

SYMPOSIUM ON CURRENT STATUS OF FISHERIES STATISTICS

A symposium on "Current Status of Fisheries Statistics" was held on the 12th February, 1968, during the 21st Annual Conference of the Society at Lucknow. Dr. N.K. Panikkar¹ presided over the symposium. The contributions made by the speakers who participated in the symposium are given in what follows.

G.N. Mitra² : *Development of Fisheries Statistics in India*

INTRODUCTION

Fish constitutes one of the basic sources of supply of animal protein required for healthy growth of the people. It has been estimated that approximately 10% of the world supply of animal protein is contributed by fish. India has considerable resources of this protein rich food both from marine and inland water areas and is one of the eight major fish producing countries of the world. We can augment supply of this protein rich food to the people by developing these resources.

For the phased development of fisheries, planned exploitation of the resources and the efficient management of the fishing industry, in general, the need for sound and reliable basic statistics requires no emphasis. The requirements of information cover wide-range of such data including production, resources potential, planning, trade, prices and various other factors, like processing, transport etc.

The question of collection, coordination and improvement of these important basic statistics in general and statistics of production in particular has been receiving the attention of both Central and State Governments as well as other Organisations for a long time. As early as 1945 the Fish Commodity Committee of the Indian Council of Agricultural Research pointed out the need of accurate fisheries

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statistics. In 1949, the Ministry of Agriculture, Government of India, in pursuance of the recommendations of the All-India Fisheries Conference held in 1948 constituted a Technical Committee for the coordination of fisheries statistics. The recommendations of this Committee cover wide-range of fisheries statistics. In the following paragraphs an attempt has been made to give the details of the development in some of the important sectors of fisheries statistics.

STATISTICS OF PRODUCTION

These statistics may be broadly classified under two main heads, *viz.*, Marine and Inland. The task of obtaining reliable statistics, however, is not easy in view of large coast line of India, multitude of inland fisheries sources, the diversity of fishing practices and scattered distribution of the exploiting units.

MARINE FISH PRODUCTION

The first serious consideration of the adoption of sampling techniques was made in 1945 by the Fish Commodity Committee of the I.C.A.R. and in pursuance of the recommendations of this Committee an attempt at developing suitable sampling technique for the estimation of the catch of the marine fish was first made by the I.C.A.R. in 1950 by initiating a pilot survey in 1949-50 which was carried out in the Malabar coast and later on extended to various parts of the Indian coast, in the light of the encouraging results obtained. The I.C.A.R. was engaged in carrying out 11 pilot and extension surveys (8 in the West coast and 3 in the East coast) and in working out several sampling designs for the estimation of the marine fish landings from 1950 to 1956. The results of these surveys have been published by the Directorate of N.S.S. in one of their publications.

The Central Marine Fisheries Research Institute (C.M.F.R.I.) immediately after it was set up in 1947, started periodical collection of data on fish production and felt the need of data on effort and production and initiated collection of the same. The scale of this work was gradually increased and improvements were made in the methodology from time to time. The plan of sampling adopted by C.M.F.R.I. was one of stratified multi-stage design with landing centres, days and boat-net combinations as the successive stages of sampling. The C.M.F.R.I. which has a network of observation centres spread on the eastern and western coast of the country has been carrying out fisheries survey with a view to estimate the total

marine fish landings in India along with its variety-wise composition and also the total amount of effort put in obtaining the landings. The C.M.F.R.I. also collects information on catch per unit of effort (man hour) separately for each State. The present methodology has been evolved with expert advice from various bodies and is considered to be satisfactory.

Some of the States also build up estimates of marine fish production even though full details regarding the methodology are not available. However, the estimates of marine fish production supplied by the States are not directly used for aggregating the production on all India level. The estimates on marine fish production furnished by the States and the C.M.F.R.I. do not always reconcile with each other. However, the figures released by C.M.F.R.I. are regarded as official figures for all purposes.

INLAND FISH PRODUCTION

The collection of inland fisheries statistics is far from satisfactory. A step for developing suitable sampling techniques for inland fisheries was taken up during 1955-56 when pilot investigation was launched by the I.C.A.R. in 2 districts of the erstwhile Hyderabad State. In pursuance of the Government decision the work relating to the sample surveys for the estimation of catch of fish was transferred from the I.C.A.R. to the Directorate of National Sample Surveys (N.S.S.) in April 1956.

According to the proceedings of the Inter Departmental Meeting convened by the Central Statistical Organisation in April, 1962 the Directorate of N.S.S. was requested to undertake the work of evolving the methodology for statistics on inland fisheries on priority basis. Till now no nation-wide survey of estimation of fish production in inland waters has been undertaken. The question of evolving suitable sampling design for inland fisheries is still undecided.

The Directorate of N.S.S., however, undertook in 1962-63 pilot survey of inland fisheries in Orissa in 3 districts, *viz.*, Cuttack, Sambalpur and Mayurbhanj. The primary objective of this pilot survey in Orissa was to develop suitable sampling technique for the estimation of (i) number and area of ponds, tanks and swamps; and (ii) total catch of fish therefrom. On that basis, the Directorate of N.S.S. has brought out a draft report for the consideration of the Technical Committee on Fisheries Statistics.

The Central Inland Fisheries Research Institute, Calcutta (C.I.F.R.I.) also conducts survey for the estimation of inland fish covering mainly selected rivers, estuaries, lagoons, such as the estuarine area of the river Ganges, Chilka Lake etc. But uptill now these have been mainly conducted as research on biological problems rather than as production estimation surveys.

For want of any reliable data of production of fish from inland sources, till recently the All India estimates of inland fish production was estimated as a percentage of the marine fish production. Recently, however, the position has considerably improved as the State Directors of Fisheries are furnishing the estimates of inland fish production although without any source-wise break-up. Even though the methodology adopted by the States in regard to the compilation of these production statistics is not known, broadly the estimates are arrived at by the field agencies of the State Departments of Fisheries and are largely based on factors like lease amount, issue of licences, departmental exploitation, market arrivals, transaction of cooperative societies etc. Information on inland fishery production are nowadays compiled by the States on an uniform basis in accordance with the concepts and definitions in respect of catch, evolved by the Food and Agriculture Organisations as per the proformae prescribed by the F.A.O. There is, however, acute need, for developing sampling techniques of different types of inland waters to estimate fish production from year to year.

The various aspects of fish production statistics was considered by the Inter Departmental Meeting convened by the Central Statistical Organisation in 1962 and subsequently in 1967 by the Technical Committee on Fisheries Statistics consisting of the C.S.O., Ministry of Food and Agriculture, I.A.R.S., Planning Commission and the Directorate of N.S.S. The Technical Committee recommended that a critical review of the work done by the Central and State Agencies in respect of fish production statistics may be made for the consideration of the Committee at its next meeting.

