

MONITORING WITH LOGIC AND ILLOGIC

A CASE FOR DEMOCRATISING OBSERVATION IN FISHERIES

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The bioeconomic logic of monitoring

Marine animals and environments have offered multiple meanings to people living and interacting with them. Marine resources have been understood and depicted variously across time and contexts, by a range of actors—fishers, scientists, government officials, vendors, traders, conservationists, development agencies etc.—as being cultural artefacts, as food, as locally exchangeable commodities, as ecological entities, and so on. Each of these meanings has driven these actors to make a range of observations and produce different fisheries ‘knowledges’. However, fisheries science today has become synonymous with natural sciences, and involves expert driven quantitative data collection and analyses. The ecological research conducted today and the analyses and theories on marine systems and fisheries owe a deep debt to the knowledge that fishers generate of their areas, their observations on fishing grounds, species behaviour, habitats, the political economy of fisheries, etc. Communities of fisheries scientists recognising and seeking fisher knowledge have often richly benefited from such knowledge. Aside from fishers themselves, associated agents in

fisheries, such as traders, merchants, women vendors etc., are also custodians of knowledge produced from their observations of trends, patterns, and changes in what they see. However, in its task of fisheries management, does the state machinery draw upon any of these regular observations and related knowledges? What is the relation between official fisheries monitoring and fisheries management, and has this monitoring achieved its putative goals?

The post-Cold War world has seen fish most strongly discussed as a national produce particularly in developing countries, as a means of ensuring self-reliance and as a product for sale in distant domestic and global markets (Smith 1994). Institutions were set up at the international, national, and state level to promote fisheries productivity and to establish control over the exploitation of fish stocks (Silas 2003; Bavinck 2011), which themselves were categorised as national, regional, or global. This understanding of marine life as ‘produce’ witnessed subtle shifts in character, in particular, a shift from being a ‘renewable’ bounty of nature to an ‘over-exploited’ resource when scientists began highlighting that stocks were depleting and too much was being harvested. The early half of the twentieth century saw the emergence of the ‘bioeconomic’ view of fisheries, which promoted two key concepts—Maximum Sustainable

Yield (MSY; the point up to which fish catches increase in response to fishing effort) and Maximum Economic Yield (MEY; where economic returns from fishing would be maximised relative to cost). This bioeconomic view is the genesis and driver of contemporary fisheries inventorying practices—the form of data and analyses employed by the state (St. Martin 2001). Importantly, it circumscribes problem identification, and sets the terms on which fisheries management solutions can be debated. The bulk of official statistics on fisheries in India relates to the monitoring of various fish stocks and fish catch, as a metric of its national wealth and development status. Investigations into what constitutes official fisheries monitoring provides insights into the successes or failures of management solutions that depend on monitoring. In this paper, we highlight the logics and

practices surrounding official fisheries monitoring in India as a means of bringing into question existing fisheries management and governance systems arising out of this exercise. We conclude by suggesting an approach to monitoring and management frameworks that accommodate what are often considered ‘illogics’ or ‘non-science’—namely the social, cultural, ‘human’ or ‘community’ dimensions of fisheries recognising that these not only exist but are critical to the situation of fishers and fisheries. In doing so, we reiterate the opinions of scholars who advocate a long overdue reorientation of fisheries governance systems (see Jentoft 2000; St. Martin 2001; Kooiman et al. 2005), which are necessary to accommodate pluralistic ways of observing, understanding, and democratically managing fisheries in India.

OBSERVATIONS, KNOWLEDGE, AND MANAGEMENT: AN INCOMPLETE CONTINUUM

The problem of deciding how much should be exploited and by whom has a recorded history, which is probably as old as the act of fishing itself. Anthropologists and sociologists have shown the multitude of ways and methods whereby fishers observe, record, produce, and share information and knowledge about not just fish, but the entire seascape (above and below the waterline) (Neis & Felt 2000; Haggen et al. 2007). Their knowledge is constructed around environmental, cultural, and social landscapes that they engage with on a daily basis (St. Martin 2001), and this knowledge brings individual fishers and their communities together over understandings of resource challenges and solutions.

