most significant factors modifying marine ecosystems across the world, the sustainability of fisheries is critical to the sustainability of oceans themselves.

Today, fisheries across the world, and especially in developing countries, grapple with a host of similar challenges. Overfishing due to production-centric development paradigms and the resultant degradation of natural ecosystems has led to several well-documented examples of fisheries collapses and catch declines in several parts of the world (Milch, 1999; Hauge et al, 2009). Differences in the scale at which fishing operations take place, i.e., the degree of fishing intensity and differential access to fishing technology to harvest a common pool of fishery resources lead to conflicts between large-scale fisheries and small-scale fisheries. Additionally, large-scale infrastructure development along the coasts poses severe threats not only to coastal ecosystems but also to coastal communities to access their common spaces and traditional fishing grounds. Looming heavily in the background are larger, global

factors like anthropogenic climate change which further exacerbate the impacts of unsustainable coastal development, increased incidences of extreme weather events, and increased fluctuations and uncertainty in fish catch.

In such a backdrop, fishing communities, in particular small-scale fishing communities, are in a highly vulnerable position, and are increasingly being pushed to the margins in the current development landscape. Small-scale fisheries contribute over 40% of the world's fish catches and have a vital role to play in ensuring the nutritional and livelihood security of millions of marginalised coastal communities across the world. Considering their low-intensity fishing techniques, the ecosystem impacts of small-scale fisheries are far more benign as compared to those of large-scale fisheries and small-scale fisheries are, on the whole, more sustainable than large-scale fisheries. Small-scale fisheries are thus critical to ensuring healthy oceans as well as sustainable fisheries. However, in spite of their significance, small-scale fisheries are heavily overlooked in policy agendas and considered primitive. Contemporary fisheries management regimes have failed to acknowledge the importance of small-scale fisheries and build resilience in them.

Fisheries management refers to managing or regulating how fishery resources are harvested through a set of clearly defined rules and guidelines. Presently, most fisheries management systems across the world are top-down in nature i.e., the power to make rules and enforce them is concentrated in the hands of the concerned authorities, typically, the government. Top-down fishery management approaches have not only failed to address ecological challenges associated due to overfishing but also failed to stem the degradation of coastal ecosystems with severe consequences for the social, economic, nutritional security of small-scale fishers and marginalised coastal communities. Top-down approaches also fail to take local social-ecological contexts into consideration and therefore, often do not have any tangible impacts on the ground.

Fishing, like forestry, is a primary sector activity i.e., it involves the direct harvest of natural resources from the ecosystem. Local communities engaged in these occupations, due to their dependence on these natural systems for livelihoods and also the close proximity that they share with them on account of living there, are the most vulnerable to changes in the ecosystem. Local fishing communities are thus, the primary stakeholders in oceans and marine ecosystems, especially the many small-scale fishing communities that have traditional, historical, and cultural relationships with the natural resources around them. There is a growing consensus among scientists and practitioners working on fisheries about the need for alternative fisheries management regimes that are participatory in nature, with adequate spaces for fishing communities to engage with the dialogue and decision-making around fisheries resource management. Several studies on fisheries governance from

developing countries across the world have identified that active participation of local community members in management along with an equitable distribution of access and decision making rights are necessary for ensuring better management of resources (Pomeroy, 1995; McKay and Jentoft, 1996; Lobe and Berkes, 2004). Such approaches can better reflect local social-ecological contexts, incorporate fishers' traditional ecological knowledge, and help design appropriate solutions to address local fishery issues. Given the inherent stake that fishing communities have in fishery resources and preserving aquatic ecosystems, such approaches can not only have positive impacts for ecosystem sustainability but also empower communities to collectively address local fishery issues. Thus, philosophically, participatory approaches seek to empower fishing communities by shifting the agency for decision-making towards them. While there are several examples of such alternative models of fisheries governance in other parts of the world, examples from India are few.

Considering the vast diversity of fisheries in India, centralised, top-down, 'one size fits all' management approaches are ill-suited to the complex Indian fisheries landscape. There is an urgent need for alternative models that can demonstrate the crucial role that communities can play in managing their fisheries and resources through collective action and the benefits that this can have for ecosystem sustainability as well as food and livelihood security. It is imperative to bring newer narratives to the forefront of the discourse on development; narratives that are inclusive, holistic, equitable, and those which ensure the sustainability of life and livelihood. The belief that local communities are well-equipped and best-suited to govern natural resources that they have traditionally been utilising lies at the core of Dakshin Foundation's work. With this conviction in mind, Dakshin has been engaged in working towards the creation of alternative, participatory models of small-scale fisheries governance that can be templatised and in turn be replicated in several sites and lead to positive outcomes for ecosystems as well as fishing communities. Our efforts towards this began in the Lakshadweep Islands which are one of Dakshin's long-term engagement sites.

### *1.2. The Lakshadweep Islands*

The Lakshadweep Islands off the west coast of India are home to about 70,000 people. Out of the total of 36 islands in the Lakshadweep archipelago, only 10 are inhabited. Ecologically, these islands are classified as coral atolls i.e., islands that are formed when land is uplifted and corals form a ring encircling a lagoon and an island. The Lakshadweep Islands are India's only coral atolls. Owing to their limited land area of 32 sq. km, these islands constitute one of the most densely populated regions in India with a population density of 2149/sq. km. However, these tiny specks in the ocean confer an Exclusive Economic Zone (EEZ) of 4,00,000 $km^2$ making them very significant, both strategically and economically.

Administratively, the Lakshadweep Islands are classified as a Union Territory under the Government of India. The Lakshadweep Islands together constitute one district, with each inhabited island designated as a village with its own Village (Dweep) Panchayat. Lakshadweep also makes up one Lok Sabha constituency. The people of Lakshadweep practice Islam. The exact settlement history of the islands is unclear with varying accounts by different historians. However, it is generally accepted that the islands were settled by people from the Malabar region of present-day Kerala before the 7$^{th}$ century CE. Malayalam, Jeseri or Dweep Bhasha (a dialect of Malayalam), and Mahal (a dialect of Dhivehi) are the main languages spoken in Lakshadweep. Mahal is spoken in Minicoy whereas Jeseri is spoken in the other 9 inhabited islands viz. Agatti, Amini, Androth, Bitra, Chetlat, Kadmat, Kalpeni, Kavaratti, and Kiltan. Lakshadweep is the second most literate region of India with a literacy rate of 92%. Minicoy, the southernmost island of the Lakshadweep archipelago is geographically and socio-culturally closer to the Maldives. The people of Minicoy share ethnic and linguistic ties with the Maldives. The main occupations of the people of Lakshadweep are government service, fisheries, tourism, and coconut farming and processing.

### *1.3. Fisheries in the Lakshadweep Islands*

In Lakshadweep, fishing is not just a source of livelihood but an activity that is deeply embedded in the social fabric of the islands and a crucial element of the cultural identity of the islanders. The main fishery practised in Lakshadweep - the "live-bait pole and line tuna fishery" is a unique fishery that targets the resilient, oceanic skipjack tuna using small planktivorous baitfish in a low-impact, selective manner that diverts fishing pressure off the sensitive coral reefs that constitute these atolls. Additionally, being a labour-intensive technique, it is one of the major sources of livelihoods for the local community in Lakshadweep. It may thus be one of the last remaining examples of a sustainable fishery in India.

Historically, the pole and line fishery has its origins in the Maldives. From the Maldives, this fishery came to Minicoy Island a few centuries ago (Jaini et al. 2017). In the rest of the Lakshadweep Islands, only artisanal fisheries targeting reef and other offshore resources existed, until the 1960s. It was only in the 1960s that the pole and line fishery was transferred from Minicoy to the other 9 inhabited islands of Lakshadweep by the Fisheries Department along with the introduction of mechanisation. Since then, this has been the major fishery practised in Lakshadweep with a contribution of 92.8% out of the total tuna landing of the islands (Vinay et al. 2017). While fisheries targeting various other resources such as yellowfin tuna, pelagic fish like half-beaks and needlefish, various lagoon and reef fish, and octopus, are also practised, the pole and line fishery remains the major fishery of

Lakshadweep. Worldwide, pole and line fisheries are considered to be best-practice fisheries due to their inherent sustainability. In India, the fishery is practised only in the Lakshadweep.

Over the past few years, however, the fishery has been facing challenges at various levels. On the one hand, the fishery is facing operational challenges due to rising costs, inadequate post-harvest processing and storage infrastructure, and lack of access to good markets. On the other hand, the impacts of production-centric fisheries development doctrines are clearly visible in the form of a steady increase in fishing capacity with larger boats capable of multi-day fishing being built with the help of government subsidies. A combination of both is leading to a situation where fishers are compelled to catch more fish to make a profit or at least break even. These developments have triggered transitions in the fishery that can threaten a departure from its inherent sustainability. The most significant one is the emergence of unsustainable practices for baitfishing.

The term baitfish collectively refers to groups of small fish found in the lagoons and reefs around the islands that are used as bait for catching tuna. The baitfish are caught and kept alive in on-board holding tanks before heading out to catch tuna in deeper waters giving the technique its name - 'live-bait' pole and line fishing. The availability of adequate amounts of baitfish is one of the major resource inputs as well as a critical limiting factor for the pole and line fishing operations**.** The rise in the number of large-sized fishing vessels over the past few years is leading to disparity and differential powers to access a common pool of resources and increased competition among fishers which have in turn led to unsustainable practices such as using LED lights at night to attract and catch baitfish in large volumes, catching baitfish at the time of spawning, and using very fine-meshed fishing nets to catch baitfish. Such practices can have deleterious impacts on baitfish stocks and stand to threaten the viability of the pole and line fishery. Consequently, a divide between smaller boats (~25-30 feet in length) and larger boats (~50-60 feet) in what was hitherto a fairly homogeneous fishery, is gradually becoming evident, leading to conflicts over resource access and use on the ground.

Another transition that has been occurring is a shift from tuna fisheries to reef fisheries. Although reef fish have been caught and consumed by the islanders for centuries, this was always done at small-scale and primarily for local consumption. With the advent of the big boats equipped with facilities to store excess fish on the boat in ice and powerful engines capable of long-distance trips, a new trend of large-scale and multi-day fishing for reef fish, especially high-value, predatory reef fish such as groupers and snappers, which are transported straight to the mainland on the big boats, has steadily been emerging. While on the face of it, this might seem like a positive development that can bring economic benefits for Lakshadweep's fishers, the consequences of intensive reef fishing in the coral atolls of

Lakshadweep can be disastrous. The removal of predators in large numbers can especially drive top-down cascading changes across the ecosystem and severely affect reef function. A collapse of Lakshadweep's reef systems can be highly detrimental to the low-lying Lakshadweep Islands and its inhabitants. Lakshadweep's reefs act as a natural barrier that protect the islands from high-intensity waves of the sea, storm surges, flooding, salt-water incursion, and provide structural integrity to the archipelago.

Thus, we see a situation where a traditionally sustainable fishery is being pushed down an unsustainable pathway, mainly due to the influence of external drivers. The pole and line fishery, if managed sustainably, can help ensure the social, economic, and ecological stability of these islands. Recognising the significance of this fishery for Lakshadweep, Dakshin Foundation's work in Lakshadweep has focussed on preserving the pole and line fishery and buffering unsustainable transitions. Over the years, our work has grown and evolved from ecological studies around baitfish to a holistic intervention aimed at participatory and sustainable fisheries management. In the early years of our engagement in Lakshadweep (2013-2017), in addition to in-water ecological surveys of baitfish populations, we launched our flagship initiative in Lakshadweep i.e., a community-based fisheries monitoring programme that involves pole and line fishers in regular and voluntary monitoring of day-to-day fishery dynamics to fill crucial knowledge gaps around the otherwise data-deficient pole and line fishery. The programme did well over the years, demonstrating the unique potential that fishing communities have to engage with activities like resource monitoring. This work helped us build strong networks within the community and the local administration and prepared us for the next phase of interventions – to initiate larger dialogues around community-based management for Lakshadweep's pole and line tuna fisheries.

### *1.4. The Island Sustainability Pathways (ISP) project*

We were able to scale up our existing work in Lakshadweep and transition to the next phase of interventions with the support of the TATA Trusts. The ISP project that Dakshin conducted in Lakshadweep in partnership with the TATA Trusts from April 2018 – September 2021 was a holistic intervention aimed at developing a scalable model of rights-based, participatory fisheries governance in Lakshadweep that is rooted in an interdisciplinary knowledge foundation and that empowers local fishing communities to take collective action to manage their resources sustainably. The Lakshadweep Islands, given their relative social and ecological homogeneity, small administrative units, and high levels of community literacy are ideal to test out participatory fisheries management approaches to natural resource monitoring and management. They have the potential to be developed as a bright spot in the governance of small-scale fisheries. In time, the insights stemming from this

intervention can be used to create similar models of participatory fisheries governance in other parts of India as well. Our work in Lakshadweep seeks to tap the nascent potential of local communities to facilitate knowledge-based actions for tangible, on-ground impacts on fisheries management.

Combining our nuanced understanding of Lakshadweep's social-ecological context and key issues on the ground with the larger philosophy of participatory governance, the ISP project focused primarily on addressing issues around baitfish availability and management by adopting a fisheries co-management approach. However, the larger goal of the project has been to create systems for co-management that can serve as resilient platforms for fishing communities and other stakeholders to come together, engage in dialogue, and take collective action on various issues facing the fisheries as well as other inter-connected, cross-sectoral issues in Lakshadweep.

This document is a comprehensive report of the interdisciplinary research and interventions that Dakshin Foundation carried out in the Lakshadweep Islands from April 2018 – September 2021 with the support of the Tata Trusts. The work was aimed at creating a framework for fisheries co-management for Lakshadweep's pole and line tuna fishery. Wherever required, the document also refers to research and interventions carried out by Dakshin prior to the current project period to ensure continuity and coherent messaging. Each chapter of this report discusses a distinct component of our work, the key insights gained from it, how the component ties into the larger intervention that we have been working towards, and the next steps for that component. The concluding chapter discusses the challenges faced during the course of this project, and the significance and overall outcomes of the project. Even though the ideas discussed here are about fisheries and fishing communities, in essence, they can be applied to other fisheries systems and communities as well, as they share fundamental similarities in the challenges they face and potential solutions to address them.