Dissemination of production statistics. One of the major sources of data on fisheries is the report on "Fish Marketing in India" brought out by the Directorate of Marketing and Inspection, Ministry of Food and Agriculture, giving among other things information on production, consumption and utilisation of fish etc. The data on marine fish production are also published in the annual

reports of the C.M.F.R.I. and the Institute's journal "The Indian Journal of Fisheries" as well as in the publication "Indian Fisheries Bulletin" of the Department of Agriculture. The data published in these are being utilised by the Central Statistical Organisation for estimating the national income from the fisheries sector. The data on fish production are also published in other publications, such as "F.A.O. Year Book on Fisheries Statistics," "Bulletin of Food Statistics", "Indian Agriculture in Brief" of the Directorate of Economics and Statistics, Ministry of Food and Agriculture, "Statistical Pocket Book of the Indian Union" brought out by the Central Statistical Organisation etc.

OTHER FISHERIES STATISTICS

Regarding other important basic statistics pertaining to fisheries, it may be stated that very little effort has been made to compile these statistics on a systematic and a sound basis, except in the case of exports and import data and to some extent in the case by fish price data. Regarding the export and import of fish and fishery products the data are regularly collected and published by the Directorate of Commercial Intelligence and Statistics, Ministry of Commerce -- Government of India, in their monthly bulletin. Fish price data are being collected and published recently by the Directorate of Economics and Statistics, Ministry of Food and Agriculture in their monthly publication. Besides, other Central and State Agencies are also compiling some price statistics to meet their own requirements. These data are useful though they are limited in nature and purpose.

One important item on which the need for basic data is felt acutely is regarding the potential resources of production both from marine and inland sources. C.M.F.R.I. and other Agencies have made in the past some attempts in this direction in respect of the marine fish production potential in which quite a lot remains yet to be done. Regarding the fish production potential on the inland side a very broad picture about water resources in different States has been assembled and published in 1966 by the Fish Seed Committee set up in pursuance of a recommendation of the Central Board of Fisheries by the Ministry of Food and Agriculture.

In respect of other sectors, such as output of processed fish and fishery products, inter-state movement of fish, fishermen population, fisheries crafts and tackles, disposition and consumption etc., very

little data has been collected and much remains to be done for the collection of systematic and continuous data in these fields.

Conclusion

From what has been described above, the development in the field of fisheries statistics has been rather slow and the current position regarding the basic statistics is far from satisfactory. It is, therefore, very essential that the collection, coordination and improvement of fisheries statistics should be undertaken on a systematic basis as in the case of agricultural statistics so that accurate and reliable data of various aspects of the fishing industry are available regularly and continuously for the day to day administration as well as for planning and developmental purposes.

Shri R. Giri³ : *Current Status of Fisheries Statistics and Improvements Needed.*

The problems relating to improvement of fisheries statistics in India were highlighted as back as 1950 by the Committee on Co-ordination of Fisheries Statistics set up in the Ministry of Food and Agriculture. But little improvements appear to have been made in the existing fisheries statistics. Under the Five Year Plans, much emphasis has been laid on the development of fisheries and large financial provisions have been made for the purpose, but reliable data are not available for an assessment of the progress of the fisheries schemes.

The statistics of marine fish catches are at present collected by the Central Marine Fisheries Research Institute, Mandapam, through Sample surveys. The statistics collected cover total fish catch, catch of individual species, hours of absence of fishing units from the shore, number of crew in a unit, etc. The coverage of these surveys needs to be extended to other items.

The inland fisheries statistics are collected by the Central Inland Fisheries Research Institute, Barrackpore. Data are collected for the rivers of Ganges, Narbada, Tapi, Godavari and Krishna and also for Malta-Mahanadi estuaries and Chilka Lake. To arrive at the all-India estimates the scope of the work of the Institute has to be expanded to cover all rivers and canal systems. Some fisheries statistics are

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also collected by individual States, e.g., Maharashtra and Madras. West Bengal has also conducted some sample surveys to estimate fresh water fisheries and their disposal. Much needs to be done to improve their coverage and reliability. Surveys also need to be collected to estimate fish production from still waters (lakes, reservoirs, tanks, ponds, swamps and fish farms), back waters and paddy fields.

The Directorate of National Sample Survey has also conducted pilot sample survey on inland fisheries in three districts of Orissa in 1962-63. The primary objective of the survey was to develop suitable methodology for estimating fish production for each district. The survey was, however, confined to tanks, ponds and swamps only. The information on off-season catches was obtained by inquiry and that on bulk catches by actual verification. Off-season catches were found to be as important as bulk catches in two out of the 3 districts. Much of the data on catches was thus collected by inquiry affecting the reliability of the results. The data on bulk catches were collected through only one visit, whereas there might be more than one period of bulk catches during the year. The work load on investigators in the different districts was unequally distributed and the duration of inquiry in a sample village was too short to enable ascertainment of catch details from all the Units by actual verification. The stratification adopted in the survey was not found to be efficient. There are numerous other aspects of this survey which need improvement when the survey is extended to cover the entire area in a State.

In order to fill the gaps in the basic fisheries statistics required for planning fisheries development programmes and for purposes of national income estimation, the following programmes for collection of data seem necessary :

(A) *Data to be obtained by complete enumeration :*

(i) *Once in five years :*

- (a) Water resources—nature, number, area and exploitation ;
- (b) households and population engaged wholly or partially in any branch of fish industry ;
- (c) fishing crafts and tackles, and fish transport vessels ;
- (d) Number of curing yards, fish farms, ware-houses, ice plants, refrigeration and transport equipment ; and
- (e) sources of supply of spawn, fry and fingerlings.

(ii) *At shorter intervals :*

- (a) arrivals at selected markets (daily) ;
- (b) internal trade ;
- (c) output of processed fish and fish products, such as fish liver oil, fish oil, fish meal and fish manure (annual) ;
- (d) data on spawn fry, fingerling and fish collected, reared, and dispersed off by inland fish farms under Government or quasi-government management and large commercial farms (annual) ; and
- (e) landings, wholesale and retail prices of fish at selected centres of production and consumption (weekly).

(B) *Data to be obtained through periodical sample surveys :*

(i) *Once in 5 or 10 years, conducted on an intensive basis :*

- (a) extent of exploitation of different classes of fisheries ;
- (b) sources of supply of gear, yarn, nets and crafts and other materials required for fishing ;
- (c) efficiency of different fishing practices ;
- (d) efficiency of different types of craft and gear ;
- (e) marketing, storage, transport and refrigeration facilities;
- (f) economics of fish industries, manufactured fish products and by-products ;
- (g) sources of supply of finance and indebtedness of fishermen ;
- (h) consumption of fish by fishermen and non-fishermen ; and
- (i) economic and sociological conditions of population engaged in fishing and allied industries.

(ii) *Data to be obtained through continuous sample surveys :*

- (a) Catches of marine, inland and fresh water fish.

(C) *Data requiring controlled experiments and observations over a long period :*

- (a) Data on biological factors.