Much of the community management of resources is done at local scales where the management boundaries are often abstract and contiguous with a cultural-social-ecological landscape, unlike the physical resource-based boundaries found in official management designs. While scientists and managers cite this scale-dependent attribute of community monitoring and management as its biggest limitation, even the official version is not free of problems, either at local or larger scales (CSO 2011). What therefore is the true nature of the problems

in fisheries that need managing? Are these local in nature, or are they at scales that can only be managed by state systems of management? In exploring these questions, we cannot neglect the problematic role of the bioeconomic assumptions of state fisheries monitoring and management systems as a contributor to crises in fisheries.

Social scientists have described the existence of legal pluralism in many contemporary fisher societies (Bavinck 2005), and suggest that fisheries exploitation problems can best be understood and addressed through governance systems that are inclusive and highlight the need to embrace concepts that reflect the actual dynamics that operate at varying scales within fisheries (Bavinck & Jentoft 2011; Kooiman et al. 2011). The term legal pluralism refers to the operation of local non-official rules simultaneously with official state rules; many of these non-official rules have an old and established history. Social scientists have shown the existence of local regulations among more traditional small-scale fishers and similar possibilities in First World fisheries (St. Martin 2005), where decisions and rules are devised not by individual fishers (as assumed

by the bioeconomic model) but by the social group, based on observations and reasons that defy the logics of MSY and MEY (i.e., neither stock dependent nor economically rational). On the contrary, fishers make a range of observations and fashion their reasoning based on social, cultural, spatial, ecological, political, and economic considerations (McCay 1978; St. Martin et al. 2007). However, official fisheries monitoring mechanisms are designed and carried out through structures that allow no formal means of gathering and applying these forms of observations, analyses, and knowledges. Legal mechanisms for managing fisheries also do not formally

recognise the role of communities in regulation. Ironically, scholars (both social and natural scientists), government officials, fisher leaders, and merchants often point that fisheries information, monitoring, research, and governance (including aspects such as development programmes, law and order, regulation, planning, etc.) do in fact rely a great deal on the cooperation and assistance received from a range of non-government actors, particularly fishers. What therefore appears to be the fixed responsibility of the state is in actuality shared with communities, albeit informally, unequally, and arbitrarily.

TRACING INSTITUTIONALISED FISHERIES MONITORING IN INDIA

The need for the state (whether colonial or post-colonial) to control the use of fish resources prompted efforts toward documentation, research, and management. In 1862, Sir Francis Day was instructed by the British government to record all extant species of fishes in India. His colossal monograph titled “*The Fishes of India*” was inspired by concerns over potential declines in the fishery resources as a result of the construction of dams over some of the major Indian rivers (Day 1878). The Indian Fisheries Act was introduced in 1897, which empowered the colonial administration to formulate rules and regulations for managing and controlling fishing activities in the Indian Empire. After Independence, the state governments inherited the colonial fisheries departments, and adopted this legacy of exclusive dominion over regulating fisheries.

The first Fisheries Department was established in the Madras Presidency, and a substantial volume of marine research was undertaken through this department. However, the need for a specific fisheries research institution was raised in 1943 and subsequently in February 1947, a Central Marine Fisheries Research Station was established at the Zoology Department of the Madras University. After independence in 1949, the research station was upgraded into a federal government body, the Central Marine Fisheries Research Institute (CMFRI) under the Ministry of Agriculture (Silas 2003). Around the same time, a pilot project known as Deep

Sea Fishing Station was operational with the objective of augmenting food supply through the development of deep-sea fishing. This project was to soon transform into the Fishery Survey of India in 1983, whose primary responsibility would be the survey and assessment of fish stocks in the Indian Exclusive Economic Zone.

Data on fish catch in various states has been collected by both the state fisheries departments and the CMFRI since their inception, although each used different methods altogether. Since independence, fish production by the marine fisheries sector has grown from an annual figure of about 0.5 million tonnes in the 1950s to approximately 3 million tones in 2009-2010 (ICAR 2011). The Indian Council for Agricultural Research, one of India’s premier scientific research institutions, rely on the data and statistics generated by the CMFRI (and not the state fisheries departments), which had the mandate of monitoring and assessing marine fishery resource exploitation for the entire country.