# 2. Long-term Monitoring of Lakshadweep's Baitfish Populations

Globally recognised as one of the most eco-friendly fishing methods, pole and line fisheries stand out as sustainable yet viable commercial fisheries at a time when many fisheries and fish stocks are on a declining trend due to overfishing. However, a crucial limiting factor for pole and line fisheries to operate is live baitfish. Live bait is thrown in the sea after spotting tuna schools during pole and line fishing operations to attract tuna. In the feeding frenzy that ensues, tuna are caught one by one by fishers. An estimated 25,000 tonnes of baitfish (IPNLF, 2012) are utilized annually to meet global pole and line fisheries demand. Thus, baitfish is a vital resource to safeguard to ensure the viability of pole and line fisheries, both globally as well as in Lakshadweep. Recognising the significance of baitfish for Lakshadweep's fisheries, Dakshin has been engaged in filling critical gaps in knowledge and understanding various aspects of baitfish resources that can inform sustainable management. This chapter details Dakshin's work on baitfish starting with a background on baitfish resources in the Lakshadweep and the current threats to baitfish populations, Dakshin's earlier studies on baitfish, and the steps that were taken to scale up this work as part of the ISP project.

### *2.1. Baitfish - the pivot in Lakshadweep's pole and line fishery*

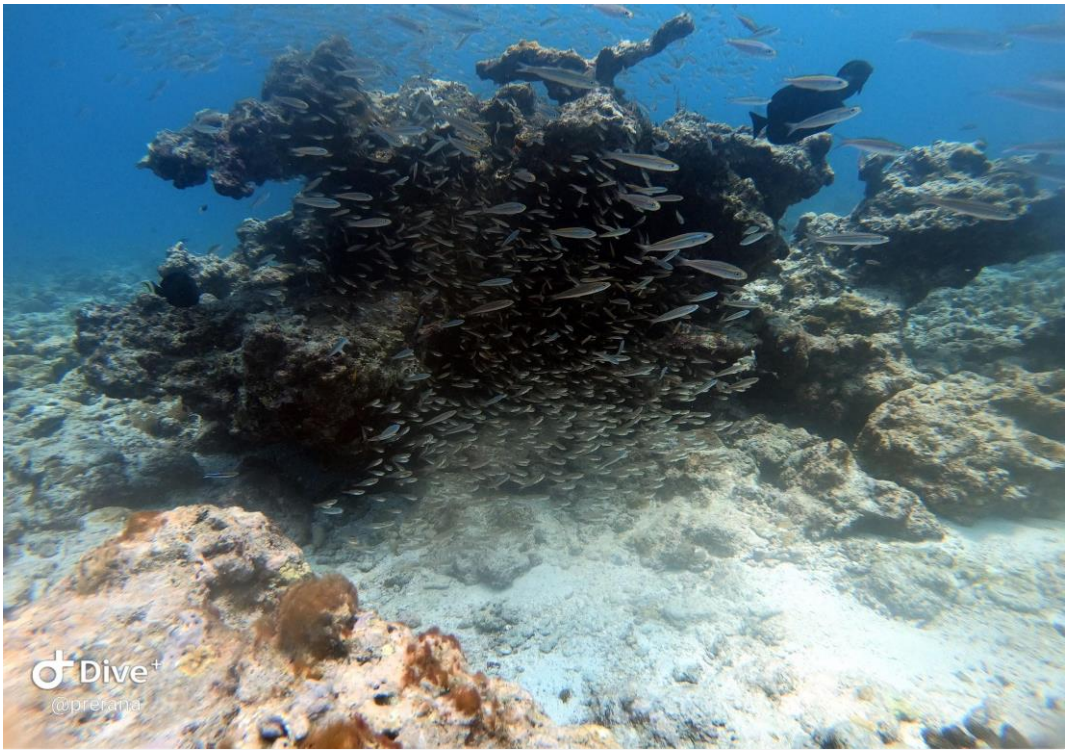
The term baitfish refers to a group of small-bodied schooling species of fish intentionally caught to lure and catch larger predatory fish. In Lakshadweep, baitfish are caught from the expansive sandy lagoons and coral reefs and kept alive in circulatory holding tanks on-board fishing vessels to be used just before catching tuna (Picture 1). The commonly targeted baitfish groups in Lakshadweep include small pelagic fish like herrings (*Spratelloides* spp.) and silversides (Atherinidae) as well as reef-associated groups like cardinalfishes (Apogonidae), fusiliers (Caesionidae), and damselfish (Pomacentridae, *Chromis viridis* in particular) (Table 1).

| Baitfish species/groups | Local name | Method of catching | Location |
|---|---|---|---|
| *Spratelloides delicatulus* | Hondeli | Encircling net | Lagoon/ Reef |
| *Spratelloides gracilis* | Rahi | Encircling net | Lagoon/ Reef |
| *Chromis viridis* | Nilamahi & Pachha chaala | Lift net | Lagoon |

| | | | |
|---|---|---|---|
| Apogons | Bodhi | Lift net | Lagoon/ Reef |
| Fusiliers | Mukuram, Dandi & Pachha chaala | Lift net | Lagoon/ Reef |
| Silversides | Phitham/Madam chaala | Encircling net | Lagoon |

**Table 1. Baitfish groups used in Lakshadweep**

Pole and line tuna fishing, the main fishery of Lakshadweep, is contingent on baitfish to a degree that insufficient catches of baitfish can reduce tuna catches or even cease tuna fishing on a fishing day, emphasising the fact that baitfish resources are indirectly crucial to the socio-economic stability of Lakshadweep. In addition, baitfish species occupy positions in the marine food web that constitute critical trophic links in the aquatic ecosystem, playing their part in maintaining the natural balance in the ecosystem of the archipelago. Thus, from a socio-economic as well as ecological perspective, safeguarding baitfish stocks is a means to ensure well-being of the islands' livelihoods as well as marine life.




**Picture 1. Mixed school of baitfish used for pole and line fishing in Lakshadweep**

While the sustainability of pole and line tuna fisheries is recognised globally, there are aspects particularly related to baitfish that have received limited to no attention. For example, the pole and line tuna fisheries of Indonesia have faced issues like decline in baitfish catches at certain sites and their reduced usability due to rough handling (Gillett, 2014). The Maldivian pole and line fisheries too have reported a perceived decline in baitfish catches and increase in light fishing (a potentially adverse fishing practice that uses artificial lights to attract and catch fish) for harvesting baitfish (Gillett et al. 2013). Failure to address such issues can push pole and line tuna fishery to the threshold of unsustainable transitions. Lakshadweep's pole and line tuna fishery too stands to face a similar fate, if immediate steps to address issues surrounding baitfish availability are not taken.

### *2.2. Challenges associated with baitfish management in Lakshadweep*

The pole and line fishery of Lakshadweep was introduced from Minicoy, the southernmost island of Lakshadweep (separated by approx. 300 km from the rest of the islands), where a range of localised, traditional management strategies had evolved over time, particularly with a strong baitfish management regime. In the 1960s, the pole and line fishery was introduced to the rest of the islands, albeit without transferring the traditional baitfish management practices associated with the fishery. This oversight, although unintentional, has led to significant issues around baitfish resources on the other major pole and line fishing islands in the archipelago. These issues are summarised below.

#### Increasing pressure on baitfish

Our work indicates that the unavailability of adequate amounts of baitfish for catching tuna is one of the major operational challenges in Lakshadweep. Scaling up of the pole and line fishing fleet, both in size and in number over the past decade is increasing the pressure on baitfish. Due to the differing boat capacities, fishers are competing with each other for their fair share of baitfish, resorting to unsustainable practices like harvesting baitfish using non-selective, fine-meshed or 'mosquito' nets or using LED lights at night to attract baitfish. In Lakshadweep, baitfish is traditionally caught on the morning of tuna fishing before going out into the open ocean. However, baitfish is increasingly being caught using LED lights from midnight to pre-dawn time, especially by bigger boats that require larger amounts of baitfish but face difficulties in maneuvering the shallow lagoons of the islands. Although it ensures increased catches and improved fishing efficiency, use of lights for fishing has adverse impacts like overfishing (Nguyen and Winter, 2019) and increased bycatch of juveniles and untargeted fish (Solomon and Ahmed, 2016). There are certain species of baitfish, like the herrings *(Spratelloides spp.)* that form spawning aggregations during pre-dawn times. Using LED lights during spawning aggregations poses an alarming risk to numerous fish stocks (de

Mitcheson, 2016), and such practices although currently unregulated, can threaten baitfish stocks and their sustainable yield. Focussed management interventions at the local level are needed to regulate such practices.

**Lack of fishery management**

The pressure on baitfish stocks is further exacerbated by the lack of fishing regulations. The lack of an active management plan for baitfish resources calls for addressing the baitfish issue with a precautionary perspective of implementing diverse measures for their sustainable management. This is something that is being seen and acknowledged in many pole and line fisheries around the world.

**Critical gaps in knowledge on baitfish resources**

It is crucial to understand the impacts of removal of small planktivorous baitfish to be sustainably used in fisheries (Stone et al. 2009) like the pole and line fishery of Lakshadweep. However, the dearth of local or regional-level data on quantities utilised or ecological populations of baitfish species makes it difficult to assess the impacts (IPNLF, 2012). Baitfish catches in major pole and line fisheries around the world are largely unreported, unmonitored, and unregulated. These glaring gaps in data are required to be filled to take any appropriate and locally-relevant measures to address issues around local baitfish resources.

### *2.3. Dakshin's work on baitfish*

Dakshin Foundation's research efforts in Lakshadweep since 2012 have been aimed at generating a holistic understanding of the pole and line fishery with a view to inform its sustainable management. Baitfish resources used in the pole and line tuna fishery are largely overlooked in Lakshadweep but warrant immediate attention. Our work on baitfish employs a multi-pronged approach that uses a combination of researcher-led and community-based methods to study different aspects of baitfish resources (Table 2).

| Filling data gaps on baitfish resource of Lakshadweep's pole and line tuna fishery to inform management | | |
|---|---|---|
| Community-based fisheries monitoring | Fishery-independent Baitfish population assessments | Fisher perceptions on baitfish resources and community mapping |

**Table 2. Dakshin's multi-pronged approach to study Lakshadweep's baitfish populations**

## Community-based fisheries monitoring (CBFM)

Routine gathering of information on various aspects of fisheries or *monitoring,* is crucial to understand the status and issues around fisheries, implement management measures, and assess if they are effective. However, it faces challenges like collecting large amounts of data over a long period of time, area coverage, manpower, funding etc. Our community-based fisheries monitoring programme (CBFM) for the pole and line tuna fishery has emerged as a cost-effective approach that involves local communities to monitor resources on a much larger spatial and temporal scale. While the CBFM programme has been discussed in detail in Chapter 4 of this document, here we discuss some of the key outcomes from a baitfish management perspective.

### *Key outcomes*

- CBFM is the only large-scale fisheries monitoring initiative in Lakshadweep that has an active focus on baitfish resources. As a contextualised and truly participatory monitoring exercise, the CBFM logbooks which have been co-created with the fishing community include parameters like baitfish species used, which are absent in fisheries monitoring conducted by government agencies that typically focusses only on tuna and other commercial species.
- CBFM has helped build the capacity of pole and line fishers to generate data on various aspects of their fishery and given them access to big-picture information like trends in their catches or fuel consumption, which is otherwise exclusive to fishery managers.
- Over time, the data from the CBFM programme is enabling us to observe patterns in the usage of the most critical resource for Lakshadweep's pole and line tuna fishery, understand commonly harvested baitfish species, inter-island differences in baitfish preferences, etc. and can in turn help inform sound fisheries management plans.

## In-water assessments of baitfish populations

Despite being a critical limiting factor for the pole and line fishery, information on baitfish populations or their stocks from Lakshadweep is sparse. Baitfish fishing is a largely unmonitored, unreported, and unregulated activity because for a long time its significance for pole and line operations was not recognised. Also, an evident gap in knowledge that numerous pole and line fisheries are facing and have made attempts to address is the absence of a standardised method for baitfish population assessments (Gillett, 2014). This lack of information makes it difficult to understand the impacts of various fishing practices on baitfish populations, reasons for stock declines, and long-term trends in baitfish stocks.

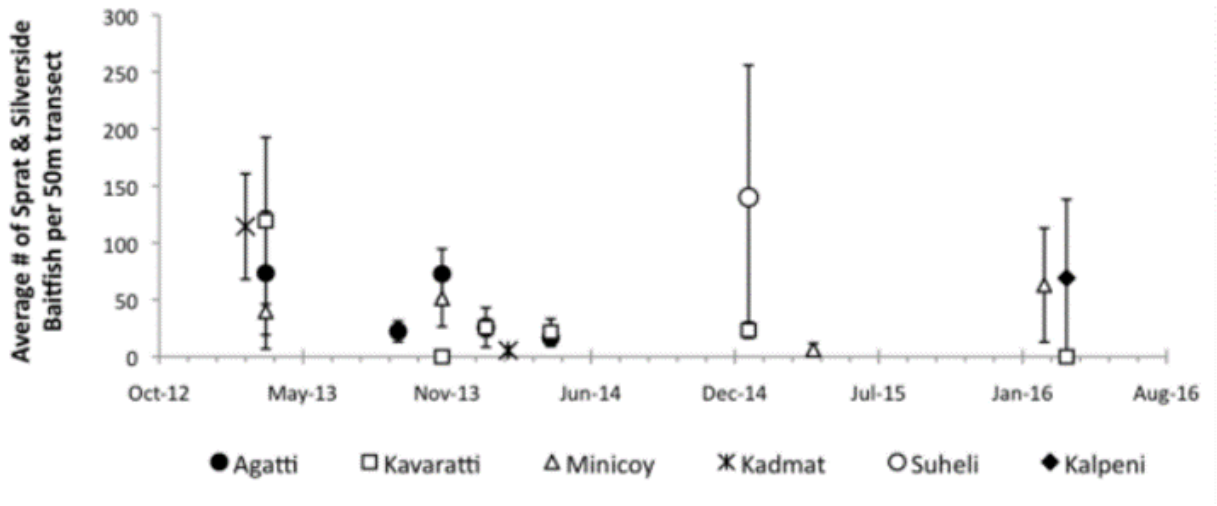



**Figure 1. Average numbers of baitfish belonging to the Clupeidae and Atherinidae families observed in the lagoons of various islands of Lakshadweep from 2013-2016**

To address this dearth of information, we initiated in-water ecological surveys of baitfish populations in the early years of our work in Lakshadweep. While these early surveys were useful in understanding preliminary patterns in baitfish abundance across various islands (Figure 1), the methods applied for the assessments were highly subjective and researcher-dependent, posing challenges in terms of scaling them up. Additionally, these surveys were severely limited by factors like logistics and funding. To compound these challenges further, there are no well-established, standardised underwater monitoring protocols for small, schooling fish populations as conventional in-water methods often focus on commercially important and typically ecologically representative reef fishes.