In view of increasing tempo of fishery development and exploitation, there is an increasing demand for fresh types of data relating

to fishery. Data on fishing crafts and tackles have been collected as a part of the Quinquennial Livestock Census conducted in 1961. The other items yet remain to be covered. In addition, a large number of administrative reports, statistical reports and progress reports are received by the Fisheries Development Adviser from the States in connection with implementation of the various Central and State fishery schemes. These reports need to be scrutinized and the progress assessed from time to time with a view to removing the bottlenecks. A special unit to initiate collection and effect improvements in the method of collection of data has been set up in the Fisheries Division of the Ministry of Food, Agriculture, Community Development and Cooperation which is concerned with day-to-day administration and execution of fishery development programmes.

This Cell may (a) organise collection of fisheries statistics as enumerated above; (b) examine the sample survey techniques followed at present from the point of adequacy of sample size, errors of estimation, availability of estimates for smaller regions; (c) guide and coordinate the activities of the States in the field of fisheries statistics; (d) coordinate the data collected by the States and other organisations; (e) publish the data on marine, inland and fresh water fisheries separately; (f) examine the progress reports on fishery development schemes indicating physical and financial progress and short-falls and (g) undertake analytical studies of the progress of the schemes.

Shri Y. R. Tripathi⁴ : *Need for basic statistical data and its proper analysis*

The importance of statistics in fisheries has been recognised for last 2 decades or so in India. During the War period the Fish Sub-Committee of Policy Committee No. 5 had emphasised the importance of fisheries statistics for post-war development. With the establishment of Central Fisheries Research Institutes the whole matter was again considered at an All India Fisheries Conference in 1948. Since then both marine and inland statistics of fish production have been collected but still there is no coordinated policy on an All India basis for all the States. The condition of marine fisheries statistics is much better than that of the inland fisheries for the obvious reason that latter is scattered over a wider area and consists of large number of smaller units where the variation is very much.

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The need of fisheries statistics is felt for—

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| (a) planning | (c) economic & |
| (b) administrative | (d) scientific work |

In the absence of detailed and correct statistics on all aspects of fishery not being available planning has been more or less on ad-hoc basis, based on pilot surveys, or information on limited items in limited fields which have been projected on a wider scale. The basic reason for these deficiencies is that the Fisheries Departments in most of the States are of recent origin. Fisheries science being a fast growing science, the persons incharge of fisheries administration have at times failed to keey pace with the latest developments. There had never been any training in statistics of the biologists who form the central core of the manpower in fisheries and hence a proper appreciation of importance and correct approach to statistics has been missing.

Statistics collected in different parts of India by different agencies are not on uniform pattern with the result that conclusions derived from one type of study on the same topic cannot be directly compared with or applied to the other part of India. It is, therefore, necessary that a uniform format for collection of data and its analysis may be devised. If the vast data for a big country like India is to be analysed on a uniform basis then it has to be done with the help of computers and in each area persons should be trained to collect and compute the data which can be fed into computers. Training of fisheries personnel for this is absolutely essential.

To increase the production of fish large sums of money are being invested in this sector and to get a proper return from it correct basic data is essential. Fisheries is also an industry where a broad base has been laid by large amount of inputs. These inputs should now be in a position to give return on the investment and at the same time increase substantially the production of fish. The investment will be one only in those sectors of fishery where the return is quick. Thus the economic aspect of the fishery assumes a very important part in the present state of affairs. Unlike agriculture where scholarly studies have been made regarding agricultural economics based on statistics, in fisheries just a beginning has been made. Fisheries economics as a science so to say is still non-existent in India and we hardly have any specialist in this field. For planning and administration fisheries economics and the ancillary part for it is essential,

The major part of the studies in statistics have been mainly confined to collection of catch data, species composition, market price and export and import both inter-State and outside India. Besides a number of surveys on water potential, socio-economic condition of fishermen, effect of cooperatives on the fish trade, etc. have also been made. But these few statistics by themselves though important have not been integrated into an organic whole because other aspects in this are missing. In fishery the gear plays the basic part which makes the fish available from water to the man on land. Hardly any statistical study with regard to efficiency of different types of gear have been made. A beginning in this regard perhaps has been made in the maritime States but definite results are not yet achieved. In fresh water area statistical studies of efficiency of gear are totally absent though such studies have no doubt been made here and there but very few have been published.

Statistical approach in fish biology studies have been made to a great extent but these are confined mainly to age and growth, length, weight, fecundity studies. But no approach has yet been made for assessment of stocks.

In inland waters even for smaller ponds no statistical parameters have yet been developed for stock assessment which can be applied by the extension workers in the field. The condition for reservoirs and rivers is still worse. Whatever assessments are made are based only on the basis of information obtained during commercial fishing taking into consideration the total intensity of fishing but no scientific studies have been made for prediction of catches. We have, therefore, to develop statistical parameters suited to Indian conditions for reservoirs and riverine fishery. This would lead to a proper development of the reservoirs and would help the administrators to understand the problems faced by the fishery scientists. Since the stock assessment for fishery has to be done under water there is generally a large probable error. Non-fishery people generally are unable to appreciate these difficulties to the fullest possible extent.

In the field of fish culture experiments should be carried out statistically which can only be done where large farm is available and the various factors can be controlled. Till the Third Five Year Plan many of the States did not have properly laid out fish farms and hence the experimental work has suffered. Now many of the States have become aware of the importance of fish farms but this awareness is only for the production of fish seed for stocking purposes. Greater

emphasis, therefore, needs to be given on practically all the cultural aspects at these farms based on statistics. There is no doubt greater awareness to use statistics more and more in the fisheries science in the various branches but these efforts appear to be uncoordinated. It may be pointed out that the statistician on his part is not a biologist and the biologist is not a statistician. It will, therefore, be necessary that statistician has to become partly a biologist and a biologist partly a statistician for proper understanding of each other's problems then only there will be a quick progress in this. Many of the personnel engaged in fishery in the field have not even a correct understanding of the need for sampling which gives the basic data for any further study. Therefore a concerted effort is required for a thorough field oriented training for the field staff and theoretical understanding of the statistical science by the fishery biologist and fishery administrators.

Shri S.K. Banerji⁵ : *Estimation of Marine Fish Production*

The need for reliable estimates of total marine fish catch hardly needs any emphasis. They are the basic data necessary for measuring the growth of the marine fishing industry. For an efficient economic policy of development, marketing and distribution, it will, however, be necessary to have a break-up of the total catch by smaller regions, by seasons and by species or varieties. Again since catch is obtained by fishing from self-renewable fish stock, it is necessary to have a rational policy of exploitation and management of different fisheries so that stocks of different fisheries are not depleted and an optimum sustainable yield from each stock is derived on a continuing basis. For the purpose of determining the optimum level of exploitation, various vital statistics like growth, fishing and natural mortality rates are necessary. This will further necessitate the break-up of the species-wise catch by type of gear, by size and by age. Thus, for various needs, we require reliable estimates of the total marine fish catch classified into various sub-divisions.