The Fisheries Survey of India (FSI) now plays a translator role, where it reconciles the data received from the state fisheries departments and the data collected by the CMFRI (Nair 2012). It does this in addition to its central mandate of conducting stock assessment surveys, and is expected to interface with the CMFRI for scientific and technical guidance.

As early as the 1950s, both the Food and Agriculture Organisation and CMFRI, the main champions of national fisheries productivity, articulated the need to monitor fisheries exploitation with the main objective of sustaining the profitability of this sector. Monitoring in India thus started based on the need to maximise yield within an optimum exploitation framework. The CMFRI was quick to recognise that India's diverse and dispersed fisheries operations would pose a logistical challenge to spatio-temporal monitoring, particularly if this was to be undertaken by a single agency and its staff. The earliest attempt at sampling strategies for fisheries monitoring was attempted through a pilot survey in 1951 (Bal & Banerji 1951). This involved dividing the entire Indian mainland coastline into 12 sectors, each measuring about 400 km to be covered by a single CMFRI enumerator. The enumerator collected demographic data about fishers, statistics on fishing crafts and gears along with some additional socio-economic data. Data on the availability of fish and their seasonality was also collected. Bal and Banerji (1951) highlight crucial difficulties in carrying out such surveys such as the lack of cooperation from fishermen, difficulties in transportation, resource constraints, and absenteeism among data collectors or enumerators (Bal & Banerji 1951). These early problems affected reliability and accuracy of official fisheries data.

Many monitoring protocols were experimented with in subsequent years. A significant breakthrough in devising a large-scale data collection protocol was made in 1959, when scientists at CMFRI applied a multi-stage stratified random sampling (MSRS) approach to infer statistical information on Indian fisheries (Srinath et al. 2005). Today, the Fisheries Resources Assessment division of the CMFRI based in Cochin is responsible for the collection and estimation of fisheries data. It estimates region-wise, species-wise, and gear-wise marine fish production. It is also charged with developing methods and mathematical models for assessing stocks and managing an extensive and exclusive database on harvested marine living resources.

A deeper investigation should be undertaken on the emergence of India's post-independence plans, institutions, and actors, and how they engaged with fisheries. Such an enquiry alone can aim at constructing a satisfying explanation for the apparent redundancy in fisheries data governance, or why (at least) three different government bodies (state fisheries departments, CMFRI, and FSI) all continue to engage steadfastly in the activity of catch data collection and stock assessments. While this is beyond the scope of this paper, the authors recognise the value of a historical and critical understanding of any diagnostic or prescriptive exercise concerning fisheries.

MONITORING UNSUSTAINABILITY

The question that is central to the enquiry of this paper is 'what forms of data and analyses should be considered valid and necessary for decision-making'. A wider understanding of fisheries can only come from a wider series of observations. This in turn can assist in the identification of what aspects of fisheries need attention in the form of development or regulation and which institutions (of community and state) can shoulder these responsibilities.

In India, post-colonial approaches to resource control and management have changed little in the realm of fisheries. Fisheries management in independent India

is the responsibility of the state governments, but at the federal level the Ministry of Agriculture formulates the overall fisheries development and policy trajectories. A Fisheries Division housed in this ministry was merged in 1997 as a suffix (literally and figuratively) to what is now known as the Department of Animal Husbandry, Dairying *and Fisheries* (author emphasis). Although the Ministry of Agriculture handles the entire subject matter of fisheries in conjunction with the state fisheries departments, the CMFRI, the FSI, and a range of other institutions emerging over the years, fisheries is actually a subordinate concern of this mammoth ministry historically concerned with revenue and land-based

Role of various agencies involved in monitoring fishery resources

Monitoring of fisheries resources and its exploitation in India involves three broad sections that are under the mandates of three different organisations. The table below and the illustration on the following page summarise the roles and broad mandates of these organisations.

