TPM Vol. 32, No. S2, 2025
ISSN: 1972-6325
https://www.tpmap.org/

EVALUATING THE IMPACT OF CO-MANAGEMENT APPROACHES ON SUSTAINABLE FISHERIES MANAGEMENT

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ABSTRACT
Co-management is a way of life. Co-management is based on the principle of one for all and one for all. Since its inception in 1904, the cooperative management movement has become an integral part of our economic, social, political, and even religious activities. It aims to maximize the use of human and natural resources to accelerate economic expansion. Fishery is a major industry all over the world and fishing is one of the oldest occupations of man. There is no substitute for fish as a major animal protein source. Nearly one tenth of the world's protein supply is thought to come from fish, either directly or indirectly. Fishing provides sustenance directly without much time lag between the effort and its effects. In the case of agricultural production, the results are realized after a certain amount of time has passed. Fishing methods got better as demand grew, and a number of new inventions were made. The present model may be treated as a simplistic yet first effort towards impact of co-management approaches on sustainable fisheries management in this region. A more detailed study involving fishery data and biological observations for a longer time frame coupled with measurements of changing nutrient and physicochemical parameter of the coastal marine ecosystem is required to develop a real time model suitable for practical field applications.
Keywords: Co-management, Fishery, Sustainable Fisheries Management, economic, fishing

1. INTRODUCTION

2.5 million square kilometers of fresh water area constitute one of the important fishery resources of the world. It includes great river systems [2]. The act of fishing is defined as the pursuit of fish [1]. The coastal people of India have been engaged in marine fishing since ancient times, making it an important part of their maritime heritage [4]. Fishing operations have, however, largely remained near the shores, venturing out into the open sea only a few kilometres from the base upon distances which could be covered easily by sailing crafts [11][3].
The development of fishing industry needed a technological chain extending from mechanised vessels to fishing harbours, cold storages, ice making units, fish processing plants, refrigerated rail / road transport, quality control and inspection services. The application of modern and scientific methods in landing, preservation and distribution provide maximum utilisation of our marine resources and improving the socio-economic conditions of millions of fishermen [12].
In the context of fisheries, "technological change" can refer to the use of new tools and techniques in any one or combination of the processes of catching, handling, preserving, processing, and distributing fish. In fish production, new methods may be introduced in the organisation of the production process, in the quality of fishing equipments and in skills of fishermen [6]. For locating fish shoal locations, new radar, sonar, and underwater television devices are being introduced. However, among all such innovations, mechanisation of fishing crafts has been the most significant [5].