Before 1947, no reliable statistics were available for any of the items enumerated above. The earliest records of estimates of marine fish catch are provided by the "Report on the Marketing of fish in the Indian Union" 1948. The Central Statistical Organisation in a review of these statistics in National Income Statistics (1961) have stated that "these data on total landings of marine fish or marketable

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surplus of fresh fish are not based on any scientifically planned surveys but mostly on trade enquiries and similar other evidence." In fact, the Government as well as the Planning Commission were seized of the unsatisfactory position concerning fishery statistics from the very beginning. The large coast line, the diversity of fishing practices and the scattered distribution of the fishing units made the task of collection of such statistics formidable. The application of some sort of sample survey for obtaining reliable estimates of production was recognized from the very beginning. In this respects, the sample surveys carried out by the I.C.A.R. and the C.M.F.R.I. deserve special mention.

I. C. A. R. Surveys. On the recommendations of the Fish Commodity Committee of the Indian Council of Agriculture Research, the Statistical wing of the I.C.A.R. initiated a pilot enquiry on the Malabar coast in 1949. On the light of the encouraging results obtained, the scope of the enquiry was gradually extended through pilot surveys to other parts of the coast also. These were subsequently followed by extension surveys and by 1955-56, the whole coast accounted by the present States of Andhra, Madras, Kerala and Mysore was covered by the survey. In all 11 pilot and extension surveys were carried out during the period 1950-56, of which 8 were on the west coast and 3 on the east coast. The Directorate of the National Sample Survey has given an admirable account in its mimeographed publication (1958) titled "Sample Surveys for Estimation of Catch of Marine Fish 1950-56" regarding the details of these surveys.

The main purpose of the I.C.A.R. pilot and extension surveys was to evolve suitable sampling technique or techniques which would be employed in the existing field conditions in the different coastal regions for estimating marine fish catch with some degree of accuracy. Naturally, therefore, several sampling designs were employed by the I.C.A.R. in these pilot and extension surveys. The mimeographed report of the N.S.S. has presented all the details of these surveys. Though the various designs varied in details, space and time stratification was followed in all the surveys. It was observed that the overall stratification both in space and time resulted in an efficiency varying from 120 to 170 per cent in all cases except the shorescines. The stratification followed in all the surveys was with a group of contiguous landing centres. In one of the surveys, stratification of the landing centres according to previous records of catch landed in the centres was adopted but it did not improve the results. Simple

geographical stratification was found to be statistically more advantageous apart from the fact that such stratification has a natural advantage from the organizational point of view.

Different types of primary sampling units were tried out in the various surveys. In some surveys, the centre-day was taken as the primary unit, in others it was centre-group of days. The N.S.S. after studying the analysis of the various surveys has concluded that "subject to the limitations of field work, the best results would be secured with a centre-day as the primary unit. The restrictions imposed by field conditions are, however, an important consideration in the final choice."

Regarding the size of the ultimate sampling units, several sizes were tried out from small time intervals to a whole day. In case of small time intervals, one hour intervals were found to be more efficient. It was also found that systematic selection of these intervals was more efficient than a random selection of these intervals.

C.M.F.R.I. Survey. The Institute needs, in addition to various biological data, estimates of production of various species of fish in order to assess the status of the various fish stocks that are being exploited. Since no reliable statistics of fish production were available, the Institute began its own programme of collecting statistics of fish production from 1950 onwards. In the initial stages, due to lack of resources, estimates of production were obtained from selective sampling. Bal and Banerji (1951) have given a description of this selective sampling. Essentially, the design was as follows. The whole coast line of India was divided into several zones, and in each zone one field staff was posted. In each zone, a number of representative centres were selected and these were visited in a systematic fashion twice a month. The number of boats landed and the catch of a sub-sample of the boats were noted for each day of visit. From these, monthly estimates of catch of these centres were estimated. The zonal estimates were made from these by ratio estimates based on the knowledge of the total number of boats in the zone and those in the selected centres in the zone. In the course of this survey, a complete list of landing centres with their inventories of fishing boats, fishermen population was also prepared on a complete enumeration basis and the same was made upto date from time to time. As more field staff were made available to the Institute, full scale random survey was introduced from 1959 for the entire coast line of India for the purpose of estimation of marine fish production. As fishing

practices and the communication facilities between fishing centres vary from region to region, the sampling designs employed vary to some extent from region to region. All these designs are similar to the one or the other that were tried by the I.C.A.R. in their pilot surveys. They involve space time stratification. A number of geographically contiguous landing centres form the stratum in space. The time stratum is a 10 day's period. On the west coast, excepting in Kerala, 3 centres are selected at random during the period of 10 days and 2 days are devoted to each centre. On the first day, the afternoon is devoted to field work for counting the number of fishing units landing catch and a sub-sample of the units selected systematically are examined in details for catch and other ancilliary informations like gear used, manpower, time engaged in fishing etc. On the second day, the forenoon is devoted to similar work. Night catches are obtained by enquiry on the day the field work is done in the forenoon. The primary unit of sampling is thus a centre-day. In Kerala, 3 centres are selected at random as before during the 10 day period. But unlike in other States mentioned above, on the first day two systematically selected periods of 3 hours are selected for field work and on the second day the rest of the 3 hour periods are selected. Night catches are obtained by enquiry on each day. The primary unit of sampling in this case becomes centre-group of two days. On the east coast, the design is essentially the same as in Kerala excepting that field work is carried out for the entire period of fishing each day. Provision of a day is made for journey from one centre to the other.

For the purpose of estimation, three 10 day periods are clubbed together and monthly estimates are obtained. The method of estimation consists in first obtaining the centre-day (or centre-group days) estimates of catch and then multiplying the average by the number of centre-days (or centre group days) in the space time stratum. The error of estimate is calculated from the estimates of primary units. The error of estimate for the country as a whole for a whole year lies between 4-5% but errors for State estimates or seasonal estimates are high. Similarly, the errors for variety-estimates are also high. These results are similar to the ones obtained from the I.C.A.R. pilot and extension surveys.

In addition to the collection of catch statistics, the sample survey of C.M.F.R.I. includes a provision of length measurement of some of the commercially important species from a sub-sample, so as to obtain estimates of size and age composition of the commercially important fishes.

The variety-wise estimates of fish landings for each State are published annually in the Indian Journal of Fisheries. The Statistical Abstract of India publishes data on fish catch and landings, but as regards marine fish landings the data are supplied by the C.M.F.R.I. The primary source of data on marine fish landings of India published in the F.A.O. Statistical Year book happens again to be C.M.F.R.I.