Fisheries Survey of India (FSI)	The Central Marine Fisheries Research Institute (CMFRI)	State Fisheries Departments
<ul style="list-style-type: none"> Under the jurisdiction of the Department of Animal Husbandry, Dairying and Fisheries Characterising fisheries resource availability and their distribution Monitoring trends in resource distribution Increasing Human Resources by providing training on fisheries techniques Marine fisheries forecasting Collating fisheries data from the state fisheries departments and the CMFRI, and making it available to the Ministry of Agriculture 	<ul style="list-style-type: none"> Under the jurisdiction of the Indian Council of Agricultural Research Monitoring fisheries exploitation along the Indian EEZ through its Fisheries Resources Assessment division Understanding population fluctuations and developing critical information on the biology and ecology of important species Developing mariculture technologies Maintaining a repository of information on marine fishery resources of India 	<ul style="list-style-type: none"> Under the jurisdiction of the state government Fisheries regulations and management is state specific and guided by the state Marine Fisheries Regulation Acts (MFRA) State fisheries departments also are the nodal departments to implement welfare schemes and subsidies for the benefit of fishers Till recently, the state fisheries departments were collecting data attempting to enumerate all the landings in the state. Since 2003, they started following the CMFRI method.

agriculture. The development trajectory of fisheries in post-Independence India followed the objective of maximising productivity and modernising a so-called 'backward' sector and people. The story of state-promoted technological inputs, capitalisation, and industrialisation of this sector has been well documented (Kurien 1978); catches over the decades saw an increase by several orders of magnitude, but also a corresponding growth in many states towards unsustainability (Kurien 2005). Fish resources the world over are now considered to be declining, and many regional fisheries are considered over-exploited (Pauly et al. 1998). There is an overall consensus that the current rate of fisheries exploitation is unsustainable, and the fisheries sector needs management and regulation if it is to continue being profitable, and for some fisheries to even survive (Pauly et al. 2003). While the nature and rate of decline is strongly contested by

fisheries scientists (Walters 2003; Polachek 2006; Daan et al. 2011), it is clear that the bioeconomic model of growth in fisheries has crafted the current crisis.

Depleting resources lead to the question of tackling 'unsustainability' in fisheries. Ironically, the approaches and frameworks proposed to quantify and arrive at sustainable exploitation rates continue to view fisheries as a production-oriented problem, a question of merely incentivising irresponsible individual fishers to return to MSY and MEY, or accurately quantifying catch data through improved protocols or restoring stocks or finding new ones to exploit. All these solutions remain within the neoclassical frameworks of capitalised fisheries ignoring the operation of myriad social, economic, cultural, and ecological dimensions that determine fisher knowledges, strategies, and adaptations to face challenges.

MINISTRY OF AGRICULTURE

DEPARTMENT OF ANIMAL HUSBANDRY, DAIRYING AND FISHERIES

INDIAN COUNCIL FOR AGRICULTURAL RESEARCH

FISHERY SURVEY OF INDIA

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

FISH STOCK

Information on populations of individual species including parameters of growth, recruitment, mortality and fishing related mortality.



SPECIES OBSERVATIONS

Including interpretations of fish breeding patterns, observations on presence of gravid females, fish behaviour in relation to certain nets, boats, motors; observations are also made on interactions between fish and other marine species like sea turtles, dolphins etc.



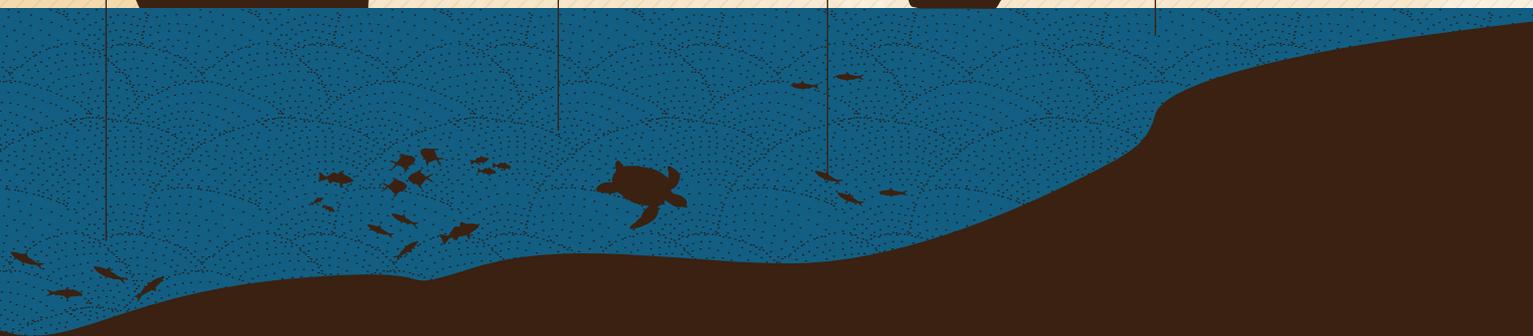
DEEP SEA STOCK ASSESSMENT

Interactions of fish at these depths, information on bycatch, on competing fishers and the availability and abundance of species.