To address these methodological and logistical limitations, our focus as part of the ISP project was to develop a scientifically robust and standardised survey protocol in order to

create scalable systems for long-term monitoring of Lakshadweep's baitfish populations that can fill the existing knowledge gaps. It is crucial to ensure that the protocols so developed are easily replicable, require minimal resources and expert supervision, and can generate comparable data on baitfish populations. Over the course of the project, following a detailed review of published literature and field trials for various sampling strategies, we tested and developed a survey protocol that uses a combination of visual and video-based methods to quantify the baitfish populations from the lagoons and reefs of the Lakshadweep (Picture 2). The protocols focus on collecting quantitative data on herrings (*Spratelloides* spp.), silversides (Atherinidae), cardinalfish (Apogonidae), fusiliers (Caesionidae) and damselfish (Pomacentridae, *Chromis viridis* in particular) and processing and analysing the collected data. Baitfish numbers are quantified visually or by using a camera (video/photo footage), based on their speed of movement, density, and size. The data collected, especially in the video or photo footage, is processed for to arrive at conservative estimates of baitfish numbers by using established metrics that are widely used to retrieve information from camera-based fish footage. The metrics are used as a proxy for true abundance. This has helped resolve the issue of standardising the quantification of baitfish schools.


**Picture 2. In-water assessments of Lakshadweep's baitfish resources in progress in Agatti in 2021**

With the survey protocols thus developed, the next step was to identify index sites for long-term monitoring. However, this activity took a hit due to the Covid-19 lockdown and associated travel restrictions which made it difficult to conduct fieldwork in Lakshadweep and will be taken up again in the future once the situation on the ground improves.

Going forward, with the survey protocols in place and index sites identified, we are keen on instituting a long-term monitoring programme for baitfish populations that can be conducted by the people of Lakshadweep. A significant proportion of Lakshadweep's local youth is trained and certified in SCUBA diving by the local administration. We would like to leverage this potential and involve local youth in the assessment of baitfish populations using the protocols that have been developed through this project. We intend to approach local dive schools and government agencies involved in resource monitoring to assess the feasibility of such a long-term baitfish monitoring initiative involving local divers. Based on this, we plan to identify volunteers, conduct training and capacity building sessions for them, and launch a local diver-led baitfish monitoring programme in the Lakshadweep Islands.

***Key outcomes***

- Quantitative information on baitfish utilised in Lakshadweep's pole and line fishery is sparse and stock assessments are lacking. The in-water assessments of baitfish populations help fill this critical data gap.
- A key outcome of this project has been the development of robust survey protocols for long-term, in-water monitoring of baitfish which will make it possible to generate local-level, comparable data by non-extractive, standardised, and replicable methods.
- The protocols developed for baitfish assessment can be applied to quantify other small schooling fish as well.
- The protocols for in-water assessments of baitfish populations have been designed to be straightforward and intuitive so as to build capacity within Lakshadweep's local diver community for baitfish monitoring rather than keeping them limited to trained marine scientists.
- The data and patterns that emerge from the long-term monitoring of baitfish populations can play a crucial role in the formulation of sustainable baitfish management plans.

## Documenting fisher perceptions on baitfish resources and their community mapping

A significant proportion of Lakshadweep's populace spread across various islands constitutes pole and line tuna fishers. Due to their constant interaction with the ecosystem and marine resources, fishers are best-placed to observe changes in resource availability. Fisher perceptions regarding resource availability, changes in usage patterns over time, and potential solutions to resource crises on the ground can prove invaluable for the design of effective management interventions. Their insights and suggestions can help piece together an accurate picture of ground realities, understand differing perspectives on a given issue, and come up with solutions that are locally appropriate and acceptable.

Therefore, as part of our efforts to gain a well-rounded understanding of the issues surrounding baitfish availability and management, we conducted detailed, semi-structured interviews of 20 key informants constituting active pole and line fishers (boat owners as well as crew members) with about 20 years of fishing experience across Agatti, Kavaratti, and Kadmat. The interviews shed light on preferences for baitfish species and islands frequented for baitfish fishing, current baitfish availability, fishers' knowledge on seasonality, spawning, factors affecting baitfish catches, and fishers' suggestions for potential measures to address baitfish concerns.

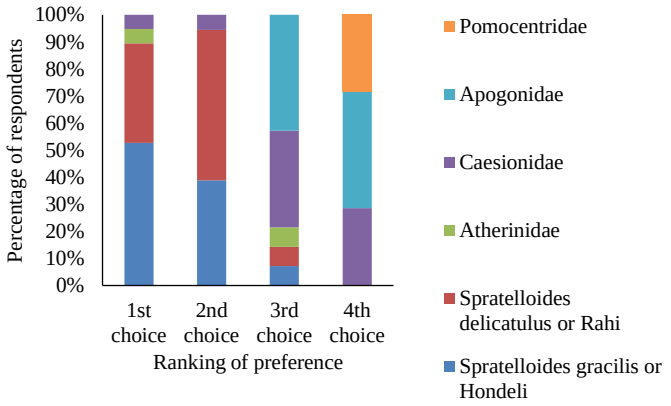
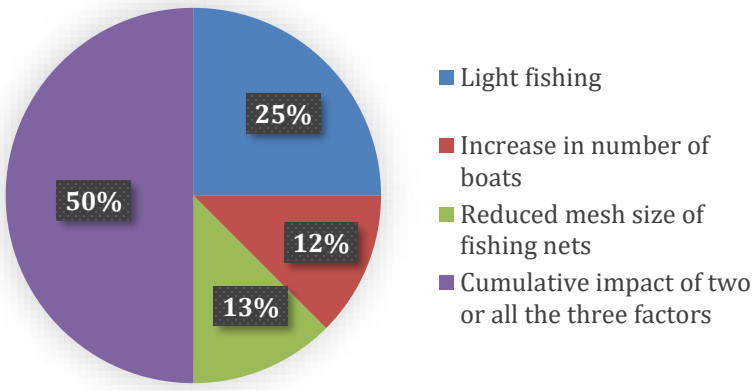



**Figure 2. Ranking of fishers' preference of baitfish for pole and line tuna fishing**

*Spratelloides delicatulus, Spratelloides gracilis* and fish belonging to the Apogonidae family dominate as the preferred baitfish for pole and line fishing (Figure 2). Regarding the gear used for catching baitfish, fishers share that it has undergone significant changes. The mesh size of the nets used for catching baitfish has almost reduced by half (from 5mm mesh size to 2.5mm size) over the years. This kind of fishing using very fine-meshed nets or 'mosquito nets' sieves out spawning baitfish, many a times with layers of sticky eggs. The majority of

fishers we interacted with perceived an overall reduction in the availability of baitfish over the years. However, fishers also indicated that baitfish catches fluctuate seasonally, with the highest yield after monsoon that reduces as the year progresses.

**(a)**




**(b)**

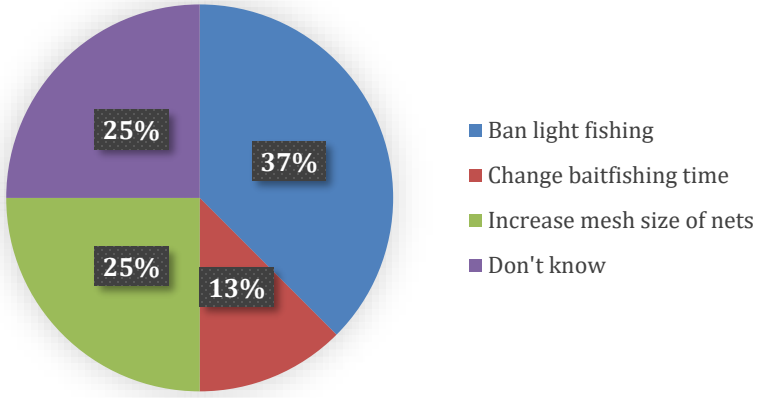
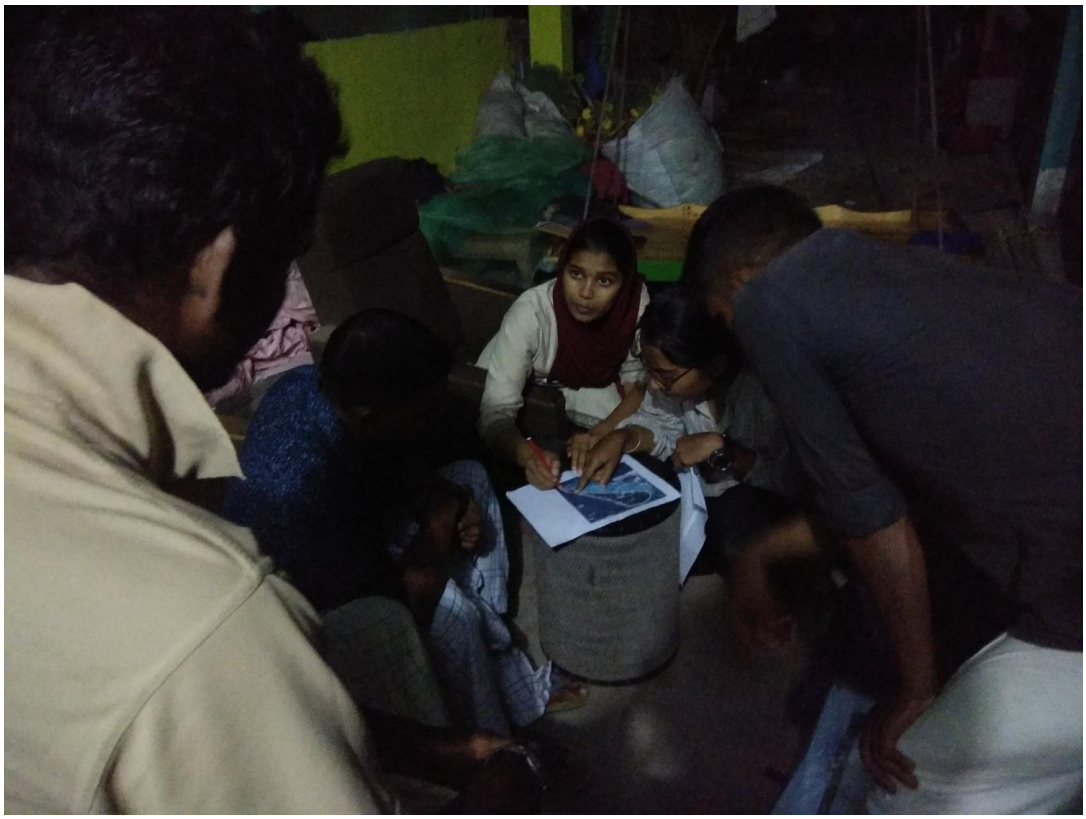



**Figure 3. Perceptions on (a) factors affecting baitfish availability; (b) possible measures to address concerns of perceived decline in baitfish availability**

Fishers also noted that there is more than one factor that has a cumulative impact on baitfish availability, particularly light fishing, increased number of active boats, and small-meshed nets (Figure 3(a)). Our interactions with fishers also highlighted evidence of inter-island

conflicts over baitfish fishing grounds. Deliberating on the possible measures to ensure sustainable harvest of baitfish, the majority of the fishers considered that banning light fishing could be one of the most effective ways to resolve the baitfish availability issues. Highlighting the damaging impacts of using fine-meshed nets, fishers also indicated that increasing the mesh size of nets used for baitfish fishing could improve their chances of obtaining baitfish in the long run by allowing baitfish eggs and juveniles to escape, thus aiding their stocks to recuperate. Additionally, we obtained a fascinating insight from fishers that changing the timing of baitfish fishing to morning could also help in ensuring sustainable baitfish catches (Figure 3(b)).

In addition to documenting fisher perceptions regarding the state of baitfish resources in Lakshadweep, we also conducted a community mapping exercise with the help of active pole and line fishers to map out critical areas for baitfishing within Lakshadweep's lagoons and reefs (Picture 3). This mapping exercise aided in documenting spatial information on baitfish fishing grounds, local knowledge on baitfish spawning grounds and most notably, highlighted the potential of using fishers' ecological knowledge for the spatial management of fisheries.



**Picture 3. Community mapping exercise in progress in Kavaratti**

With the help of ESRI satellite maps and GPS mobile applications (Figure 4), fishers located and marked areas in the lagoons and outer reefs of the islands Agatti, Kavaratti, Kadmat, Amini, Bangaram, Perumal Par, and Suheli that are important for baitfish fishing and important baitfish spawning areas based on their local ecological knowledge and extensive fishing experience. The maps created through this exercise were digitized using QGIS software with polygons used to create layers showing areas of baitfish use and then independently validated with the help of other fishers to refine the resolution of the maps wherever required.