Other Estimates of Fish Productions : The Fisheries department of Madras State through the agencies of their Fish Curing Yards regularly maintains comprehensive accounts and statistics of species-wise daily catches of fish at landing centres lying within the jurisdiction of these yards. Similarly, chank fishery in the Gulf of Mannar being a government monopoly, sufficiently reliable data regarding chanks fished are available with the State-Fisheries Department. These data are published in *ad hoc* publications of the Madras Fisheries Department.

Apart from these, the State Statistical Bureau of the Madras Government is estimating production of marine fish in the State from 1958-59. In the initial few years, their estimates were very much lower than those obtained by the C.M.F.R.I. but from 1964-65 their estimates do not differ significantly from the C.M.F.R.I. estimates. It is understood that the earlier estimates of State Statistical Bureau do not include the landings by mechanized boats as also the night landings but even accounting for them, their estimates for earlier years are very much on the lower side.

In Maharashtra, the Fisheries Department, is carrying out sample survey from 1959-60 for the estimation of marine fish production but details for such survey and the results obtained from these surveys have not been published. The Bureau of Statistics and Economics in Gujarat with the help of the Fisheries Department of the State is also supposed to be estimating fish production by sampling method from 1960-61. The Fisheries Departments of other States also build up their own estimates of marine catch by non-sampling methods.

Discussion. Considering the diffused nature of marine fishing practices, sample survey is probably the only reliable method by which reliable estimates of marine fish catch can be obtained. The pilot surveys and the extension surveys carried out by the I.C.A.R. along different regions of the coast line between 1950 and 1956 have successfully demonstrated the feasibility of employing suitable sampling technique for the estimation of marine fish production. These surveys also helped to arrive at some broad conclusions regarding the type

of stratification to be followed and the size of the sampling units at various stages and their relative intensity of sampling. The C.M.F.R.I sample survey covering the entire coast line for several years also confirm the suitability of sampling method in arriving at estimates of marine fish catch. Both surveys show that the annual estimate for the country as a whole can be obtained with a reasonably small error of 4-5%, though the State estimates and the variety estimates will be associated with a still larger error. The most important thing that need be stressed is that a machinery for carrying out a sample survey on a continuing basis over the whole country has been developed under the auspices of the C.M.F.R.I. A sample survey is theoretically very simple but its employment to field conditions and its successful execution depend to a great extent on the organization employing it. In any case, great strides have been made since 1949 towards the collection of statistics of fish production. Attempt should be made to further improve the accuracy of the estimates. This can be done in 2 ways. The easiest way to increase the accuracy is by increasing the size of the primary sampling units. From the practical standpoint of a sample survey this can be done by increasing the number of space strata in a State. This will however increase the cost of the survey, even though smaller space strata will mean less travel expenditure per individual field staff. The other method will need some basic research in improving the sampling design.

In this connection, the following points need special mention. A large number of small and medium mechanized boats have been introduced for marine fishing during the last two years. Since they are operated from certain important ports in a State, the present sample survey method may not be suitable to cover their catch. Either, their catch should be obtained on a complete enumeration basis or again a separate sampling scheme to cover up these boats is necessary. The motorized boats of Maharashtra and Gujarat which operate from usual landing centres, however, continue to be covered by the present sample survey. Secondly, some discrete but localized fisheries, e g., mussel fisheries, chank fisheries etc, cannot be properly covered by the present sample survey. Here the State Fisheries Departments can help a great deal by collecting the production statistics of these isolated fisheries either on a complete enumeration basis or again on a sample basis. The data collected by them can be passed on to the Central agency responsible for compiling the all India figure.

Nothing has been mentioned so far about non-sampling errors. These errors can be minimised or eliminated to a great extent by well

planned training programme for the field staff, and by frequent regular and surprise inspection of the staff in the field.

V.G. Jhingran⁶ and Shri P. Datta⁷ : *The inland fisheries resources of India*

The fishery resource of a country like India having a long sea-coast as well as considerable inland water areas, naturally falls into 2 main divisions viz. inland and marine. While there are many other countries with a highly developed marine fisheries or possibilities for the same, India is potentially one of the richest countries in inland fisheries resource as well.

Inland fisheries can be divided into 2 broad sub-divisions ; Freshwater and brackishwater (*i.e.*, saltish water) fisheries. There is, however, yet another important way of sub-dividing them and that is into capture and culture fisheries depending upon the mode of operation and management. In capture fisheries comprising the fisheries of rivers, estuaries, large lakes and similar other water bodies, the role of the human agency is limited only to capturing fish or utmost to regulating the mode of capture to achieve some desired objectives. In culture fisheries which are provided by the impounded waters of tanks, ponds, embanked brackishwaters and to some extent by reservoirs also, the role of the human agency extends beyond merely capturing fish to undertaking various positive measures for culture effecting definite increase in production. In other words in capture fisheries human beings only reap the aquatic harvest without having to sow and in culture they have to tend and nurse before reaping.

Freshwater fisheries exist in the rivers, canals and irrigational channels, large freshwater lakes, numerous small lakes, beels, jheels, reservoirs, ponds and tanks. Of these, the reservoirs, ponds and tanks are important chiefly as culture fisheries. The capture fisheries in freshwater are mainly in the rivers with network of canals and irrigation channels, in the freshwater lakes, beels etc. It has been estimated that the length of principal rivers in India along with tributaries is about 27,360 km. The Ganga, the Indus, the Brahmaputra, the Mahanađi, the Narbada and the Tapti river systems in North and

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Central India and the Godavari, the Krishna and the Kaveri river systems in Peninsular India may be specially mentioned in addition to the numerous other streams and rivers of medium and smaller lengths throughout the country. Canals and irrigational channels also cover an additional about 1,12,650 km. Amongst important freshwater lakes may be mentioned the Collair lake (25,382 hectares, Andhra Pradesh), the Loktak lake (52,836 hectares, Manipur), the Wular (Kashmir), and the mountain lakes in the Tal area. The contribution to production from the numerous beels, jheels and other small lake-like water-bodies is also significant particularly in eastern India. The main freshwater species of fish found in India are the following :

| <i>Groups</i> | <i>Representing species</i> |
|-------------------------|--|
| 1. Major carps | <i>Catla</i> , <i>catla</i> , <i>Labeo rohita</i> , <i>L. calbasu</i> , <i>L. fimbriatus</i> , <i>Cirrhinus mrigala</i> , <i>Tor</i> and <i>Puntius</i> spp. |
| 2. Catfishes | <i>Bagarius bagarius</i> , <i>Pangasius pangasius</i> , <i>Silonia silondia</i> , <i>Mystus seenghala</i> , <i>M. aor</i> and <i>Eutropiichthys vacha</i> , <i>Rita rita</i> . |
| 3. Sheat fishes | <i>Wallago attu</i> and <i>Ompok bimakulatus</i> |
| 4. Live fishes | <i>Clarias batrachus</i> , <i>Heteropneustes fossilis</i> , <i>Anabas testudineus</i> , <i>Channa striatus</i> , <i>C. gachua</i> and <i>C. Punctatus</i> . |
| 5. Mulletts | <i>Mugil (Liza) corsula</i> and <i>M. cascasia</i> . |
| 6. Featherbacks | <i>Notopterus chitala</i> and <i>N. notopterus</i> . |
| 7. Herrings & anchovies | <i>Hilsa ilisha</i> and <i>Setipina phasa</i> . |
| 8. Eels | <i>Anguilla bengalensis</i> , <i>Mastacembalus armatus</i> . |
| 9. Miscellaneous | <i>Cirrhinus reba</i> , <i>Labeo bata</i> , <i>Chela</i> spp., <i>Baralius</i> spp., <i>Nandus</i> , <i>natus</i> <i>Etroplys</i> spp. |
| 10. Prawns | <i>Macrobrachium rosenbergii</i> . |