MOOD OF THE SEA

Colour of the waters and emotional states such as calmness, anger, and physical states such as being "in heat".





DATA COLLECTED BY FISHERS



DATA COLLECTED BY GOVERNMENT FISHERIES AGENCIES



FISH CATCH

Total fish catch landed by a fishing vessel, collected from the shore or fishing harbours.



WIND PATTERNS

Direction, speed, and duration.



MARKET DYNAMICS

Demands for various species and their distribution among various markets (local, distant domestic, international, credit inflows).



FISHING EFFORT

Time spent in each trip, duration of soak time of a net, how many times nets are deployed, how many trips are made, trip routes, number of fishers using a particular ground in a given instance, popular fishing grounds, and un-fished areas (by different categories of fishers).

MONITORING FISHERIES: CONTRASTING KNOWLEDGE-MAKING

CHASM BETWEEN MONITORING AND MANAGEMENT

A crude division of labour is discernable in the evolution of official fisheries management institutions post-independence. The responsibility of developing, managing, and regulating fisheries (within territorial waters) was the prerogative of the state governments, and the mandate of generating information about the state of fisheries and devising national policy goals lay with the federal government (assisted by the monitoring and research activities of the CMFRI). With few mechanisms in place for information sharing and application between these agencies, management and monitoring appeared to take place without any points of intersection (see infographic on Karnataka fisheries monitoring).

Fisheries mechanisation had started in the early 1950s, and by the time the catch data collection protocols among government agencies were streamlined and revised in the 1980s at the first national workshop on marine fisheries data acquisition and dissemination (CSO 2011), the trends of over-exploitation had already become evident. Conflicts began to emerge between the artisanal and mechanised sectors, and the state Marine Fisheries Regulations Acts (MFRA) emerged only in the 1980s as a means of resolving social conflicts by spatially separating these categories of fishers (such that the nearshore waters belonged to the small-scale fishers and mechanised fishing was permitted only in the areas beyond). The legislation and its implementation mechanisms did not utilise fisheries data to devise immediate and local management efforts, and even if data could play some role, the departments demonstrated an inability at tackling complex fisheries management challenges that accumulated (Bavinck 2001) by the time the CMFRI data became available. The non-implementation of various conservation measures of the MFRAs—namely regulating incursions by mechanised boats into the fishing zones designated for the small-scale fishers, and implementing seasonal (monsoon) bans—is highlighted by fisher unions, activists, and scholars (NFF 2001; Kurien 2005). If fisheries data played little role in management in the 80s, are matters different now?

A study on data collection practices in Karnataka shows that officials of fisheries departments describe their primary engagement as the regulation of boat licences, registrations, and processing schemes for fishing communities (Nair 2012). They see their role as only