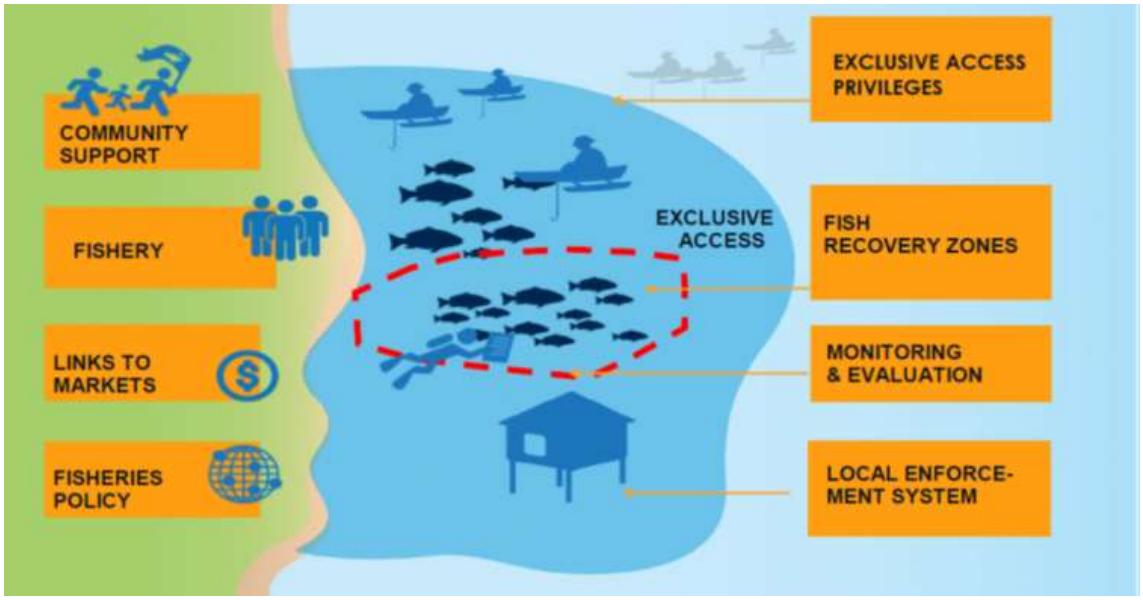

Figure 1: Co-Management and Sustainable Fishery Resources (Source:Web)

2. MARINE FISHERIES DEVELOPMENT

It is not necessary for all members to contribute equally to the unit's total investment. A fisherman acquires a share in investment by contributing to any of the several fishing implements [8]. Each unit member is required to contribute laborers proportional to his or her investment. The crew can also include non-owners. They are treated like paid employees [13]. They are required to provide their services to the owners on the terms that were agreed upon when they received the advance payments at the beginning of the fishing season [10]. There are some other fishermen workers who remain free labourers and do not enter into such agreements but take up work under employers of their choice. Share-based distribution of fishing earnings was used. In practice, the sharing system varied according to participant's relation with capital, type of craft and gears used and the type of fishing resorted to [7].

At the time of introduction of mechanised fishing, several arguments were raised in its favour. The most significant of these was its technical advantage over fishing with hand-operated boats. With mechanised fishing it was expected to be possible to

(i) Operate on a larger fishable area by going further and deeper into the sea.
(ii) Put in greater fishing effort by reducing the time spent in to and fro trips
(iii) Fish catch for larger number of days in a year by controlling the seasonality factor and
(iv) Diversify the catch composition by harvesting unconventional species.

Research Questions

1. What are the effects of co-management approaches on the sustainability of fisheries management?
2. How do co-management approaches influence the behavior and decision-making of fisheries stakeholders?
3. What are the key factors that contribute to the success or failure of co-management approaches in fisheries management?
4. How can co-management approaches be adapted and scaled up to address the complex challenges facing fisheries management?

Objectives:

1. To evaluate the impact of co-management approaches on sustainable fisheries management.
2. To identify the key factors that influence the effectiveness of co-management approaches in fisheries management.

3. SYSTEM DESIGN

There are two types of fisheries management systems: (i) a holistic approach in which the entire ecosystem is viewed as the controlling factor that has the potential to improve each individual target fishery; and (ii) a single species approach that is solely focused on the target fishery. Both of these approaches are possible. The major problem with the single species approach is that it is not holistic and it ignores the fact, that marine ecosystems are multi species in nature. Since fish is an integral part of the aquatic system, changes in its habitat would definitely have an impact on the fish biology and population dynamics. Fishing activity in the coastal and nearshore area is known to have a direct or indirect impact on the structure and functioning of the ecosystem [14], including alterations in habitat structure, species diversity, and ecosystem productivity.

The single species approach does not consider species interactions, ecosystem functions, effect of discarding large amount of by-catch and changes in habitat structure (Mace 2001). Pauly et al. (1998) stated that managing fisheries based on single species approach can lead to changed trophic interaction and reduced ecosystem functionality which determine the long term fishery yield. However, holistic or ecosystem-based fishery management strategies are also criticized for their complexity, need for a wide range of data, uncertainties caused by measurement, estimation, and process errors, and potential inability to anticipate community structure shifts. In spite of these criticism and partial incompetence, ecosystem based fisheries management (EBFM) is an important complement to the existing fisheries management approaches as proposed by several fisheries scientists. Construction of sustainable management options using ecosystem based models requires few predictive indicators that can be parameterized using easily accessible data [9].