Of the above groups, the most important contributors are the major carps and the cat-fishes, followed by 'live' fishes, prawns, featherbacks and mullets. The approximate percentages commanded by

marketed surplus of the above groups among total freshwater fish marketed are as follows :

| Major carps | Cat-fishes | Live fishes | Prawns | Feather-backs | Mulletts |
|-------------|------------|-------------|--------|---------------|----------|
| 37.0% | 34.0% | 10.0% | 6.5% | 4.8% | 4.4% |

Capture.—Fisheries in brackishwater : The brackishwater or estuarine fisheries comprise the fishreies in (i) typical estuaries of river-mouths, (ii) brackishwater lakes and (iii) back-waters in addition to those of numerous lagoons and swamps lying along the coastline. In the first category we have the extensive estuaries of the Ganga, the Mahanadi, the Godavari and other important rivers, discharging into the sea. The brackishwater lakes : Chilka (Orissa) and Pulicat (Madras) and the backwaters in Travancore-Cochin in Kerala represent the second and third categories of water bodies respectively. The brackishwaters are particularly rich in fish-resource and harbour a number of economic species. The vast majority of fishes in brackish-water are marine species with sufficient tolerance for salinity variations. The groups of important estuarine species are listed below :

- | | |
|--------------|--|
| 1. Clupeoids | <i>Hilsa ilisha</i> |
| 2. Anchovies | <i>Anchoviella, Thrissoles, Nematalosa</i> and <i>Setipinna</i> species. |
| 3. Mulletts | <i>Mugil (Liza) corsula, Mugil cephalus</i> <i>Mugil parsia.</i> |
| 4. Catfishes | <i>Tachysurus, Osteogeniosus, Pangasius</i> and <i>Mystus</i> spp. |
| 5. Perches | <i>Lates calcarifer</i> and <i>Etroplus suratensis</i> . (Also <i>Epinephelus tauvina, Etroplus maculatus</i> and spp. belonging to the genera <i>Lutianus, Ambassis, Therapon</i> and <i>Otolithes</i>). |
| 6. Prawns | Penaeid prawns of the genera <i>Penaeus</i> and <i>Metapenaeus</i> and species of the Palaemonid genus <i>Leander</i> . |
| 7. Crabs | <i>Scylla serrata</i> and <i>Neptunus</i> spp. |

Bombay-duck which contributes highly to the marine fish catches of India forms a major fishery in the estuarine waters of

West Bengal. *Hilsa ilisha* is regarded as one of the most esteemed food fish ; perches, prawns and mullets are also highly valued.

Culture—Fisheries in brackishwater : The estuarine waters mentioned in the foregoing constitute the so-called "open estuaries" which have perennial or at least seasonal connection with the sea. For fish-culture in brackishwaters, utilisation is made of the embanked brackishwaters or confined estuarine waters. Although not comparable to the more-developed and organised fisheries of their type found in Indonesia or the Philippines, brackishwater culture fisheries in India are none the less of special importance both as to their present status as well as potentialities. The cultivable saline water resource of the country is estimated to be about 0.5 million hectares, Though this entire area may not be suitable for fish-culture, a good part out of it can be converted into productive salt-water fish farms to obtain substantial contributions to total production. At present utilisation of embanked brackishwaters for fish-culture is made mainly in West Bengal and Kerala—in the former in the reclaimed areas of the gangetic delta and in the latter in the areas adjacent to the backwaters.

The bhasa-bandha fisheries or *bheris* in the gangetic delta of West Bengal are formed in the following manner. Due to continuous silting, beds of many rivers and creeks in estuarine areas get gradually elevated and give rise to new lands which are ultimately reclaimed for agricultural purposes by constructing bunds to keep off flood water. In the shallows adjacent to such bunds fish are cultured by providing another outer bund to form an impoundment. Natural stocking takes place when water is let in at high tides through improvised sluice-arrangements. Split-bamboo screens which are specially set allow fish to go in with tide water but prevent their escape when water recedes. Usually, no selection of desirable species or weeding of trash fishes is done. The economic species cultured and produced in such bheris are mullets, prawns, perches, thread-fins etc. Stocking is usually done in monsoon and harvesting in winter. The bheris may be seasonal or perennial depending on whether they are shallow and dry up (or are dewatered) in summer or retain water all the year round. In the latter case fish grow to a large size. Although not well organised, such fisheries also exist in the South-East coast of India where saline lagoons get inundated in monsoon and establish temporary connections with the sea allowing large numbers of fish fry to enter these areas. Such water bodies are subsequently subjected to exploitation.

Embanked brackishwater fisheries of the Malabar Coast are slightly different from the above in that low-lying paddy fields adjacent to backwaters are utilised after harvest for fish culture. Cultivation in these fields is restricted to a single crop from July to September due to high salinity of the adjoining water at other times when these are utilised for pisciculture. Natural stocking, mainly of penaeid prawns is obtained through an analogous process as that used for bheris in West Bengal by regulating influx of tidal water from the backwaters. About 80% of the harvest which starts from December, consists of prawns while the rest comprises mullets, pearlspot and orange chromides etc. Culture of mullets in embanked brackishwaters has also been attempted to some extent in Malabar Coast. The farms at Narakkal and Airamthengu may be mentioned in this connection. In these farms adjoining backwaters, stocking is done similarly as above by regulating tidal inflow through sluice gates in monsoon months. However, this is supplemented by directly introducing additional numbers of fish in the impoundments collected by netting. Besides mullets, pearlspots, milk-fish, thread-fins and prawns are also produced.

Fish culture in fresh-water : Fish cultured in ponds and tanks contribute substantially to the production of freshwater fish especially in Bengal, Bihar and Orissa and their production is also appreciable in some of the southern states. Fish-culture in specially laid out fish farms has emerged in India in the last few decades. A large number of such farms have come up in north and peninsular India. The total area of cultivable waters in India is about 1,640,000 hectares. Of these 1,003,000 hectares are readily available for culture and 637,000 hectares can be made available through reclamation. Of the area readily available, however, only 615,000 hectares are at present actually utilized for culture. The yield from a cultured pond varies from about 800 to 2000 kg./ha. per annum. Fisheries research conducted in the recent past has clearly shown that the cultural practices can be improved in a variety of ways to obtain much higher yields, mortalities can be diminished markedly and pure spawn can be obtained through the process of induced breeding.