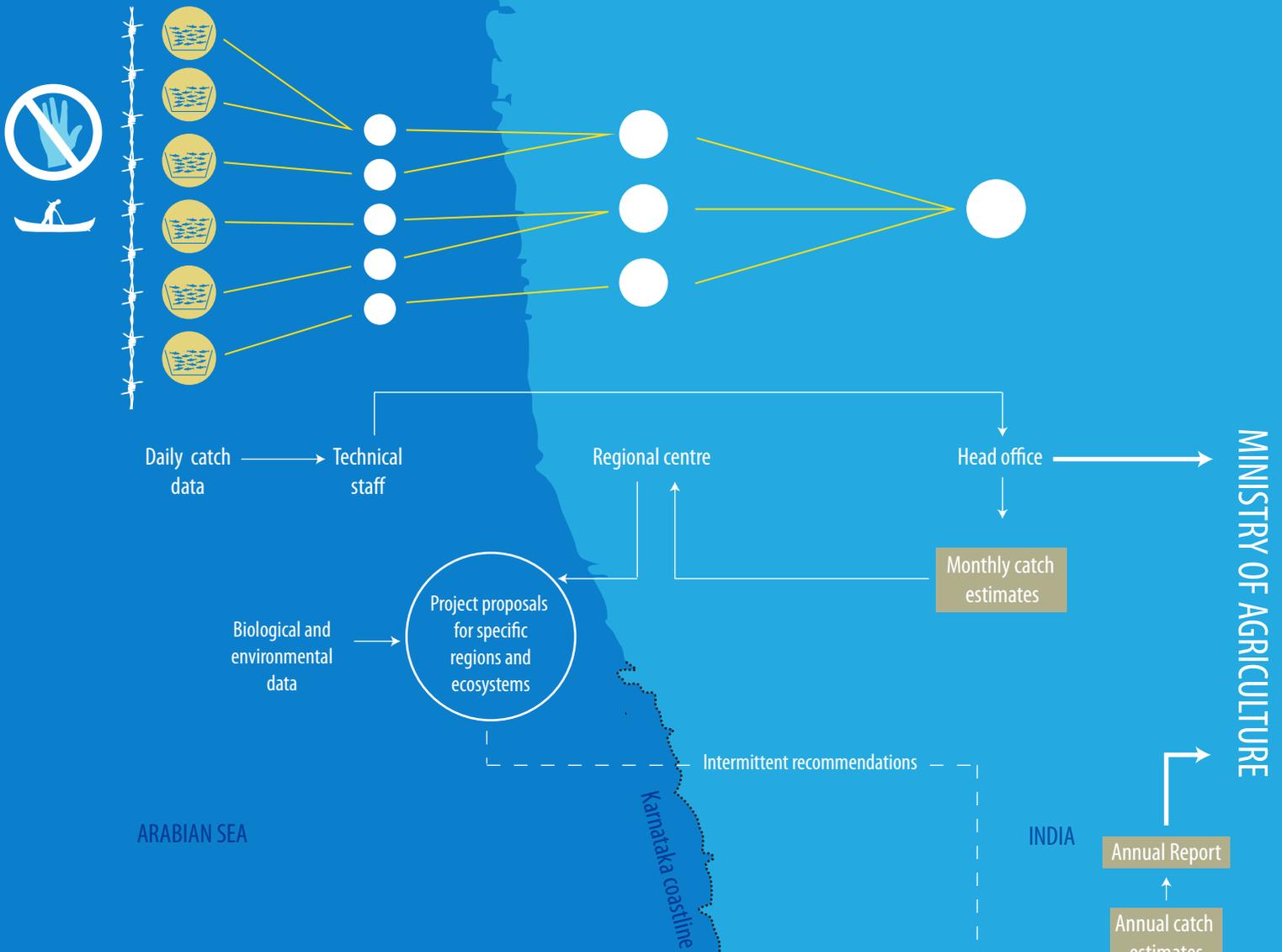
estimating the yearly catch and not to design species- or habitat-specific policies. Till 2003, the Karnataka state fisheries department collected data on total fish catch by means of total enumeration (Nair 2012). The objective was to maintain a report card of performance, and it is not clear if and how this information was used to regulate fisheries. Fisheries departments had data on the number of vessels, since the MFRA required vessels to obtain licences and register with the departments. However, finer observations on what impacts each fishery had on the resource and inter-fishery data was not factored into fisheries statistics that sought to aggregate total catch-based information.

The act of two institutions—namely the CMFRI and the state fisheries departments—both collecting catch related data using different methods, was not considered problematic for several years. Owing to growing criticism about the reliability of this data and its collection methods (see Bavinck 2005; Nair 2012 for examples), the central government attempted to standardise the methodology followed by both agencies in order to bring about a uniform means of data collection for future integration and exchange of data (CSO 2011). It is important to note that neither institution sought to give up its role as a generator and custodian of such information. Fisheries department officials claim that data is still not exchanged between the CMFRI and the fisheries departments since the latter converted to the sampling framework of multi-stage stratified random sampling (MSRS) (Nair 2012). Overlaps in, and a duplication of, data collection efforts and inefficiencies still persist.