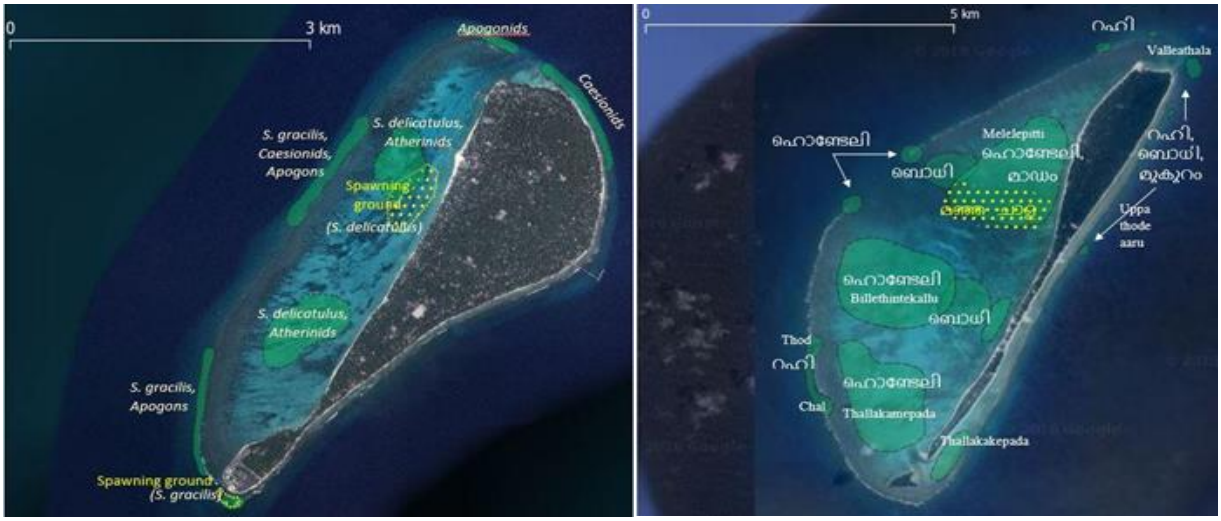



**Figure 4. Critical fishing and spawning grounds for baitfish in Kavaratti (L) and Agatti (R) mapped through the community mapping exercise**

Going forward, we plan to conduct a similar mapping exercise in other atolls and islands that are important for pole and line fishing. Building on the initial insights on spatial use patterns for baitfishing in Lakshadweep that have emerged from the community mapping exercise, we also plan to do a ground-truthing exercise with the help of fishers to further refine this information and improve its efficacy for spatial management.

### *Key outcomes*

- While our efforts to institute long-term monitoring systems are simultaneously underway, getting reliable trends from such activities takes time. The assessment of fisher perspectives gave us grounded insights and a good understanding of pertinent issues with respect to baitfish resources in a short span of time.

- These assessments also helped identify issues in current baitfish fishing practices that may hinder fishery management measures, for example, inter-island differences among fishers regarding baitfish fishing access.
- Most importantly, the information gained from the perception survey helped understand fishers' readiness to implement management measures and paved the way for the co-management consultations that followed during May and June 2019.
- The community mapping exercise helped document embedded spatial knowledge on baitfish resources in a form that can be used to formulate spatial management measures for baitfish in consultation with fishers.

### *2.4. Conclusion and next steps*

The sustainability of baitfish resources is crucial for the survival of the pole and line tuna fishery, which in turn is the key link to ensure the social, ecological, and economic security of these islands. Through the ISP project, we were able to scale up our engagement with Lakshadweep's baitfish resources on multiple fronts and this has had significant outcomes in terms of knowledge and outcomes. Our fishery independent and fishery-dependent research methods to study issues pertaining to baitfish populations are helping fill critical data gaps through long-term monitoring. Similarly, the insights that have emerged from the perception studies, and community mapping and are already demonstrating the potential to inform sustainable management measures. For example, fisher interviews helped determine what type of regulatory measures need to be put in place for managing resources as well as gauge their willingness to participate in management interventions. The restrictions pertaining to light fishing and use of small-meshed nets that were proposed and subsequently adopted as resolutions during the co-management consultation meetings were supported by information obtained from fishers, thus demonstrating the efficacy of the knowledge-to-action model that the ISP project seeks to create.

# 3. Engaging with Customary Systems of Resource Governance and Fishers' Traditional Ecological Knowledge (TEK) on Minicoy Island

One of the core focus areas of the interdisciplinary research component of the ISP project is the documentation of fishers' TEK on Minicoy Island. Minicoy Island has a special significance for Lakshadweep's fisheries. The pole and line tuna fishing technique has its origin in the Maldives from where it came to Minicoy (Jaini and Hisham, 2013). Even though the exact period or mode of arrival of the pole and line fishery to Minicoy is unclear, fishers of Minicoy claim that this technique has been practised on the island since time immemorial. Over time, the native community of Minicoy has evolved a comprehensive customary system for the governance of their commons which includes a dedicated system for fisheries resource management. The customary fisheries management system of Minicoy has an elaborate and dynamic set of practices that covers the spatial and temporal aspects of resource management. These customary practices, in general, demonstrate a sense of stewardship for resources and the community's deep understanding of the ecology of their islands and the biology of the species they harvest.

It was from Minicoy that the pole and line fishery was first introduced to the rest of the Lakshadweep Islands by the Lakshadweep Fisheries Department in the 1960s with the help of training given by expert fishers from Minicoy (Dept. of Fisheries, 1990; Hoon, 2003). However, during the transfer of the pole and line fishing technique, the associated customary systems of Minicoy were not adapted to the other Lakshadweep Islands. This is probably due to the failure of the then fisheries managers of Lakshadweep to recognise the significance of fishers' TEK as well as the customary practices of Minicoy and the role it could play in the sustainable management of Lakshadweep's fishery resources. This has had major implications for the way fisheries have been managed in Lakshadweep since the 1960s and could be one of the factors that may have contributed to the baitfish crisis that has currently been precipitated on the ground.

Simultaneously, we have also observed transitions within Minicoy's customary resource governance system and the gradual erosion of traditional knowledge systems and customary practices. Thus, as part of the ISP project our engagement in Minicoy has been two-fold -

1) Understanding and documenting the customary systems and their associated traditional ecological knowledge with a focus on fisheries
2) Assessing ways to strengthen the existing systems by understanding their weaknesses and the challenges that they face

This chapter details the significance of TEK from a fisheries perspective and discusses the key insights generated from this component of our work.

### *3.1. Significance of Traditional Ecological Knowledge (TEK) for fisheries management*

Traditional Ecological Knowledge (TEK) is defined as "a cumulative body of knowledge, practice and belief evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes et al. 2000). In the context of fisheries, the traditional knowledge possessed by fishers is an important source of information on the history of changes in local ecosystems and their current status. Fishers' TEK arises from their relationship to the local marine environment in which they live and use based on local fishing practices (Berkes, 1993).

TEK is indispensable for cultural survival as it is site-specific information that represents multiple bodies of knowledge acquired through iterative and trial-and-error methods over many years. No community, especially the natural resource-dependent ones, can afford to ignore such a vast body of knowledge. Providing an illustration from fisheries, the fishers' knowledge of fishing grounds and appropriate gear is highly important in retaining their livelihoods as well as for their fisheries-based culture. Similarly, various studies conducted across different locations (Johannes, 1981; Sutherland et al. 2014; Teng€o et al. 2014) have found that traditional knowledge generated by the different users of marine ecosystems is immensely helpful in understanding local resource use patterns.

Several conventional management regimes have failed in various parts of the world due to their ignorance of fisher's TEK in monitoring and management processes (Johannes, 1981; Hilborn et al. 1995; Johannes et al. 2000; Berkes et al. 2001; Castilla, 2001). Similarly, fisheries governance systems that function in a top-down manner based on knowledge from contemporary fisheries science and do not necessitate fisher community participation or inclusion of their knowledge, thereby failing to elicit compliance (Jentoft, 2000; Castilla, 2001; Almudi and Kalikoski, 2010). On the contrary, it has been witnessed that programmes that incorporate TEK-based customary practices in their design draw better support from the local communities (King and Faasili, 1999; Evans and Birchenough, 2001; Johannes, 2002; Aswani and Hamilton, 2004).

In recognition of the importance of fisher's knowledge as a crucial source of information on local ecosystems and their history, recent literature can be found proposing the application of fisheries TEK via customary management plans as a useful strategy for modern ecological

conservation programs (Drew, 2005). Various academicians have advocated the integration of traditional ecological knowledge (TEK) with conventional scientific knowledge (CSK) as a feasible option for managing coastal small-scale fisheries (Johannes, 1998; Berkes et al. 2001; Berkes, 2003, 2012; Haggan et al. 2007; Thornton and Scheer, 2012). The above discussion stresses the need for carrying out systematic and relevant research to document the traditional knowledge acquired by fishers with a special focus on its historical and social context. It gives us an opportunity to improve our collective capacity for stewardship by sharing the documented knowledge with other stakeholders who interact with these systems. Following this rationale, we conducted a thorough documentation of fishers' TEK on Minicoy Island (Picture 4), which exists as a rare example of a system which is still governed by customary management practices based on TEK.

**Picture 4. Minicoy fishers discussing the details of their traditional practices during an interview**

### *3.2. Customary systems of resource management in Minicoy*

In the following sections, we describe some of the customary systems of resource management in Minicoy and how those practices are informed by a huge wealth of traditional ecological knowledge that has been gained over years of direct practical experience.

### Customary institutions

- The Fisheries *Jamaath* of Minicoy is a customary governance management institution that decides the rules and management practices for the management of fishery

resources on the island. Known officially as *Maliku Masverin Jamaath* (MMJ), this customary body is registered as a fisheries union under the state legal frameworks. Decisions are taken democratically through a consensus in the *Jamaath* meetings which are attended by the owners and boat captains of all the pole and line tuna boats of Minicoy.

- Another important customary arrangement in Minicoy is its 'village system' through which the entire populace of the island is divided into 11 villages. Each village is headed by two *Moopans* (male heads) and two *Moopathis* (female heads) who look after the internal and external affairs of the village. These villages are responsible for the governance of common lands and other common pool resources that come under the purview of each village. These villages function as an economically active unit and organise collective activities that cater to the overall benefit and welfare of its members (Picture 5).


**Picture 5. A village house in Minicoy**

**Customary practices and the associated Traditional Ecological Knowledge (TEK) of Minicoy**

TEK is the intellectual antecedent of customary ecological management practices and those practices are management plans based on applied TEK (Drew, 2005). Minicoy is a classic example of a customary system that is rooted deeply in Traditional Ecological Knowledge (TEK) and functions for the co-existence of sustainable livelihoods and ecosystems. Baitfish is one of the critical resources for pole and line tuna fishing - the livelihood mainstay of Minicoy Island. Since baitfish resources are vulnerable to rapid population declines and unsustainable fishing practices, their management has been given primary importance in Minicoy. The spatial and temporal restrictions in place for the management of local baitfish species in Minicoy illustrate the community's understanding of the biology of the species and their ecology. Some of the TEK based baitfish management practices in Minicoy are discussed below.

- **Seasonal bans on baitfish collection:** The *Jamaath* implements seasonal bans on the collection of a certain baitfish group i.e. cardinalfishes locally known as *Bodhi*. This customary ban that is enforced during the breeding season of *Bodhi* roughly from the period from May to September every year and provides the baitfish stocks ample time to recuperate. During this period, because of the monsoon, even tuna fishing is not carried out on a large scale and becomes more of subsistence fishing, thereby reducing the fishing pressure on all varieties of baitfish.
- **Quantification and conservation of baitfish:** While quantification of baitfish harvest is generally considered a challenge due to the small size of baitfish, there are species-specific units in Minicoy for calculating an approximate measurement of the baitfish catch volumes and weights. Also, in-water baitfish tanks known as *Labari*, capable of permitting water exchange, are often used in Minicoy to save the baitfish leftover from a fishing trip for use on the next day (Picture 6).
- ***Nakaiy* Calendar:** The *Aarukkaatti* (a senior fisherman selected by the *Jamaath*) of Minicoy decides the temporal restrictions on *Bodhi* fishing by referring to a traditional Maldivian calendar known as *Nakaiy*. In the past, this calendar was also used for correlating the direction of currents and choosing the fishing ground for each fishing day (Hoon, 2003). In recent times, however, fishers observe that the recent extreme geo-climatic events like the 2004 tsunami and cyclone Ockhi have made the use of this calendar ineffective.

**Picture 6. Modern-day labari constructed with PVC pipes**

## Spatial arrangements

Through interviews of fishers and other key informants, we were able to map the usage patterns and spatial management arrangements of marine commons in Minicoy (Figure 5). The information generated through these interviews has been digitised and illustrated by a designer. As discussed earlier, even on this map, one can find the importance given to baitfish management in Minicoy.