Overfishing for a prolonged period of time is taking its toll on fish health which is affecting the fish biology and population dynamics. Analysis of length-frequency studies of commercial landings showed that, in most cases, the mean length of the fish is smaller than its length at first maturity. Hence, an alternative management regime was proposed that would allow a fish to spawn at least once before being caught. However, other than fishing, some other factors are also affecting the marine fish population dynamics and catch trends all over the world. These are pollution, invasive species and climate change. The questions of sustainable marine fishery therefore demand a better understanding of the ocean environment and its change [15].

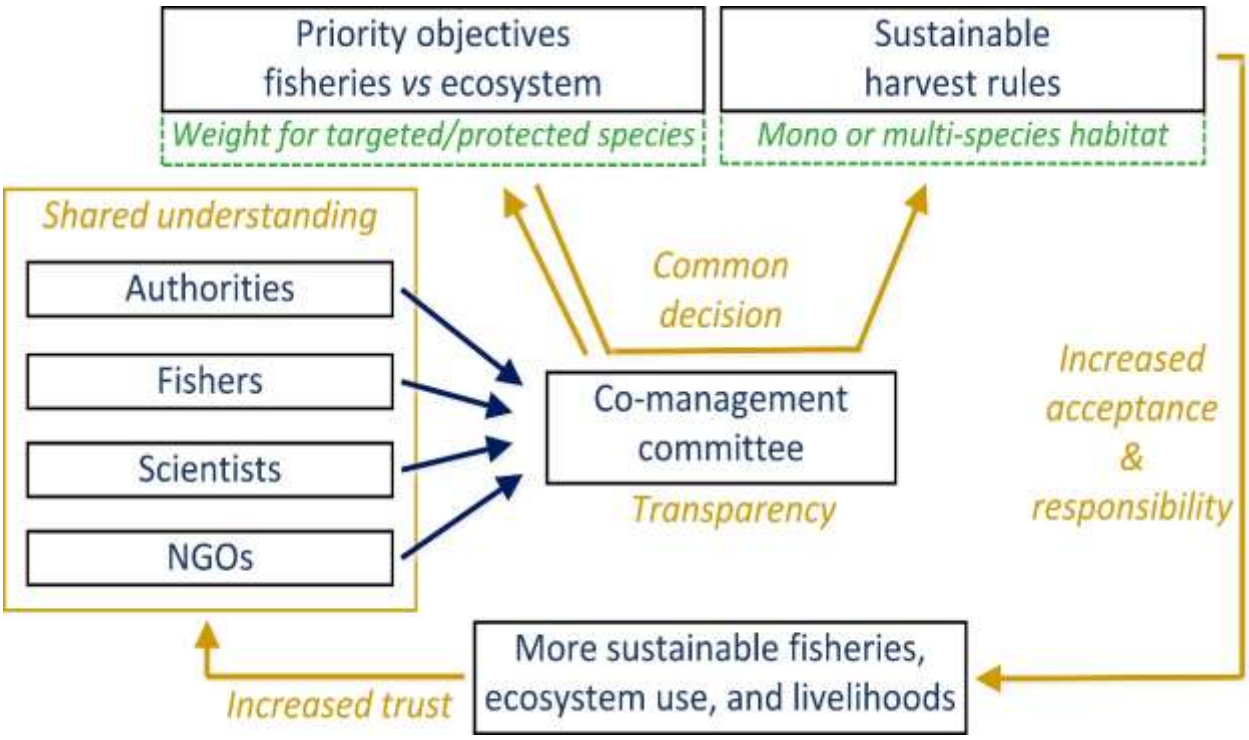

Figure 2: Conceptual framework

4. ANALYSIS AND DISCUSSION

5.

In recent years, sustainability of fisheries has become a common concern for fisheries scientists in the face of increasing world population and climate change. Several ideas were introduced during the last two decades aiming steady increase in fish catch.