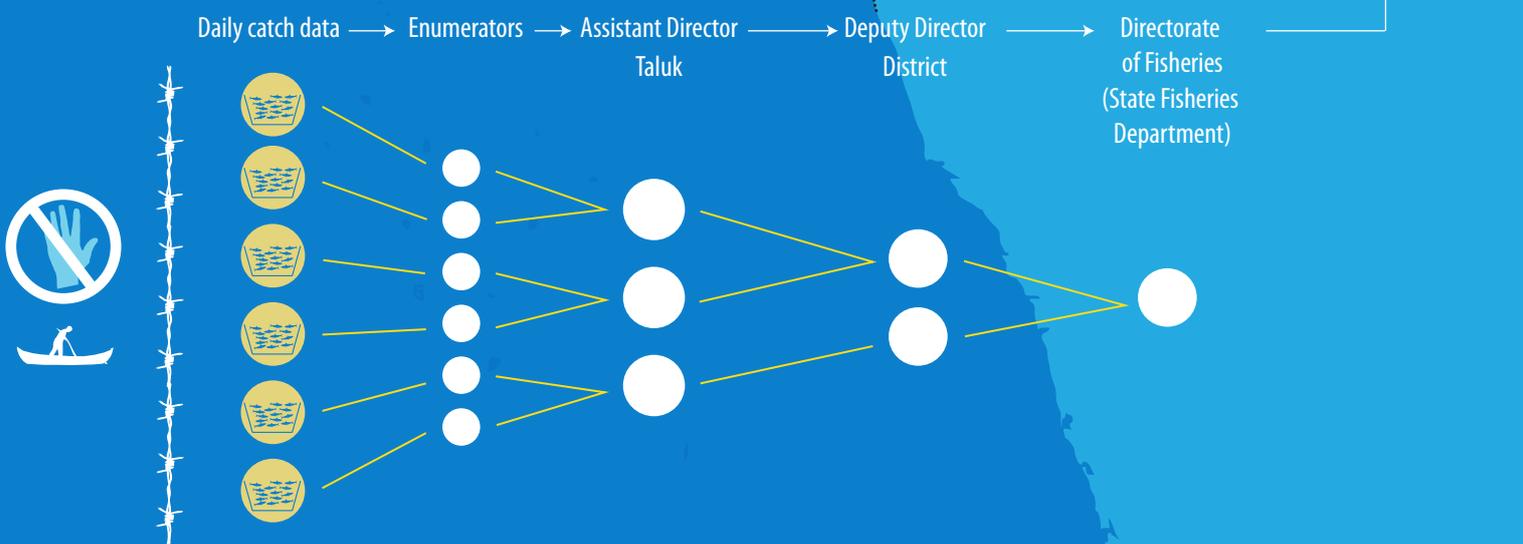
Let us examine two important publications produced by the CMFRI, namely, the marine fisheries census and the trends in fisheries production. The CMFRI had begun conducting fisheries census, which focused on social and demographic variables, but this was collected less regularly than catch data. This data was published in 1973, 1980, 2005, and 2010, the last exercise being the most comprehensive of all. Till this time, only the Tamil Nadu state fisheries department sporadically carried out a fisheries census on its own for some years. Since this information was not collected regularly, it could not have informed management decisions of a more immediate nature. The nation-wide (excluding the islands of Lakshadweep, and the Andaman and Nicobar)

FLOWS AND FATE OF FISHERIES DATA

DATA FLOW: CENTRAL MARINE FISHERIES RESEARCH INSTITUTE



DATA FLOW : KARNATAKA STATE GOVERNMENT



The processes and channels of official fisheries monitoring in Karnataka show weak outcomes for fisheries management. The data of the CMFRI is only intermittently passed on to the state government. Little exists by means of evidence that either monitoring efforts translate into management ideas through strong and transparent feedback loops. There is a complete absence of the fishing communities in this process altogether.

fisheries census carried out by the CMFRI once in five years involves collection of information on fishers, their occupational status, fleet size, etc. On the islands of the Andaman and Nicobar, and Lakshadweep, the census is carried out by the FSI, which has a better infrastructure base. The data for the 2010 CMFRI marine fisheries census took two years to enter the public domain and is at present only accessible on its website for its own staff members in a PDF format. This by itself limits the application and use of this data for management purposes by other government departments, scientists, NGOs, or local communities.