For stocking in ponds freshwater species with rapid growth and non-predaceous habits are generally selected. Besides, some species which breed in confined waters, selected exotic fishes and a few brackishwater species which can stand freshwater are also cultured in ponds. Certain species of murels are cultured especially in Peninsular India. The following are the species usually stocked in the ponds :

| <i>Common name</i> | <i>Scientific name</i> |
|-----------------------|---|
| 1. Catla | <i>Catla catla</i> |
| 2. Rohu | <i>Labeo rohita</i> |
| 3. Fringe-lipped carp | <i>Labeo fimbriatus</i> |
| 4. Black carp | <i>Labeo calbasu</i> |
| 5. Karimuli | <i>Labeo contius</i> |
| 6. Bata | <i>Labeo bata</i> |
| 7. Mrigal | <i>Cirrhinus mrigala</i> |
| 8. White carp | <i>Cirrhinus cirrhosa</i> |
| 9. Reba | <i>Cirrhinus reba</i> |
| 10. Carnatic carp | <i>Barbus carnaticus</i> |
| 11. European carp | <i>Cyprinus carpio</i> |
| 12. Pearlsport | <i>Etroplus suratensis</i> |
| 13. Gouramy | <i>Osphronemus goramy</i> |
| 14. Milk fish | <i>Chanos chanos</i> |
| 15. Grey Mulletts | <i>Mugil cephalus</i> |
| 16. Murrel | (i) <i>Channa marulius</i> (ii) <i>Channa striatus</i> |

In the recent past a few exotic species of Chinese carps have been introduced in Indian pond culture.

Paddy-cum-fish culture : Culture of fish in water held by paddy fields is practiced in the deltaic areas of West Bengal. In the lower areas of the delta natural stocking through flood-tide water takes place, and euryhaline species like mullets, prawns etc. are cultured. In the upper areas, the water held in the field is almost fresh and carps are stocked. Harvesting is done by draining out the fields suitably so that the fish can collect into catching pools or channels from where they are caught.

Fisheries in reservoirs : River-valley projects undertaken in the country after independence have given rise to a multitude of storage reservoirs formed by putting dams across streams. Because of the contained nature of the waters, these offer a large field for fishery development with high production potentialities. The total area of reservoirs in India including the larger freshwater lakes is about 1.2 million hectares. The areas of some of the larger reservoirs of the country are given in Appendix. Fisheries of reservoirs stand in nature intermediate between capture and culture fisheries. Although

control to the extent possible in ponds is not possible here increased production and general improvement of the fishery can still be achieved through a judicious programme of stocking and management including controlled fishing. For facility in stocking, nursery and rearing farms have been constructed close to several reservoirs. Fry are released in the reservoir after being reared in these farms to an advanced size which ensures better survival. Economic species of carps like Catla, Rohu and Mrigal although not ordinarily breeding in confined waters are often found to spawn either in the tail end or in the marginal shallows of a reservoir. Stocking may not therefore be necessary after the first few years by which time the fish will have established themselves and the reservoir has become self-sustaining.

Creation of storage-reservoirs by erection of dams, while offering a new fishery resource with great potentialities, may however cause appreciable disturbance to the fisheries of migratory species particularly when they are abundant in the parent river. A notable example is the fishery of the highly-valued Hilsa the upstream migration of which has been adversely affected by constructions of dams or anicuts and by the consequent reduction in run-offs, in all the estuarine rivers of India.

From what has been presented in the preceding pages it will be clear that the inland fisheries resources of India are vast and varied. In fact in their diversity they are much more complex compared to the marine fisheries. Their richness in variety while offering great potentialities for development, has also posed difficult problems for estimation of their extent and productivity due to their highly diffused nature. As it stands at present there is no reliable statistics in India of total inland production of fish. The only estimate that is available is provided by the periodic 'Report on the Marketing of Fish' which refers to marketed surplus only. Some confusion is also created due to lack of proper delimitation of estuarine and backwater fisheries to distinguish them from marine fisheries. In the absence of a reliable statistics of fish production the position existing at any point of time or the needs for the future cannot be properly assessed. Nor it is possible to correctly evaluate the success of different developmental programmes. Besides, scientific studies on population dynamics and fishery biology of commercially important species are greatly hampered due to lack of relevant statistics of production and effort. Accurate statistics of production from fisheries of different categories and their extent are thus an

urgent necessity and ways and means to collect them have to be evolved without further delay. There are a number of difficulties that are to be faced. While some of these are peculiar to culture fisheries and others characteristic of capture fisheries, a number of problems are common to both.

For culture fisheries and generally for fisheries of cultivable waters, which cover the major portion of still waters, an estimate of potentialities in the form of available water area of different categories is a pre-requisite. A total enumeration for this on village-wise basis is not impossible on account of the constancy of the quantities involved over fairly broad spans of time. Also, once completed only small-scale revisions from time to time will be necessary to keep it up-to-date. For this purpose ponds and tanks are to be properly defined, distinctions have to be drawn between seasonal and perennial ponds, between cultured and non-cultured ponds, and between ponds falling under different size-categories; minimum acceptable area and depth are to be fixed to exclude those irregular water bodies which are numerous without any appreciable contribution. Estimation of production from culture fishery waters is however a difficult problem. The main difficulty arises due to the fact that the produce should be covered at the source, *i.e.*, as and when the catches are made as otherwise the catch that is landed is subject to removals in several ways as time goes on. For this reason even when markets of convergence exist they often indicate only the balance part of total catch. Each individual producer may retain a quantity for subsistence, some quantity may be hawked out on the way to markets and the number of diminutive markets which may not be recognisable is also fairly large. Direct observations of the catch of every pond in view of their scattered nature will again necessitate too many enumerators. This difficulty can be overcome by adopting a suitable sampling procedure with due stratification so that yield-rates for different categories of water-bodies within a stratum are determined by keeping under close observation selected waters under the category. Because of the sporadic nature of fishing part of the data will still have to be based on enquiry.