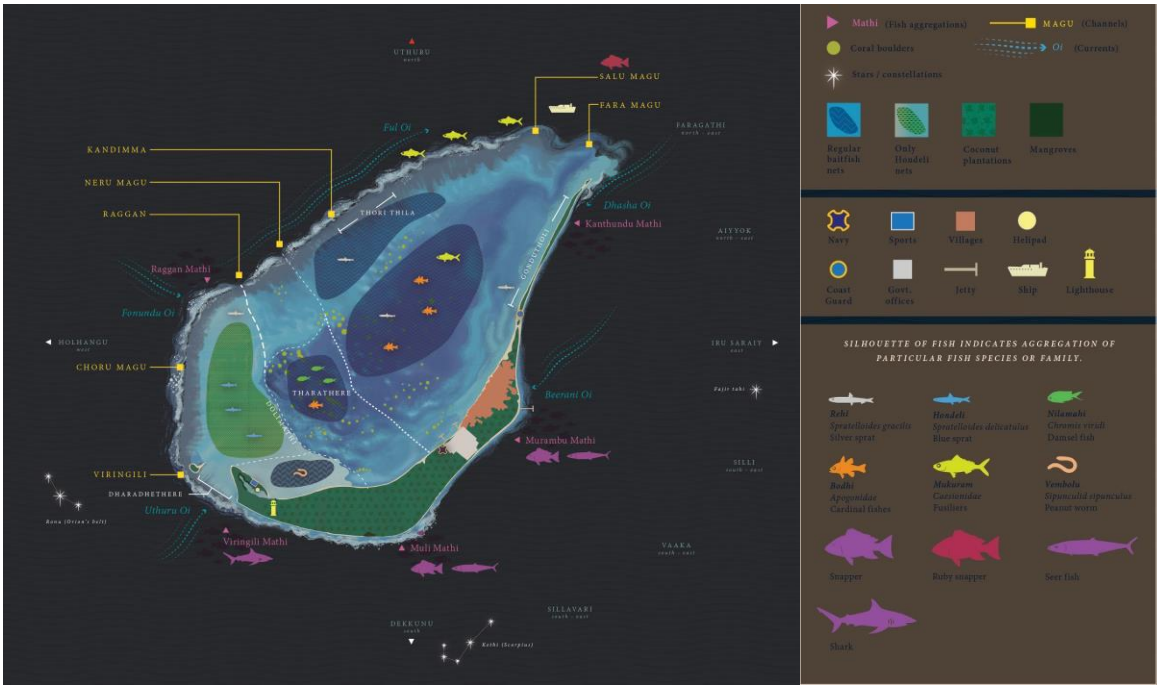



**Figure 5. Community generated map of Minicoy portraying commons usage patterns and customary resource management practices**

Such community-generated maps can serve as a useful tool in safeguarding the Minicoy community's access rights to their traditional fishing grounds and common spaces in the face of potential infrastructure developmental threats. The text below describes some of the spatial arrangements represented on the map -

- **Entrances:** There are 7 lagoon entrances that the people of Minicoy have been traditionally using to venture out into the open sea. These entrances are natural channels formed on the reef among which the *Neru Magu* channel is the one usually frequented by the fishermen as a shortcut to the open sea. Fishers set aside a day every year before the fishing season begins, for collective cleaning of the *Neru Magu* channel.
- **Rules for harvesting baitfish from the lagoon:** The *Jamaath* implements spatial restrictions throughout the year on catching baitfishes like *Hondeli* and *Rahi* (Sprats) from the lagoon. Since these baitfish species are caught by hauling nets of small mesh size, their fishing is restricted to the shallow southern side of the lagoon where coral presence is sparse. This particular restriction to protect corals from getting damaged while hauling nets demonstrates fishers' knowledge of the crucial role that corals play in the well-being of the island ecosystem. In our conversations with the islanders, they also shared that the collection and removal of corals and boulders from the lagoon could make the lagoon bottom sandy causing an increase in turbidity which will in turn retard new coral growth.
- **Currents and fish aggregation points:** Fishers have extensive knowledge of the directionality and seasonality of the ocean currents which are locally known as *Oi*. *Mathis* are fish aggregation points that are formed adjacent to the reef where the currents meet the reef. For example, *Murambu Mathi, Muli Mathi,* etc. However, the area constituting a *Mathi* can range from points near the reef to a few nautical miles from the reef. Some of the baitfish used in pole and line fishing such as fusiliers (known as *Mukuram* in Mahal) and other reef fish and pelagic fish are also caught from these *Mathis*. The islanders' knowledge about the directions, currents, and stars was of immense help to them during the days when traditional fishing boats (*Mas odi*) that were dependent on the winds were used and sophisticated tools for navigation were not available.
- ***Magao* and *Thara*:** *Magaos* are coral boulders that act as individual baitfish reserves. Each tuna fishing boat on the island selects and marks one *Magao,* before the beginning of the fishing season, which is exclusively for their own baitfish collection. These *Magaos* act as *Bodhi* banks which the boats can use as reserves on days when they are unsuccessful in harvesting bait from the coral boulders in the common pool. The *Magaos* of each boat are decided in a *Jamaath* meeting attended by the owners

and captains of all tuna fishing boats on the island. All the unclaimed coral boulders are considered as open access. Clusters of coral boulders called *Thara* are the main breeding grounds for baitfish e.g. *Tharathere* and *Dharadhethere*. Similarly, points like *Thori Thila*, *Gondutholi, Dolimathi* etc. are fishing grounds formed due to differences in the depth of the ocean. The names given to these points in Mahal convey the exact feature and terrain of the locations they represent.

### *3.2. Dakshin's efforts to strengthen the existing systems*

**Picture 7. A meeting with the leaders of the Minicoy fisheries *Jamaath***

Our interactions with the community in Minicoy reveal that the customary management regime is undergoing transitions and facing challenges on account of a variety of factors, both external and internal, such as the dominance of formal (state) management systems, the influx of local politics, changing perceptions and priorities of the youth, and the gradual erosion of Traditional Ecological Knowledge (TEK) systems. It is important to probe further into the internal and external drivers of these transitions so as to understand and sustain the factors that have been critical in retaining the Minicoy resource management system effective. Our efforts in Minicoy have thus been geared towards generating a nuanced understanding of the existing systems of resource management and their strengths and weaknesses and identifying ways to strengthen them. This is being done through the following approaches -

## Systematic documentation

Some of the key features of Minicoy's customary fisheries management systems that have been documented as part of the ISP project have been described in detail in the sections above. While these are extremely fascinating insights from an academic perspective, they are equally or perhaps more significant from an intervention standpoint. Considering the rapid pace at which communities' traditional knowledge systems are eroding in social-ecological systems across the world, a thorough and systematic documentation of such rare examples of sustainable coexistence based on customary knowledge is a very timely exercise. Documentation of these sustainable customary use systems is the first step towards preserving them and preventing them from transitioning down unsustainable pathways. Furthermore, the insights from such documentation can be of great relevance to contemporary fisheries management in Lakshadweep and a detailed documentation exercise can also pave the way for incorporating aspects of this knowledge in the formulation of new participatory fisheries management plans for Lakshadweep.

## Adapting community-based fisheries monitoring to the Minicoy context

Our on-going community-based fisheries monitoring programme is an attempt to decentralise knowledge generation, enable fishers to see trends in fishery resources over time, and equip them with the knowledge required for local-level decision-making. The initiative has been discussed in detail in Chapter 4. To adapt the initiative to Minicoy's unique context, the monitoring logbooks for Minicoy were designed in Mahal, the language spoken in Minicoy. Unlike other Lakshadweep fishers, Minicoy fishers use an indigenous system of units and measurement for baitfish quantification. While getting reliable data on baitfish quantities is usually difficult, our CBFM programme has been able to capture data on baitfish catch volumes from Minicoy due to the inclusion of Minicoy's TEK-based baitfish quantification measures as one of the parameters in the monitoring logbooks for Minicoy. This highlights the relevance and need for incorporating components of TEK to address the limitations of contemporary monitoring systems. As a follow-up to this, we are also keen on undertaking focussed studies aimed at calibrating Minicoy's traditional baitfish quantification systems and testing their applicability to other islands. In addition to developing the CBFM logbooks in Mahal, we have also ensured that our annual community outreach calendar series in Lakshadweep – 'Fish for the Future' is published in Mahal every year, in addition to Malayalam and English, so as to communicate the key message and findings from our work to the people of Minicoy. This is one of the very few publications in Mahal made outside of Minicoy and is very well-received in Minicoy.

## Facilitating inclusive spaces for participatory governance

The main aim of the ISP project has been to work towards the creation of a framework for fisheries co-management in Lakshadweep, provide spaces for the local fisher community to engage in discussions that are relevant for resource management and ensure their participation and involvement in fisheries management decisions. After over a year of groundwork, in 2019, we conducted a series of consultations on three major fishing islands of Lakshadweep (Kavaratti, Agatti, and Minicoy) to launch a co-management programme and discuss various aspects of the island's baitfish crisis. In such common pool resource crises, customary management systems that have an inherent focus on sustainability can act as a strong counterweight and help enable resilience. Therefore, in the case of Minicoy, we were very particular about ensuring that our co-management interventions do not override the existing customary management institutions but in fact try to proactively accommodate and work with the existing system.

Notably, the consultation meeting in Minicoy differed from those in the other islands in terms of the response of the participants and ease of coming to a consensus. For instance, even before the actual meeting, the Fisheries Department, which co-organised the meeting sent out invitations to the *Jamaat* President and village *Moopans* instead of sending separate invitations to individual pole and line tuna boat owners. This reflects the influence wielded by the customary institutions of Minicoy despite the modern-day challenges that they face and the state authority's recognition of this influence. While problems such as overcapacity and resultant competition as well as lack of interest of the youth in the age-old customary practices exist in Minicoy, the fisher representatives and other stakeholders were still able to voluntarily reach a unanimous decision to stop all kinds of unsustainable fishing practices on the island. The ease with which we were able to facilitate decision-making in a participatory and democratic setting in Minicoy further illustrates the importance of customary management systems. Credit is due to the customary institutions of Minicoy since it is their history and experience of engaging in participatory decision-making processes that stood apart in Minicoy unlike on the other islands where the decision-making wasn't so smooth. This particular example reaffirms why we need to strengthen the existing systems of resource management in the country and work with them wherever possible during the creation of alternative governance models so as to manage the resources in a sustainable manner.

### *3.3. Conclusion and next steps*

Minicoy Island has one of the very few common property management systems of the world that has persisted and evolved over centuries in a community-driven fashion. A thorough documentation of its management and traditionally acquired knowledge systems will have huge implications for other coastal systems including for fisheries resource management in the rest of the Lakshadweep archipelago where the pole and line tuna fishery is being practised. We believe that there are ample opportunities to learn from and adapt elements of Minicoy's TEK to the other islands of Lakshadweep where similar cultural, political, geographical and ecological conditions exist. In addition to documenting the knowledge, it is also equally important to try and integrate relevant aspects of the existing management practices and work towards the creation of hybrid models of participatory fisheries management. Such adaptations could help in successfully ensuring that there are checks and balances in place to prevent the island fishery from going down unsustainable pathways.

Going forward, this will be one of the focal areas of our work in Minicoy based on the foundation gained from the ISP project. The customary management practices of Minicoy are locally tested and most likely effective since this fishery is being successfully managed in Minicoy for centuries. Despite the slow erosion and other challenges faced by Minicoy's system, sufficient information is available for its systematic documentation and an identification its strengths and weaknesses, along with drivers of transitions. This can have strong learning outcomes for our endeavours to create rights-based participatory management for coastal ecosystems. At the same time, elements from modern management frameworks like co-management can help strengthen existing customary systems and help them overcome some of their inherent challenges, ensuring mutual co-learning between contemporary and traditional systems of resource governance.

# 4. Community-based Fisheries Monitoring

Our broad approach in Lakshadweep over the years has been to develop a knowledge-based framework to empower the fishing community for local-level decision-making and resource management. While our work started with simple ecological studies on baitfish populations in the islands, the need for long-term and well-rounded monitoring of the pole and line tuna fishery as a whole and not just baitfish monitoring was felt early on in the course of the work. Only a good understanding of the patterns in the fishery over time can help identify problem areas and aid in formulating sustainable management strategies. In this section, moving from the deep research engagements detailed in the earlier sections, we describe our flagship initiative in the Lakshadweep Islands - our first experience of a participatory intervention and what in time became the foundation for our co-management interventions – the community-based fisheries monitoring (CBFM) programme. The section will briefly touch upon the philosophy behind community-based monitoring, the process adopted in Lakshadweep, and the major outcomes that arose from this initiative.

## *4.1. The need for community-based fisheries monitoring*

Typically, fisheries in developing countries, particularly small-scale fisheries engagements are characterised by a dearth of information. The lack of adequate scientific data can be a huge deterrent in the formulation of sustainable natural resource management plans. Fisheries monitoring in India is generally carried out by a variety of government agencies with different mandates such as estimation of fish landings, stock assessment of fishery resources in the Exclusive Economic Zone (EEZ), census of fishing communities, socio-economic monitoring etc. In addition to these, from time to time, private research institutes and NGOs also conduct studies on specific aspects of fisheries and in specific regions. Given India's vast coastline of over 7500 km and the numerous fishing harbours, fishing villages and fishing communities that are scattered across the country's coastline, monitoring of fisheries becomes a huge challenge. Fisheries monitoring as an activity is largely limited by factors such as logistics, funding and human resources and almost always fails to cover the whole ground. Furthermore, considering the highly diverse nature of fisheries in India, current monitoring approaches often fail to capture the diversity and nuances of fishing practices. In spite of these inherent limitations, monitoring approaches continue to be centralised and also exclusionary i.e., local fishing communities have little to no involvement in the processes (Sridhar and Namboothri, 2012).

Community-based monitoring is an approach to natural resource monitoring that involves local communities in monitoring and collecting data on their resources and ecosystems. In the fisheries context, this means an activity where fishers themselves are involved in

collecting data on various aspects of their fisheries. While this approach might outwardly seem similar to citizen science initiatives, the stakes at play are very different as community-based monitoring involves local communities whose lives and livelihood depend on the state of the natural resources that they monitor as opposed to a group of well-meaning citizens who are passionate about nature. Involving fishing communities in monitoring can facilitate data generation on large spatial and temporal scales and can help overcome some of the fundamental limitations to natural resource monitoring mentioned earlier. This data can in turn feed into fisheries management plans. However, the advantages of an approach such as community-based fisheries monitoring go far beyond data generation.

Fishing communities interface with the ocean on a daily basis and have tremendous knowledge and observations about their fisheries and resources. However, these forms of knowledge are often not recognised by decision-makers or fishery managers because they are not embedded in a modern science framework. This leads to a disconnect between stakeholders on the ground with scientific knowledge being concentrated in the hands of scientists and policy makers, leaving communities out of the loop. Community-based monitoring aims to bring fisher knowledge and observations into the mainstream, within an 'acceptable' modern science framework. Thus, it can serve as a bridge in enabling local communities to engage with state agencies through a common language i.e., the language of science (Shanker and Oommen, 2018). By involving fishers in regular monitoring of fisheries, CBFM aims to decentralise the process of knowledge generation and lead to the creation of a community-generated data repository that fishers can use to understand trends in fisheries over time without having to rely on external agencies. Thus, CBFM seeks to empower fishing communities to engage in knowledge-based decision-making for fisheries management at the local level.