In the year 2005, the CMFRI published a book that analysed basic trends in fisheries production between the years 1985 and 2005. This first time publication was priced at INR 10,000 and was only available as a hard copy, limiting the use that such information could be put to. The authors' investigations revealed that many state fisheries departments did not possess a copy of this publication. This publication provides aggregated data for fishes at the family level, and the finest resolution of data is at a state level. The CMFRI does not publish disaggregated data showing landing centre-based information, zonal level data, species or genus level catch data, or even seasonal data.

ASSESSMENT OF MONITORING OBJECTIVES

Having invested more than 50 years in manpower and infrastructure resources, it is important to assess the fisheries monitoring exercise in India against its putative objectives. It is clear that local management decisions could not and did not benefit from the detailed monitoring carried out by three agencies (CMFRI, FSI and state fisheries departments), as the data was not disseminated in a timely and accessible manner, and was bereft of feedback loops to address local fisheries challenges and implementation issues. As part of a 28-volume series of compilations of statistical indicators, the Central Statistical Organisation of the central Ministry of Statistics and Programme Implementation produced the *Manual on Fishery Statistics* in 2011. Both the CSO and the National Statistical Commission point to significant constraints in generating reliable and precise estimates of fisheries statistics. They refer to methodological problems (such as the lack of periodic review of the CMFRI sampling strategy), the problems in data flow and consistency between the CMFRI and state fisheries departments, and the need for reclassification of gear types and fishing methods. An important set of observations was that they noted an absence of

communication of information to stakeholders, few policy relevant analyses, a poor understanding of user requirements, and a mismatch in terms of more local management needs (CSO 2011).

“The fishing industry is diffuse and is in the hands of fishermen without education” (Bal and Banerji 1951).

More than half a century has passed since the first fisheries monitoring protocols were developed. Despite substantial methodological modifications and inward introspection as it were, it still appears that the monitoring edifice has worked in a fair amount of isolation, not only from the ‘users’ or stakeholders, but also from various wings of the state itself, effectively distancing the aspect of observation, data gathering, and analysis from the more social and political demands of management. Thus the periodic shifting of mandates, overlapping jurisdictions, opaqueness and inaccessibility of data are not mere data management inefficiency problems but far more serious symptoms of the failure of certain bioeconomic logics and measurements in a society and occupation that is inherently social, cultural, and often times, ‘illogical’.

CONCLUSION

Both the bioeconomic logic and the state's monopoly over fisheries management decisions are strongly contested today, as numerous local social tensions on the ground indicate. The ideas of co-management promoted as a governance reform concept suggests the imagination of a shared endeavour. However, this necessitates revising our ideas of fisheries data itself and constituency of expertise. We believe that it must go beyond the counting of items falling in the realm of the bioeconomic logic, and accommodate new logics, however illogical they appear to the fisheries scientist.

Fisheries management is as much a concern of social, political, and economic processes, as it is about ecological aspects such as rates of total catch, by-catch, and the physical materiality of fishing. A number of actors who make daily observations in several non-bioeconomic aspects of fisheries therefore can contribute valuable analyses that have (at least) immediate decision-making value.

There are definite epistemological challenges in trying to frame an inclusive approach for fisheries monitoring. The inertia associated with transforming the national fisheries institutions poses another formidable problem. Institutions such as the CMFRI can make a beginning by investing more in drawing from social science pools and networks of scientists who have the expertise and the capacities to engage with local communities and traditional ecological knowledge. In order to investigate potential middle ground, there must be substantial efforts to work with fishers to understand the implications of the methods and logics they employ in observing, recording, and responding to shifts in fisheries. Equally important is the investigation of shifts in knowledge systems, transmission, innovations, and diffusion. Exploring these dynamics of knowledge custodianship is not just an academic exercise but also a political one, and must therefore be executed in equal partnership with fishing communities. Even a belated beginning in such experiments will be instructive.

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