Chapter 6

Summary

6.1 Brief Summary:

The absence of management of renewable natural resources like fishery is a major cause for concern to the government and non-government agencies, policy makers, conservationists and economists. Reason is that the uncontrolled exploitation of these resources may prove to be disastrous in future for both economy and ecology of our country as well as of the world. Indian marine fishery is one of the important sectors with respect to employment generation, revenue and foreign earning of the government, availability of nutritious diet of the general populace and many other factors. Considering the large coastal zone of India and involvement of millions of people in traditional marine fishing in every maritime state, mis-allocation of effort levels among these states can not be ruled out. Non-optimal distribution of harvest factors among these states, that constitutes the total effort, may be detrimental to the marine resource in many ways. First and foremost reason is that over-employment of any factor of effort in any state would reduce the harvest per unit of effort. This would, in turn, induce to enhance effort level as well as to adopt other means violating restrictions and regulations. For example, it may increase amount of juvenile catch or volume of discarded species. Evaluation of the efficiency of the Indian marine fishing fleet of maritime states using DEA is a small step towards the optimal natural resource utilization problem.

India or any country can hardly ignore the efficient management of its natural resources. The efficient management of natural resources with the objective of optimal exploitation as well as conservation requires appropriate application of managerial techniques. With a view to long term sustainability, the study of current practices of management of natural resources like marine fishery is needed to find the solution of management, control and the scope of improvement of optimal resource exploitation. Harvesting of marine fish requires careful control to avoid overexploitation. The renew-ability of natural resources depends on our aptitude to see that too many marine animals and plants are not harvested and that the environment on which they depend does not deteriorate. This implies that fishing has to be regulated and the marine environment to be protected. The present thesis, applies DEA to obtain optimal allocation of fishing fleet among different maritime states with relation to the efficient performance.

Chapter 2 presents an overview of Indian marine fishery and its management problems as a whole. It gives a compact physical description of Indian marine fishery along the east and

west coasts of India. This section contains topological description of harvesting zones, account of marine resources and its estimated potential or availability in the Indian EEZ. This chapter also briefly discusses the infrastructure and facilities existing for the marine fishery of India. This chapter devotes a section to deal with somewhat detailed discussion of Indian marine fishing fleet, their types, differentiations etc. Another section contains information about actual marine fish harvest in different maritime states and fish landings in different zones. The available data and information of Indian marine fishery indicate that although India has rich natural marine resource and a great possibility in utilizing renewable resources successfully and efficiently there is a large gap between the target and the potential. We tried to have a plausible, rational and logical explanation of the situation. In this context the present practice of management and its problems and challenges were discussed. It has been observed that improvements in the harvesting methods, increase in the fishing effort and extension of fishing zone into relatively deeper regions have continuously been made over the years since independence. As a result of that fleet size and operations underwent quantitative and qualitative changes. However, continuous increase of number of fishers, use of different kinds of boats and introduction of new gears etc pushed Indian marine fishery towards 'tragedy of commons' like situation. There are many empirical finding that claimed over- crowding problem, as well as overcapitalization and overcapacity and that possibly reached to an open access equilibrium point. This tempted the government to promulgate regulations to enforce restrictions in order to sustain marine resource. We have shown in this chapter that government regulations include size restrictions, closure of seasons, imposition of moratorium for specific species etc. In this chapter, we also discussed briefly the present statutory jurisdiction of provincial and union government. We have described the existing government policy regarding different types of vessels, incentives policy of export oriented venture, licensing policy of Indian owned vessel in Antartic waters etc.

In chapter 3 we present a very brief and comprehensive discussion on DEA as a technique of measuring efficiency. Since model selection is one of the difficult task in application of DEA, we give the specific formulation of DEA that we have applied in this thesis. We also explained the reason of choosing the particular model to be applied for our study. Along with these, we also discussed the different types of efficiency concepts those are present in the literature and how DEA could capture those concepts. Different methodological restrictions and limitations of DEA method are outlived. We have concluded that output

oriented Banker, Charnes' and Cooper model of DEA in the dual form is the best suited for objective of identifying maritime states with inefficient performance when different inputs remain unchanged.

The problems of excess number of fishing vessels and over-fishing have been the subject of considerable worldwide attention and concern in fisheries for decades. Expressed concern is not single but multi-dimensional. Many different aspects are mingled with the problem of over fishing. These are ecological, economic and biological. The problem of over-fishing is directly related with capacity utilization of harvesting efforts that have been employed. It may reduce the biomass stock to below critical level, which, in turn would bring forth negative impact on ecology. Unfortunately no or limited consensus has, however, emerged about how one might effectively measure the extent of capacity utilization and how these estimates to be used to guide policy formation and implementation. In chapter 4 we apply DEA to estimate the performance of maritime states. We started with the discussion about the determinants of the maritime states' harvest output. We have identified and categorized three distinct groups of key contributing factors - firstly, types of fishing vessels; secondly, access to geographical location and man-made facilities; and thirdly, types of human resources involved. In this chapter, we have done the analysis incorporating three types of vessels only namely, mechanized crafts, motorized crafts and non-mechanized crafts without considering further sub-divisions of vessel type. In our analysis, the decision making units (DMUs) are ten maritime states. Our specific objective of this chapter is to determine whether the effort inputs, like vessels, are optimally distributed among the maritime zones (here provincial states). It has been done by using DEA.