### *4.2. The participatory process*

Guided by this philosophy, Dakshin launched its CBFM programme in Lakshadweep in 2014 on the islands Agatti, Kavaratti, and Kadmat. In 2015, the programme was expanded to Minicoy as well. Before the launch, we conducted community consultations with pole and line fishers to brainstorm on the parameters that should be included for the monitoring. The protocols for monitoring and the monitoring logbooks were, thus, co-created with the community, making this a truly participatory process. This was a very significant step as it helped incorporate the local fishery context into the monitoring logbooks such as baitfish usage and the use of Fish Aggregating Devices (FADs) to catch tuna. In contrast, the Fisheries Department logbooks, across different states often do not account for locally relevant aspects of fisheries and focus only on catches of commercial species and fuel consumption. This has multiple implications: firstly, data on other critical variables, such as baitfish, in the

case of Lakshadweep, gets excluded leading to a knowledge deficit in those areas. Secondly, it fails to capture the diverse nature of fisheries in a country like India, reducing it to a monolithic resource harvest activity characterised by inputs and outputs. This oversimplification, in turn, reflects at the policy level, when all fisheries and their contributions are viewed from a narrow 'fish landing' perspective, leading to a narrative that small-scale fisheries are inefficient and the only way to improve them and alleviate poverty is by increasing capacity and bringing in more efficient technology. Thus, the discourse on fisheries development remains short-sighted and revolves around increasing production, leaving out important issues such as equity and sustainability. Therefore, contextualised monitoring is one of the first steps towards contextualised and holistic management.

### *4.3. CBFM in action*

The programme involves active fishers in regular and long-term monitoring of day-to-day pole and line fishery dynamics. Till now, a total of 50 fishing boats have participated in this programme collectively contributing over 4000 fishing records to a community-generated dataset on island fisheries, demonstrating the potential of local communities to engage constructively in natural resource monitoring and generate data on crucial aspects of island fisheries such as - inter-island differences in catch, fishing effort, fishing strategies, baitfish preferences, dependence on Fish Aggregating Devices, and limitations to fishing operations. As the dataset grows with time, it is also possible to see temporal patterns in the fishery. In terms of spatial coverage too, the dataset includes observations that span across the entire Lakshadweep archipelago. Community-based monitoring is thus a platform for large-scale, long term and cost-effective fisheries monitoring. While there are participatory monitoring projects in other parts of the world as well, there are finer differences in the approach employed in each case. A key feature of our CBFM programme is that it is entirely voluntary with no monetary incentives attached.

As the programme is envisaged as a two-way knowledge sharing platform, the data collected through it is returned to the community in the form of reports containing boat-level and island-level fishery metrics. Our interactions with fishers who have actively participated in the CBFM programme over the years have revealed that keeping detailed records of day-to-day fishery dynamics helps them manage their fishing operations better. For example, the logbooks help fishers track their diesel consumption and baitfish utilization over time. Given below are some examples of the kinds of data that has been generated from the CBFM programme and their significance.

Our CBFM programme has been able to capture trends in baitfish utilization across islands (Figure 6).

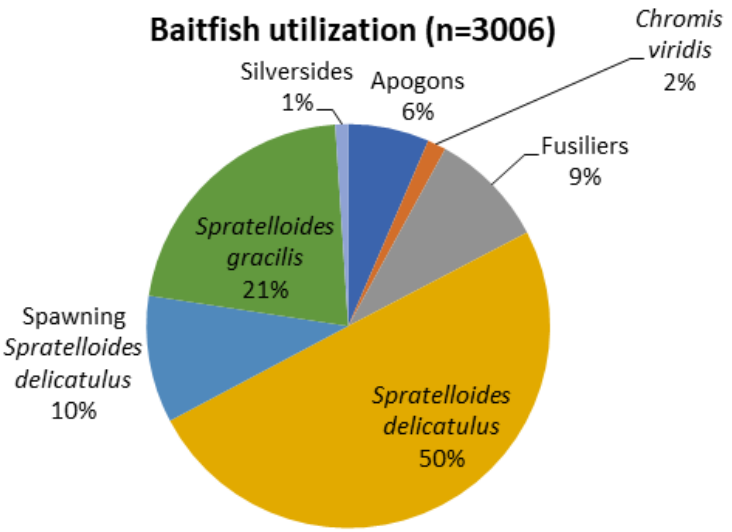



**Figure 6. Baitfish utilization pooled across islands. Calculated based on the total number of available records for each species in the dataset. Numbers in brackets indicate sample size**

Herrings (*Spratelloides* spp.) are the most commonly preferred and targeted species in the islands, followed by fusiliers. This corroborates with current fisher perspectives on declining baitfish stocks, especially of sprats. The targeted harvest of sprats, particularly *Spratelloides delicatulus* at the time of spawning i.e., *Manja challa* or through the use of LED lights at nights is a matter of grave concern and needs to be curbed.

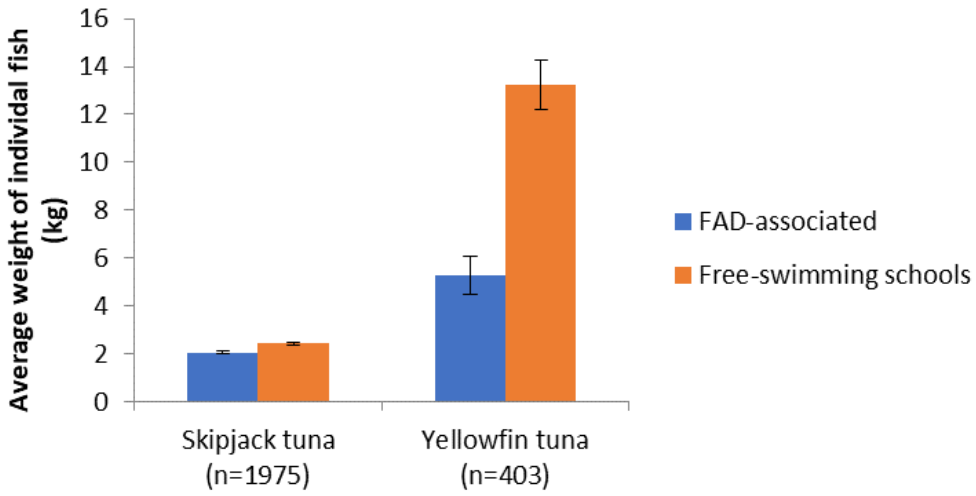


**Figure 7. Differences in average weight of skipjack and yellowfin tuna caught at FADs and without FADs. Error bars indicate ± S.E**

Patterns in tuna catches and differences between the two modes of fishing viz. FAD-based and FAD-free are also visible in our dataset. Average size of both skipjack and yellowfin tuna (*Thunnus albacares*) is smaller at FADs as compared to FAD-free fishing (Figure 7). This is of particular concern for yellowfin tuna stocks as they may be faced with the threat of growth overfishing. This aspect needs to be closely monitored, especially keeping in mind the fisheries development plans that aim to harvest the yellowfin resources of the Lakshadweep EEZ.

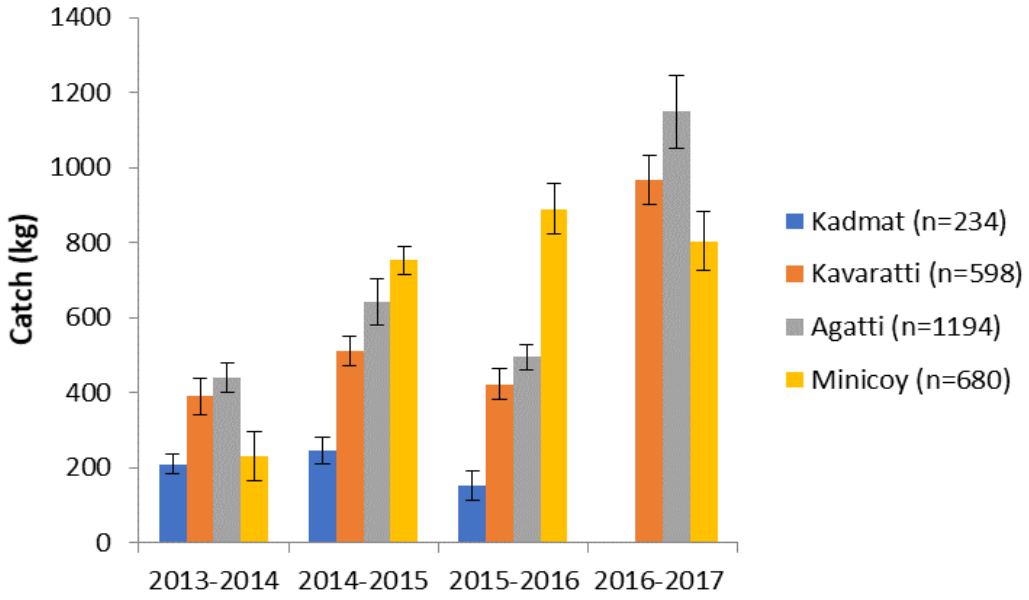



**Figure 8. Island-wise and fishing season-wise daily average catch per boat**

Daily average catches per boat have been increasing since 2013-14. (Figure 8). The increase in 2017 can be particularly attributed to a bumper season for tuna catch. Additionally, more and more fishers are converting their tuna boats into bigger boats capable of multi-day fishing. These boats are more efficient, capable of staying at sea for longer and this might be another reason for an increase in average daily tuna catches. Such temporal patterns will get more and more accurate and informative as the programme grows in size and time.

### *4.4. From monitoring to management*

With time, the CBFM programme can be streamlined and strengthened to serve as an effective tool that generates valuable information on island fisheries that can inform

sustainable management actions. However, there are other intangible but extremely significant benefits of a large-scale and long-term community engagement activity that go beyond mere data. For us, more than the data collected through the CBFM programme, the primary objective behind this initiative is to get fishers involved in the dialogue around resource management. Communities are generally suspicious or skeptical about outsiders showing up and asking questions about their fisheries. But our sustained and long-term engagement through the CBFM programme has helped build credibility and trust. Over the years, the programme has helped us create a strong network with the local fishing community. It is this network which in turn enabled us to initiate larger dialogues with the community on the feasibility for participatory management and ways to address pertinent issues on the ground such as the baitfish crisis and night fishing. Thus, participatory monitoring provided an entry point into the system and paved the foundation for the management interventions that were to follow. Going forward, we will explore ways to integrate or nest the CBFM programme under the larger co-management interventions that we have initiated in Lakshadweep.

# 5. Initiating Fisheries Co-management

The insights from our interdisciplinary action research on key aspects of Lakshadweep's fisheries and the networks built through our previous participatory work such as the CBFM programme led to the launch of the first ever fisheries co-management initiative in the Lakshadweep Islands in May and June 2019. Initiating fisheries co-management was a natural extension to all our previous work and engagements in Lakshadweep. These experiences gave us the conviction to envisage a comprehensive, scalable, dynamic, and community-based intervention such as fisheries co-management. As the primary objective of the ISP project, this is the most significant achievement of the project and has paved the way for future work. This chapter will detail the processes followed and the groundwork done in the buildup to the launch of the co-management interventions.

## *5.1. Why a co-management approach for Lakshadweep?*

The advantages of participatory fisheries management over conventional forms of fisheries management have been discussed in the introductory sections of this report. In the case of Lakshadweep, we picked a fisheries co-management approach for a variety of reasons.

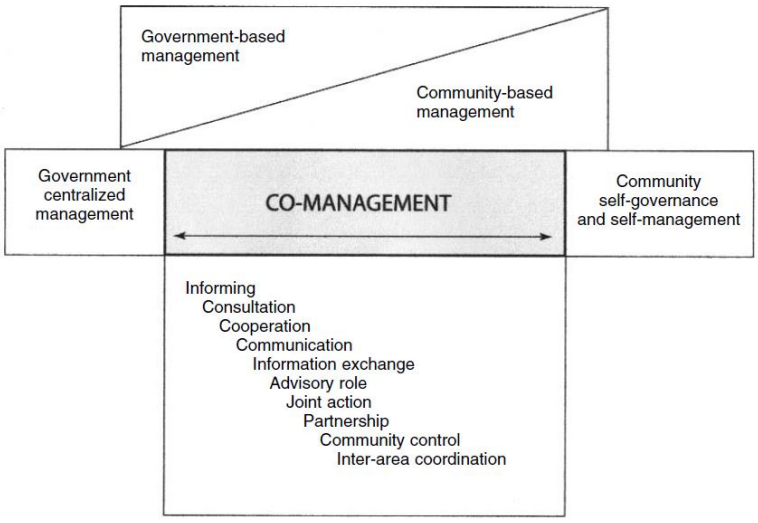



**Figure 9. Gradient of co-management (Pomeroy and Rivera-Guieb, 2005)**

Considering that Lakshadweep is a Union Territory, the development policies and natural resources management decisions for Lakshadweep are made through the conventional, highly centralised, systems. A centralised decision-making mechanism has limitations in

scope and capacities to identify challenges that might be relevant for the island community. There exists a gulf between the resource users in the community and the decision makers in the higher echelons of power. It is critical to fill this gulf to ensure that management models and development plans cater to local needs and enable sustainable management of resources. Envisioning interventions that encourage the participation of resource users in the decision-making process is one way to address this gap. Co-management, by definition, is an approach where decision-making powers and responsibilities are shared between various stakeholders, in particular, fishers and government agencies in charge of fisheries management. Even under the broad umbrella of co-management, the exact model that is implemented at a site can take different forms based on the socio-political context of the region. Co-management can, thus, be viewed as a spectrum with high government control on end and high community control on the other (Figure 9). In the case of a U.T. such as Lakshadweep, there is a lot of dependence on the government due to centralised nature of governance.

In the case of Lakshadweep, the community is very closely knit and has a good sense of the issues on the ground, for instance, the consequences of unsustainable practices such as light fishing for bait. However, due to an unhealthy competition precipitated by increasing fishing pressure, fishers are compelled to engage in such practices, just to break even, often leading to conflicts between big boats and small boats. Therefore, in spite of awareness and consciousness about the potentially deleterious impacts of certain practices, the practices are continued nevertheless due to a lack of regulations, enforcement, and compliance. At the same time, a lack of strong community organisations at the grassroots and a heavy dependence on the government due to the centralised nature of U.T. governance make it difficult for communities to collectivise on their own and attempt to resolve these crucial issues on the ground by themselves. Our preliminary interactions with the community regarding these issues and potential solutions also indicated a preference for government agencies to intervene on the regulation and enforcement front. Thus, a co-management model that would fit somewhere in the middle of the spectrum, where communities are involved in identifying key issues, discussing, and deliberating potential solutions with government agencies, and the government is in turn responsible for enforcement and ensuring compliance for the collectively taken decisions, would be ideal for Lakshadweep.