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Table1: Validity convergence

Items	Factor loading	Composite reliability	Average variance extracted	Cronbach α
How can co-management approaches be scaled up and replicated in different fisheries contexts to promote sustainable fisheries management?	0.85	0.892	0.734	0.778
What is the impact of co-management approaches on the resilience and adaptability of fisheries social-ecological systems?	0.86			
How do co-management approaches affect the distribution of benefits and costs among different fisheries stakeholders, and what implications does this have for fisheries management?	0.86			
What are the key challenges and limitations of implementing co-management approaches in fisheries management, and how can these be addressed?	0.79	0.817	0.599	0.798
How can co-management approaches be designed and implemented to promote sustainable fisheries practices and improve fisheries management outcomes?	0.71			
What role do contextual factors (e.g., economic conditions, social norms, institutional frameworks) play in shaping the effectiveness of co-management approaches in fisheries management?	0.82			
How do different co-management approaches (e.g., collaborative management, co-management, adaptive co-management) affect fisheries stakeholders' behavior and decision-making?	0.81	0.823	0.608	0.813
What is the impact of co-management approaches on the sustainability of fisheries, and what factors influence this impact?	0.77			

What are the benefits and challenges of using co-management approaches in fisheries management in developing countries?	0.75			
How do co-management approaches affect the role and responsibilities of fisheries stakeholders, including fishermen, communities, and NGOs?	0.72	0.811	0.561	0.789
What is the impact of co-management approaches on fisheries governance and institutional frameworks?	0.76			
16. How can co-management approaches be used to promote fisheries management that takes into account the needs and perspectives of multiple stakeholders?	0.78	0.808	0.538	0.781
What is the impact of co-management approaches on fisheries management outcomes in areas with high levels of biodiversity?	0.84			
How do co-management approaches affect the role of science and research in fisheries management?	0.86			
What are the benefits and challenges of using co-management approaches in fisheries management in areas with high levels of conflict or competition?	0.77			
How can co-management approaches be used to promote fisheries certification and eco-labeling?	0.91	0.712	0.584	0.702
What is the impact of co-management approaches on fisheries stakeholders' perceptions and attitudes towards sustainable fisheries management?	0.76			
How do co-management approaches affect the distribution of power and decision-making authority among fisheries stakeholders?	0.82			
What are the key challenges and limitations of scaling up co-management approaches in fisheries management?	0.79	0.782	0.522	0.778
How can co-management approaches be used to address the impacts of climate change on fisheries management?	0.71			
What is the impact of co-management approaches on fisheries governance and institutional frameworks?	0.74			

How do co-management approaches affect the role and responsibilities of fisheries stakeholders, including fishermen, communities, and NGOs?	0.85			
What are the benefits and challenges of using co-management approaches in fisheries management in developing countries?	0.73			
What is the impact of co-management approaches on fisheries biodiversity and ecosystem health?	0.81			

(Source:Prepared by author)

Changes in fish catch over a period of 15 years can be caused by several factors, viz. changes in climatic conditions, anthropogenic factors like fishing and/ or these changes in catch may be due to the dynamic nature of the fish population.

Table2: Discriminant Validity

Contextual factors	(0.806)			
Leadership and governance	0.077	(0.651)		
Capacity building and training	0.072	0.138	(0.734)	
Funding and resources	−0.096	−0.509	−0.134	(0.651)

(Source:Prepared by author)

This subsequent study of marine fish species' population dynamics and catch trend aims to investigate the anthropogenic influence of fishing on these species' biology and population structure.

5. CONCLUSION

Both, growth overfishing and recruitment overfishing if done for a longer period of time can seriously impair the fish population structure, the age composition, its recruitment pattern and hence its resilience power over any sudden disturbance (natural or anthropogenic). Therefore, in order to achieve a sustainable fishery, the maximum biomass that can be harvested from a stock without impairing its ability to function in its natural environment must first be determined. Here comes the concept of maximum sustainable yield (MSY) limits for a particular fishery to maintain it for a longer period of time.Upon analyzing the population dynamics of the selected marine fish species over the

eight years period it can be concluded that most of the commercially important fishes are being over exploited by the existing fishing pressure. This can be supported by the decreasing fish catch, deterioration of the condition factor values, changes in growth patterns, increased fishing mortality and higher exploitation values for these species as observed during the study. On the other hand, though the annual catch of subsistence fishes has increased over the last decade and encouraged an idea that these fish stocks are within the sustainable limits, the present study indicates that they are also at the verge of over exploitation and need implementation of fisheries management plan to prevent recruitment and growth overfishing in near future.

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