In applying the DEA we have come across the problems of small number of DMU. As mathematical restriction compelled us to consider only two factors as inputs at a time for every DEA run, we took the help of Frisch's Confluence analysis for the selection of appropriate factors. This chapter contains the analysis of the results obtained by using DEA to evaluate the efficiency of the maritime state with respect to the selected explanatory variables for the years 2003 and 2005. To make this study as comprehensive as possible we initially selected inputs from the set of all inputs together. Subsequently, we selected inputs from each category. We applied DEA separately for each selection and results were compared for final interpretation. DEA analysis revealed that fishing fleet is not distributed optimally among the maritime states given the biological/ geographical resources. Some maritime states within the jurisdiction of

maritime zones are over crowded with fishing fleet where over exploitation and depletion of biomass stock is a logical consequence. On the other hand, there are maritime states wherein there is enough scope for enhancement in production (harvest) to utilize the existing marine resources optimally. Analysis in this chapter appears to suggest that those inefficient states due to excess fleet should commission schemes targeting specific boats or types of boats to remove from the industry in order to enhance economic efficiency and viability of the fishery sector. However, comparing the results of the relative performances of each maritime state between the years 2003 and 2005, a positive change has been observed. Analysis suggests that conversion of the boat types from motorized to non-mechanized or vice-versa is not the solution of the excess fleet problem. Our analysis indicates that reallocation of input factors would be good for optimal utilization of Indian marine resources and it would also ensure the economic viability of entrepreneurs or fisher-folk involved in the industry. It is, therefore, required that a policy should be adopted involving all maritime states.

Intensified over-fishing had been reported by several studies including CMFRI for last few years. Many studies along with official data and estimates expose that the Indian marine production is yet to achieve the estimated potential of marine harvest. Since both observations are not feasible simultaneously, it appears paradoxical. One of the objectives of our present study is to probe the reasons of the inconsistency in observations reported by different agencies. Analysis in chapter 4 indicates that both under-employment and over-employment of effort level may be true zone wise. Analysis seems to identify two groups of inefficient zones operating below the efficient frontier. While one group of maritime states becomes inefficient because of over employment of efforts because of excess fleet, the other group of maritime states become so due to under employment of efforts by not utilizing their natural marine resource. In the first case, there seems to exist over exploitation, while in the second, there seems to exist under achievement. This revelation has further been investigated in chapter-5 with respect to mechanized boats and crew members as inputs. Phenomenal increase in the number of mechanized fishing boats in the last two decades was a cause of concern, because their zone of operation remains 50 meter depth zone to 200 meter depth zone in Indian EEZ. Operations in the deep sea depend upon the advancement of technology and expertise of crew skill. Because of this, efficiency of maritime states with respect to different types of mechanized crafts and the human resource involved in the Indian marine fishery as the key contributing factors was undertaken in chapter -5. Similar to chapter 4, Frisch' Confluence analysis is used to decide two most explanatory variables. DEA was applied considering ten

maritime states as DMUs. It is found that many of the states use excess inputs of mechanized crafts with the aim to increase their harvest. The DEA results also illustrated production shortfalls for few maritime states, which indicate that there are scopes for improvement. This implies that had the inputs been fully utilized then there would not have any production shortfall and, as a consequence, the potential target could have been achieved. Hence, it appears that some untapped marine potential still remain unexploited. On the other hand, finding of excess inputs of mechanized crafts in the few maritime states ascertains the fact that there are some zones where there may have depletion of biomass stock due to over exploitation. However, deep-sea fishing is still very much under-utilized in India.

Few important points of our study are deserved to be mentioned here. First, one is related with the limitation of data availability. Initially, we sought vessel specific data of efforts and harvest. The format that CMFRI uses to collect data from every marine vessel includes every detail of efforts and harvest. But researchers from outside that institute do not have access to those data and, therefore, we have to satisfy with those published data.

Secondly, field surveys have been done at different landing centres situated at both east and west coast. We visited Kakdwip, Namkhana, Digha, Frasergunj, Chennai and other places in east coast and Cochi in the west coast. Objective of field survey was to know the process of data recording at the landing centres, particularly the recording of catch data. Our observation is that the recording process is not at all satisfactory. For this, the accuracy of the published data is not beyond question. During our field survey, we have also observed that demarcation of boundaries of different maritime states is not very well defined. Another important is that official estimates of biomass stock, neither species specific nor any other kind, are available. Wherever, required in our analysis, we assume some geographical factors, like area of trawling zone or size of continental shelf etc, as a proxy to biomass stock. Though we know that these factors are not very good proxy of biomass stock, we did not have any other alternative. Had the biomass stock data been available, the interpretation of the efficiency of DMUs could have been more realistic.

The limitations of this study therefore, are that we could not include all input parameters in our model because of fewer numbers of DMUs. It could have been ideal if boat specific data were available for each maritime state. This would have possible to make the analysis more specific and micro-leveled. At least, the number of DMUs could be increased if

catch data were available at landing center level. In particular, DEA analysis does not easily disentangle noise from efficiency (it is deterministic rather than stochastic, so all noise is attributable to inefficiency), or permit prediction of output responses to changes in input or stock levels or the underlying technology. Moreover, the biomass stock could have been very important and meaningful input for our purpose.

6.2 Scope of further studies:

The important and urgent necessity may be to extend this study on the basis of data of every landing centre. It would make possible to extend the number of DMUs and, therefore, all relevant inputs could be incorporated simultaneously for much better analysis. Secondly, the study could be extended for considering vessel specific analysis. It requires that few vessels of every type would be selected randomly and then input and output data of these selected vessels will be analyzed. Thirdly, the same study could be extended upto species specific data. However, in all these cases, the only hindrance of study is non-availability of data.