### *5.2. The preparatory phase – initial meetings and stakeholder assessments*

In the build-up to the launch of the co-management initiative, we undertook several important preparatory steps that ensured that the work would proceed smoothly. We initiated the work in 2018 by having a high-level meeting with the Administrator of the U.T.

of Lakshadweep and senior representatives of the Fisheries Department where we introduced the concept of co-management and presented our upcoming plans and ideas for employing a co-management approach for Lakshadweep's fisheries. This meeting ensured that the project had the support of the local administration. Simultaneously, we spoke to several active fishers from our network during May and June 2018 to introduce the idea of co-management and get a preliminary sense of the major issues on the ground at the time and potential ways to address them. The baitfish crisis due to unsustainable fishing practices such as light fishing was the key issue that came up in almost all our discussions. Fishers were open to the idea of a co-management approach to address local fishery issues and suggested that large-scale, island-level meetings be organised with all fishers present along with stakeholder government agencies such as the Fisheries Department and the Panchayat to discuss the baitfish issues and figure out ways to regulate the unsustainable practices with the help of the Fisheries Department. These initial meetings with the government and the community helped us assess the feasibility of a co-management intervention in Lakshadweep.

Equipped with these preliminary insights, we launched a detailed stakeholder assessment to map the key stakeholders in Lakshadweep's fisheries, understand their perspectives on various aspects and issues in the pole and line fishery, and gauge their interest and willingness to initiate collective actions to address these issues. The assessment was carried out through detailed semi-structured interviews of key informants from Dakshin's existing networks and snowballing from the initial respondents to identify other respondents relevant for the assessment. We also used stakeholder assessment to introduce the basic idea of co-management to the community. This exercise helped in establishing a rapport with stakeholders from an early stage which is important for the success of any fisheries co-management program. This pre-implementation survey included several components, the first one being the identification and mapping of key stakeholders in Lakshadweep's fisheries, their powers, alignment levels and capacities, and inter-stakeholder dynamics. To identify stakeholders, we used the following definition - *stakeholders are institutions, social groups and individuals that possess a specific, direct and significant stake in the resource and area* (Borrini-Feyerabend, 1996). It includes people and organisations ranging from local resource users, traders and business people, government agencies. The pre-implementation study revealed that although fewer in number, fisheries stakeholders in Lakshadweep are quite diverse. The identified stakeholders are detailed below (Figure 10).

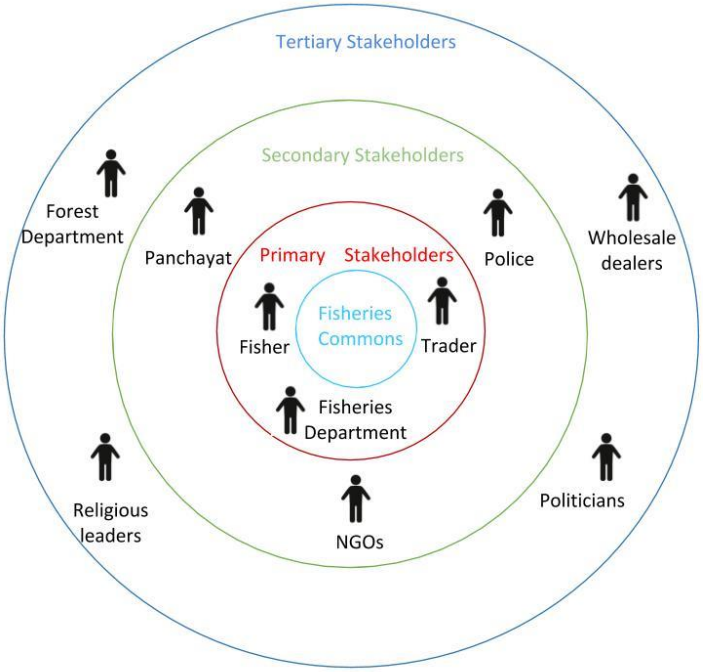



**Figure 10. Fisheries stakeholders in Lakshadweep**

The primary stakeholders as represented here (fishers, fisheries department and the traders) have very close engagements with the shared fisheries resource. Hence, they have great significance for the planning and implementation of fisheries co-management. Fishers are, by default, the primary stakeholders in fisheries as their livelihood and very survival depends on the oceans and fishery resources. In Lakshadweep, the scales of operation of fishers, their needs and priorities, etc. vary considerably across different islands and co-management interventions cannot succeed without their support and active input. The Fisheries Department, given its mandate is also a major primary stakeholder and also the most influential stakeholder.

It is the legitimate government agency in charge of fisheries management in the islands and is engaged in various fisheries management activities such as the distribution of fisheries welfare schemes and subsidies, supporting policymaking, fisheries data collection, and monitoring, surveillance, and enforcement. Through Fisheries Officers (FO) appointed at the Fisheries Units on each island, the department oversees and ensures the smooth day-to-day functioning of fisheries operations. Although few in number, the fish traders from the islands and mainland are also classified under primary stakeholders because of the influence that they wield in controlling market prices for *masmin*. They are significant players in the fishery as they are the only link between the *masmin* markets in countries like Sri Lanka and other South-East Asian countries. Based on the assessment, agencies such as the Panchayat, the

Police Department, and NGOs were classified as secondary stakeholders. These secondary stakeholders too can play a crucial role in the co-management process by offering the required institutional, legal, and knowledge support in taking the co-management process forward. The tertiary stakeholders mentioned in Figure 10 are the ones that are not very closely related to the fisheries sector but can have some influence on it indirectly.

In principle, a well-balanced representation of legitimate, powerful, and influential stakeholders is a prerequisite for successful fisheries co-management (Pomeroy et al. 2001). Also, for its smooth functioning, the participants need to reach a consensus on diverse issues on which every stakeholder possesses different perspectives. However, a sustainable and enduring co-management framework requires not only a balanced representation of actors, but also the identification of benefits and costs to them, both short- and long-term, to participate in co-management (Pomeroy et al. 2001). Therefore, as part of the stakeholder assessment, in addition to the stakeholder mapping we sought to understand the perspectives of different stakeholders, their sensibilities, priorities, and aspirations and this exercise gave us rich insights into the prevailing inter-stakeholder dynamics in Lakshadweep. As part of this exercise, we also tried to assess stakeholder alignment levels i.e. the degree to which their perspectives on various issues such as the baitfish crisis or *masmin* marketing overlapped. We found stakeholder perspectives aligned and contrasted on various issues, especially on issues related to baitfish availability and unsustainable practices where there were considerable differences in the views held by big boat owners and small boat owners. Despite the existence of diverse and contrasting perspectives on these issues, fishers and other stakeholders acknowledged that a co-management approach could help facilitate discussions and arrive at a consensus or a middle ground among stakeholders with contrasting perspectives.

The stakeholder assessment also helped develop a holistic picture of the fisheries sector vis-à-vis issues, development needs, and interlinkages with other sectors. It's important for external facilitators to know and understand the big picture which in many ways is like a jigsaw puzzle with several independent but interlinked pieces. Such an understanding helps ensure that even though the immediate focus of an intervention such as fisheries co-management may be a specific area, the intervention plans are not disconnected from ground realities and larger factors that may be influencing or driving changes on the ground. This component of the assessment shed light on several key aspects of island fisheries as well as other interlinked sectors. For instance, we were able to understand the roles and functions of cooperative societies, their strengths and weaknesses, and their ability to help with co-management interventions. We used a multi-sectoral survey to understand the interlinkages between various economic sectors such as fisheries, tourism, and coconut

farming. Among them, the tourism and fisheries sectors on the islands are closely interlinked as both sectors depend on the ocean. A closer look into these sectors revealed that the fishers and tourism actors at the local level often work collaboratively based on their mutual understanding in the matters of sharing infrastructure, resources, and areas in the lagoons. They also share similar concerns on the management of ocean resources, livelihood issues, and sustainability. This shared understanding is needed in developing a viable and all-encompassing co-management framework, especially in the current context when the islands are poised to receive massive financial capital directed at developing tourism. On the whole, the stakeholder assessment was a very insightful exercise and helped us plan the co-management consultation meetings that were soon to follow. The key concepts, process, and steps involved in the creation of a co-management framework with learnings from our work in Lakshadweep have been detailed in the other endline output of the ISP project i.e., the Practitioner's Guide to Co-management.

### *5.3. Co-management launch and consultation meetings*

Building on the insights gained from the pre-implementation surveys and feasibility studies, in 2019, we conducted 3 island-level stakeholder consultation meetings in collaboration with the Fisheries Department of Lakshadweep. The agenda for these meetings was two-fold

1) To officially launch a collaborative project on fisheries co-maanagement in the Lakshadweep Islands
2) To address concerns regarding Lakshadweep's baitfish resources using a co-management approach

The meetings were held on three major fishing islands of Lakshadweep viz. Kavaratti, Agatti, and Minicoy. This first series of meetings was the first step in facilitating conversations among stakeholders to arrive at acceptable solutions for the baitfish crisis in Lakshadweep. The meetings were attended by boat owners and pole and line fishers from the islands along with other key stakeholders such as representatives of the local Village (Dweep) Panchayat and the Dept. of Science and Technology. The meetings were conducted in a consultative format with detailed discussion sessions for fishers and other stakeholders to express their views and concerns. Following a presentation that reiterated the idea of co-management to the participants, the meetings segued into discussions on various issues ranging from regulating unsustainable baitfishing practices to other issues such as dumping of fish waste in the lagoons and mainland boats fishing in Lakshadweep waters. The meetings provided a platform for fishers to share their concerns directly with the Fisheries Department officials by bringing multiple stakeholders to the table, thereby demonstrating co-management in

action. Even though the discussions were moderated, there was room for them to evolve organically and as a result, issues such as dumping of fish waste or conflicts with mainland and foreign boats fishing in Lakshadweep waters, which were not part of the original meeting agenda were brought up by fishers themselves. This highlights the inherent power and scope of participatory and bottom-up management to identify locally relevant and high priority issues for resource users. In spite of some disagreements on proposed solutions for averting the baitfish crisis, fishers were able to discuss and collectively come to a consensus on the various issues discussed. In the case of the Agatti meeting where a consensus was not possible at the meeting, fishers themselves suggested a way to resolve the deadlock i.e. conducting a rapid opinion survey of individual boat owners and also said that they would agree with whatever the majority had to say. Thus, the meetings were not restricted to the theory of co-management but saw the first-hand application of a co-management approach to resolve local issues in a democratic manner. On all three islands, fishers constructively used the co-management platform and collectively adopted a series of resolutions for the sustainability of their fisheries (Picture 8,9,10). A summary of the key resolutions from these meetings is given below (Table 3).

| **Issue in discussion** | **Kavaratti** | **Agatti** | **Minicoy** |
|---|---|---|---|
| **Ban on light fishing** | Fishers agreed to discontinue the practice. | Fishers asked for a post-meeting opinion survey of individual boat-owners. In the survey, the majority expressed the need to ban the practice. | Fishers agreed to discontinue the practice. |
| **Regulation on the use of small-meshed nets** | The need for regulation was not felt. | In the opinion survey, fishers expressed the need to regulate the practice. | Fishers agreed to phase out small-meshed nets in a period of one year. |

| | | | |
|---|---|---|---|
| **Dumping of tuna waste in island lagoons** | Fishers agreed to discontinue the practice. | In the opinion survey, fishers expressed the need to regulate the practice. | Not a major issue in Minicoy. |

**Table 3. Key outcomes and resolutions adopted by fishers at the co-management consultation meetings**

In general, fishers were aware of the impacts of unsustainable baitfishing practices and also expressed willingness to curtail such practices if the government could provide the required support through the creation of new rules or other formal means. As a response to this request, the Fisheries Department agreed to issue an official notification that would uphold the resolutions adopted by the fishers during the consultation meetings and restrict unsustainable baitfish fishing practices, in particular light fishing. In addition to the regulation of specific practices, we also initiated discussions on potential spatio-temporal management measures for baitfish, such as the creation of community-managed reserves for baitfish that allow baitfish stocks to recuperate. While these discussions were preliminary at this stage and will need more probing before implementation, the idea was well-received and fishers in all the islands were open to the creation of spatial or temporal reserves to enhance baitfish populations for the future.

**Pictures 8, 9, 10. Fishers engaging in collective decision making through a show of hands at the co-management consultation meetings in Kavaratti, Agatti, and Minicoy respectively**

### *5.4. Taking the vision forward*

The first round of consultation meetings gave us a glimpse into the finer differences in inter-island perspectives and dynamics on each of the issues. Keeping the current priority issues in Lakshadweep in mind, we requested the Fisheries Department to issue a notifications to ban the practice of light fishing with immediate effect and the practice of dumping tuna waste inside lagoons, based on the resolutions adopted by fishers and their request for government

intervention to enforce said resolutions. Going forward, we are keen on introducing the fisheries co-management approach to other islands as well in a similar format while simultaneously expanding the scope of the intervention by identifying and solving other issues pertaining to Lakshadweep's fisheries. We also plan to follow up with fishers and other stakeholders to explore the feasibility for creating community-managed reserves for baitfish. To give structure to the co-management process and make it more autonomous such that it requires minimal external facilitation, we are also keen on exploring the potential to create legitimate and formally recognised multi-stakeholder co-management institutions that are empowered to engage with and resolve local fishery issues through a co-management approach.

# 6. Major Challenges

A large-scale and long-term intervention project such as the ISP project comes with its fair share of challenges. Rarely do things go exactly as per plan and keeping an adaptive and flexible approach helps greatly in case any course correction is required based on changing ground realities. In addition to some of the logistical difficulties that are associated with working in a remote location like Lakshadweep such as connectivity issues and delays in acquiring the requisite research and entry permits, the planned activities under the ISP project were significantly affected due to a few key challenges.

**Covid-19**

The Covid-19 pandemic, the announcement of the sudden nationwide lockdown, and the associated travel restrictions was the single most crucial factor that nearly brought the project progress to a standstill. The first lockdown happened just when the field team was set to head back to the field to follow-up on the successful initiation of co-management interventions in 2019. By this stage, the groundwork and the consultation meetings had generated significant traction and interest in the community and the travel restrictions meant that the team could not be present on the ground to engage with the community or the Fisheries Department in order to take the work forward. Existing permits got cancelled and there was a long hiatus in our engagement. As a result, there was a dip in the momentum that had been generated because of the project. As the islands slowly opened up to outsiders again and permits were reissued, the team was able to head back to Lakshadweep during early 2021. Around this time, the second wave of the pandemic hit and the islands went back into lockdown. The field staff were unable to travel between islands and organising large consultation meetings was out of the question due to the safety measures in place.

While some follow-up interviews were possible during this period, no follow-ups with the Fisheries Department could happen due to inter-island travel restrictions, thus affecting the pace and progress of the work. In addition to the planned project activities, the lockdown also had impacts on the wellbeing of the staff in the field, some of whom were stuck on remote islands for extended periods of time, yet unable to undertake work due to the restrictions in place. Like all other economic activities, Covid-19 also impacted the fisheries sector across the world and these effects were felt by Lakshadweep fishers as well. Due to the resultant economic losses, priorities and challenges for fishers changed as well, making it even more difficult to discuss issues that were highly pressing only a few months ago.

## Proposed large-scale development plans

The Lakshadweep Islands recently underwent significant political turmoil in response to proposed development plans that focus on bringing in high-end, infrastructure-heavy models of tourism. Various developments on the ground are posing direct challenges to fishers' livelihoods by restricting their access to common spaces used for fisheries and allied activities such as fish drying and boat repair. As a result, larger, external factors are currently threatening fisheries pushing the relatively smaller, localised, internal factors such as unsustainable baitfishing practices to the backseat.

## Bureaucratic delays

One of the main outcomes of the ISP project would have been an official government notification recognising and formalising the collective resolutions seeking to ban light fishing adopted by the fishers during the co-management consultations. This would have been a clear directive and an example of the success of co-management for all fishery stakeholders in Lakshadweep to see with direct sustainability outcomes. However, in spite of having submitted the required paperwork, this did not happen due to bureaucratic delays, even during the pre-pandemic times. Once the lockdown was announced, the priorities for the government changed and the notification took a backseat leading to a further dip in the momentum generated by the project.

# 7. Outcomes and Significance

In spite of the challenges described in the earlier chapter, the Island Sustainability Pathways project has been able to make significant progress towards the creation of a framework for fisheries co-management in India. As mentioned earlier, project activities and plans often have to be adapted based on ground realities. One of the major successes of the project was that it was able to achieve what was meant to be an endline activity i.e., the collaborative launch of the fisheries co-management initiative and facilitating collective decision-making for sustainable baitfish management in the second year of the project itself. This was possible due to the existing networks that Dakshin had with the fisher community and other stakeholders which helped us gauge their willingness to participate in co-management and launch the intervention at the appropriate time when the fishery was undergoing transitions and conflicts due to the baitfish crisis which had highly peaked at the time. As a result, even though a formal notification from the Fisheries Department has not yet been possible, ISP project is nevertheless a significant milestone for fisheries governance in India. The outcomes of the project in terms of knowledge and practice are highly relevant not only for the Lakshadweep Islands but also for other sites where participatory fisheries management models can be implemented.

**Creation of a strong knowledge foundation**

The project has, over a period of three and a half years, generated a strong body of interdisciplinary knowledge on Lakshadweep's fisheries and developed a nuanced understanding of the challenges facing the sector, potential solutions to these challenges, and the strengths and weaknesses of existing systems. This knowledge has already demonstrated the potential to inform and feed into direct, tangible action on the ground in the form of co-management interventions. Thus, the project has laid a firm knowledge foundation for the participatory management interventions that will be implemented in Lakshadweep in the year to come.

**The first ever co-management consultations in India**

The outcomes of the project are not limited to knowledge generation. In keeping with the knowledge-to-action model which is at the core of the ISP project, the project has demonstrated how focussed action research can directly inform management interventions. The co-management launch and consultations that were held as part of this project in collaboration with the Fisheries Department signify a watershed moment in the history of Lakshadweep's fisheries. While on the face of it, these could seem to be mere meetings, they

set a very important precedent. That of multiple stakeholders coming together, engaging in a constructive dialogue, and collectively arriving at a consensus aimed at sustainable management of fishery resources. This has immense consequences for a place like Lakshadweep that has hitherto seen only a conventional, top-down fisheries management regime. For fisheries stakeholders in Lakshadweep, having witnessed a model such as co-management work in practice first-hand makes a strong case for the adoption of participatory approaches for the resolution of local fishery issues going forward. This will undoubtedly pave the path for follow-up interventions along similar lines.

**Thinking Beyond Lakshadweep**

The ISP project's larger focus has been to create in Lakshadweep a model of participatory fisheries governance which can, in time, be scaled up and applied in other sites based on the unique social-ecological context of that site. This is not mere rhetoric. Building on the success of our work in Lakshadweep as part of the ISP project, we have been able to secure support to continue co-management interventions in Lakshadweep as well as to initiate new, long-term projects seeking to create co-management frameworks in other sites such as the Andaman Islands and Odisha. These projects have been initiated only recently. In the Andaman Islands, our upcoming work will focus on the sustainable management of grouper fisheries while in Odisha it will focus on a mix of marine and estuarine small-scale fisheries. The lessons and key insights gained from the ISP project have been crucial in gaining support for these new projects and will be equally important during the implementation phase as well. The pioneering work undertaken during the ISP project with the support of the Tata Trusts is thus, expected to pave the way for the creation of several models of participatory fisheries governance of small-scale fisheries in India, with far-reaching implications for livelihood security as well as ocean sustainability.

# 8. Bibliography


- Almudi, T. and Kalikoski, D.C., 2010. Traditional fisherfolk and no-take protected areas: the Peixe Lagoon National Park dilemma. Ocean Coast. Manag. 53 (5), pp. 225-233.
- Aswani, S., and Hamilton, R. J., 2004. Integrating indigenous ecological knowledge and customary sea tenure with marine and social science for conservation of bumphead parrotfish (Bolbometopon muricatum) in the Roviana Lagoon, Solomon Islands. Environmental Conservation 31:69–83.
- Berkes, F., 1993. Traditional ecological knowledge in perspective. In: Inglis, J. (Ed.), Traditional Ecological Knowledge: Concepts and Cases. IDRC, Ottawa, pp. 1-9.
- Berkes, F., J. Colding, and C. Folke. 2000. Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications 10:1251–1262.
- Berkes, F., Mahon, R., McConney, P., Pollnac, R., Pomeroy, R., 2001. Managing Small-Scale Fisheries: Alternative Directions and Methods. International Development Research Centre, Ottawa.
- Berkes, F., 2003. Alternative to conventional management: lessons from small-scale fisheries. Environments 31 (1), 5-19.
- Berkes, F., 2012. Sacred Ecology, third ed. Routledge, London, England.
- Borrini-Feyerabend, Grazia, 1996. Collaborative management of protected areas: Tailoring the approach to the context. IUCN, Gland (Switzerland). http://www. iucn. org/themes/spg/Files/tailor. html.
- Castilla, J.C., 2001. Marine Ecosystems, Human Impacts on Encyclopedia of Biodiversity, vol. 4. Academic Press, San Diego, pp. 27-36.
- de Mitcheson, Y. S., 2016. Mainstreaming fish spawning aggregations into fishery management calls for a precautionary approach. BioScience, 66(4), pp. 295-306.
- Dept. of Fisheries, U.T. of Lakshadweep. 1990. Thirty years of fisheries development in Lakshadweep.
- Drew, J. A., 2005. Use of Traditional Ecological Knowledge in Marine Conservation. Society for Conservation Biology, vol. 19, no. 4, pp. 1286-1293. DOI: 10.1111/j.1523-1739.2005.00158.x.
- Evans, S. M., and A. C. Birchenough. 2001. Community-based management of the environment: lessons from the past and options for the future. Aquatic Conservation 11:137–147.
- FAO. 2020. The State of World Fisheries and Aquaculture 2020. Sustainability in action. Rome.
- Gillett, R., Jauhary, A. R., and Adam, M. S., 2013. Maldives livebait fishery management plan.
- Gillett, R., 2014. Improving the Management of Baitfisheries Associated with Pole and Line Tuna Fishing in Indonesia. IPNLF Technical Report No.3, International Pole and Line Foundation, London. 117 Pages.
- Haggan, N., Neis, B. and Baird, I.G. (Eds.), 2007. Fishers' Knowledge in Fisheries Science and Management. UNESCO Publishing, Venice, p. 437.

- Hauge, K. H., Cleeland, B., and Wilson, D. C., 2009. Fisheries depletion and collapse. IRGC report: Risk governance deficits: An analysis and illustration of the most common deficits in risk governance. International Risk Governance Council Chemin de Balexert (9.1219), 21.
- Hilborn, R., Walters, C.J. and Ludwig, D., 1995. Sustainable exploitation of renewable resources. Annu. Rev. Ecol. Syst. 26, 45e67.
- Hoon, V. 2003. Socio-economic dimensions and action plan for conservation of coastal resources based on an understanding of anthropogenic threats. Chennai: Centre for Action Research on Environment Science and Society. Retrieved Sept 22, 2020.
- IPNLF. 2012. Ensuring Sustainability of Livebait Fish, International Pole-and-line Foundation, London, 57 pages.
- Jaini, M. and J. Hisham. 2013. Sustainable pole and line tuna fisheries in the Indian Ocean: Does Lakshadweep hold up to Maldives MSC' standards. International conference on small-scale fisheries governance: Development for wellbeing and sustainability (pp. 1–17). Hyderabad: Centre for Economic and Social Studies.
- Jaini, M., Advani, S., Shanker, K., Oommen, M. A. and Namboothri, N. (2017). History, culture, infrastructure and export markets shape fisheries and reef accessibility in India's contrasting oceanic islands. Environmental Conservation, Volume 45 , Issue 1: Thematic section. Humans and Island Environments, March 2018, pp. 41 – 48.
- Jentoft, S., 2000. The community: a missing link of fisheries management. Mar. Policy 24, pp. 53-59.
- Jennings, S., and Kaiser, M. J., 1998. The effects of fishing on marine ecosystems. Advances in marine biology, Vol 4, Academic Press, pp. 201 – 352.
- Johannes, R.E., 1981. Words of the Lagoon. In: Fishing and Marine Lore in the Palau District of Micronesia. University of California Press, Berkeley, CA, USA.
- Johannes, R.E., 1998. The case for data-less marine resource management: examples from tropical nearshore finfisheries. Trends Ecol. Evol. 13 (6), 243e246.
- Johannes, R.E., Freeman, M., Hamilton, R.J., 2000. Ignore fishers' knowledge and miss the boat. Fish Fish. 1, pp. 257-271.
- Johannes, R. E., 2002. The renaissance of community-based marine resource management in Oceania. Annual Review of Ecology and Systematics 33:317–340.
- King, M., and Faasili, U., 1999. Community-based management of subsistence fisheries in Samoa. Fisheries Management and Ecology 6:133–144.
- Lobe, K and Berkes. F., 2004. The padu system of community-based fisheries management: change and local institutional innovation in South India. Marine Pol 28:27181.
- Milch, L., 1999. Resource mismanagement versus sustainable liveihoods: the collapse of the Newfoundland cod fishery. Society & Natural resources (12.7), pp. 625 – 642.
- McCay, B. J. and Jentoft, S., 1996. From the bottom up: Participatory issues in fisheries management. Society and Natural Resources, 9 (3), 237–250.

- Nguyen, K. Q., and Winger, P. D., 2019. Artificial light in commercial industrialized fishing applications: a review. Reviews in Fisheries Science & Aquaculture, 27(1), 106-126.
- Pomeroy, R. S., 1995. Community-based and co-management institutions for sustainable coastal fisheries management in Southeast Asia. Ocean and Coastal Management, 1995, 27(3), 143–162.
- Pomeroy, R. S., Katon, B and Harkes, I., 2001. Conditions affecting the success of fisheries co-management: lessons from Asia. Marine policy 25 (3), 197-208.
- Sridhar, A. and N. Namboothri, N. 2012. Monitoring with logic and illogic: A case for democratising observation in fisheries. Discussion Paper. Dakshin Foundation, Bengaluru and Foundation for Ecological Security, Anand.12p.
- Shanker, K. and Oommen, M., 2018. Engaging Communities in Resource Monitoring: The Political Ecology of Science as the Language of Power.
- Solomon, O. O., and Ahmed, O. O.,2016. Fishing with light: Ecological consequences for coastal habitats. International Journal of Fisheries and Aquatic Studies, 4(2), pp. 474-483.
- Stone, R., Toribau, L and Tolvanen, S., 2009. Developing sustainable and equitable pole and line fisheries for skipjack. Greenpeace report, 20pp.
- Sutherland, W.J., Gardner, T.A., Haider, L.J., Dicks, L.V., 2014. How can local and traditional knowledge be effectively incorporated into international assessments? Oryx 48 (01), 1-2.
- Teng€o, M., Brondizio, E.S., Elmqvist, T., Malmer, P., Spierenburg, M., 2014. Connecting diverse knowledge systems for enhanced ecosystem governance: the multiple evidence-based approach. Ambio 1-13.
- Thornton, T.F. and Scheer, A.M., 2012. Collaborative engagement of local and traditional knowledge and science in marine environments: a review. Ecol. Soc. 17 (3), 8.
- Vinay A, V. Ramasubramanian, M. Krishnan, N. R. Kumar and A.E. Ayoob. 2017. Economic analysis of tuna pole and line fisheries in Lakshadweep. Indian Journal of Geo-Marine Sciences, 46 (05), 947–957.