In capture fisheries of large lakes, beels, jheels and rivers, usually unrestricted fishing goes on and in case of rivers, particularly, there is the additional problem introduced by numerous landing points. The scattered nature of fishing and landings, both in time and space, absence of common points of assemblage for the produce

and its absorption in various ways before reaching markets stand in the way of estimation of production here also. A procedure of sampling that has proved to be effective in many situations is that based on the relation between actual catch and effort potentialities present in a region. This requires a total enumeration of effort potentialities in the form of craft, tackle and fishermen population in the entire region as a prerequisite. Even so, one is confronted with serious difficulties owing to the multiplicity of gears in use involving both inter and intra-type variations which in addition create an extremely knotty problem as regards the estimation of total effort. The point is important for capture fisheries as production and effort expended are both to be considered to judge the productivity of such fisheries. Last but not least, the illiteracy and social backwardness of the fishermen community stand to a great extent in the way of eliciting statistical information from them and often lead them to cherish various suspicions and doubts about the object of an interrogation on catch, implements, income etc. and they may not cooperate unless cleverly tackled. Some sort of legal obligation, it is felt, should be there on the part of the fishermen, fishery-owners and fish-dealers to supply information to official staff. This condition may also be imposed through registration and granting of licences concerning fishing implements, fishing rights, fish-farms and fish-trading. All these indicate that collection of necessary statistical data from inland fisheries is a task beset with considerable difficulties. However, even admitting all these problems it has to be said that they are not insurmountable. Given the necessary funds, man-power and, above all, the attention that it deserves a solution can certainly be obtained.

APPENDIX

Areas of reservoirs and fresh water lakes of India
(with area 5000 hectares or above)

| <i>Name of reservoir/lake</i> | <i>Area in hectares</i> |
|-------------------------------|-------------------------|
| Andhra Pradesh | |
| 1. Nagarjuna sagar | 30303 |
| 2. Nizamsagar | 14636 |
| 3. Collair L. | 25382 |
| 4. Maner | 5100 |
| 5. Pochampad | 45325 |
| 6. Vamasamudram | 8547 |
| Assam and Manipur | |
| 7. Loktak L. | 52836 |
| Bihar | |
| 8. Panchet | 7511 |
| 9. Maithon | 11492 |
| 10. Tilaiya | 6475 |
| 11. Mayurakshi | 6734 |
| Gujarat | |
| 12. Shetrungi | 6864 |
| 13. Ukai | 51282 |
| 14. Mahi stage II (Kadawa) | 16576 |
| 15. Dantiwada (Dawas) | 8029 |
| Jammu and Kashmir | |
| 16. Wular L. | |
| 17. Anchar L. | |
| 18. Dal L. | N.A. |
| 19. Mansbal L. | |
| Kerala | |
| 20. Neyyar | 9065 |
| Madhya Pradesh | |
| 21. Dadhawa | 5654 |
| 22. Tawa | 29534 |
| 23. Barodia | 6879 |
| 24. Gandhisagar | 64750 |

Name of reservoir/lake *Area in hectares*

Madras

| | |
|------------------|-------|
| 25. Bhavanisagar | 7862 |
| 26. Mettur | 15346 |

Maharashtra

| | |
|-----------------|-------|
| 27. Sivajisagar | 12100 |
| 28. Vijjani | 29319 |
| 29. Koyna | 5439 |
| 30. Warwa | 8871 |
| 31. Yeldari | 10684 |
| 32. Kangsabati | 11655 |

Mysore

| | |
|----------------------|-------|
| 33. Tungabhadra | 37814 |
| 34. Vanivilassagar | 7252 |
| 35. Bhadra | 7770 |
| 36. Linganamakki | 38850 |
| 37. Krishnarajasagar | 12924 |
| 38. Malaprabha | 10360 |
| 39. Hidakal | 7770 |
| 40. Narayanpur | 15540 |

Orissa

| | |
|-------------|-------|
| 41. Hirakud | 74592 |
|-------------|-------|

Punjab

| | |
|------------|-------|
| 42. Beas | 26418 |
| 43. Bhakra | 16839 |

Rajasthan

| | |
|----------------|-------|
| 44. Jayasamand | 7252 |
| 45. Bajajsagar | 12950 |
| 46. Ranapratap | 20720 |

Uttar Pradesh

| | |
|----------------|-------|
| 47. Sardasagar | 7304 |
| 48. Matatila | 20720 |
| 49. Rihand | 46620 |
| 50. Ramganga | 8578 |

West Bengal

| | |
|----------------|-------|
| 51. Canada Dam | 9292 |
| 52. Kongsabati | 11396 |

Shri J.M. Sen Gupta⁸ and Shri Paul Jacob⁹ : *Fishery statistics of India with special reference to estimation of Inland fish catch*

Introduction. India has vast resources of marine and Inland fishery employing a large number of people in exploitation of fish as their main occupation. As a matter of fact, fish in its various forms constitute a very important item of our national diet. But it is well known that there is no reliable statistics available at present specially in respect of Inland fisheries. In recent years, estimates of exploited marine fish are obtained on the basis of sample surveys by the Central Marine Fisheries Research Station, Mandapam. As regards the Inland fisheries, there has been no objective methods adopted so far to obtain relevant statistics. The total marketable surplus of fresh water fish was estimated as 41.3 lakhs of maunds in the year 1948 (Report on the marketing of fish in the Indian Union). This estimate was based on information supplied by local officers, the trades and municipalities. Some ad hoc estimates of Inland fish production are being furnished at present by the States (Report on the pilot survey of Inland Fisheries, Orissa 1962-63). According to the 1948 estimates marketable surplus in W. Bengal was of the order of 12 lakhs of maunds with 10 lakhs in Bihar, 7 lakhs in Assam and 4 lakhs in Orissa respectively.

The inadequacy of fishery statistics was realised as early as 1943 and was pointed out many times since then. This was considered in some detail by the all India Fishery Conference held in 1948. A sub-committee appointed by the conference, submitted a programme of work which the conference recommended as follows :

“It should be given effect to by stages because of the practical difficulties involved and that an expert committee should be appointed at technical level to work out the detailed proposals.”

In pursuance of the recommendation of the conference a technical committee was constituted by the Government of India in the Ministry of Agriculture. This committee in its report in 1950 recommended the following integrated plan for the collection of fisheries statistics.*

A. Data to be obtained by a complete (or partial) enumeration :

(i) *Once in five years :*

(a) water resources—nature, number, area, and exploitation,

8 & 9. Indian Statistical Institute, Calcutta.

* Source : Coordination of Fisheries Statistics (Ministry of Food & Agriculture—March 1950).

- (b) families and population engaged wholly and partly in any branch of fish industry,
- (c) fishing craft and tackle, and fish transport vessels,
- (d) number of curing yards, fish farms, ware-houses, ice plants, refrigeration and transport equipment, and
- (e) sources of supply of spawn, fry, fingerlings.

(ii) *At shorter intervals :*

- (a) arrivals at selected markets (daily),
- (b) internal trade;
- (c) processed fish and fish products, such as fish liver oil, fish oil, fish meal and fish manure, (annual),
- (d) data on spawn, fry, fingerling and fish collected, reared and disposed of inland fish farms under Government or quasi-Government management and large commercial farms (annual), and
- (e) landing, wholesale and retail prices, of fish at selected centres of production and consumption, (weekly).

B. Data to be obtained through periodical sample surveys :

(i) *Once in 5 or 10 years, conducted on an intensive basis :*

- (a) extent of exploitation of different classes of fisheries,
- (b) sources of supply of gear, yarn, nets, and crafts, and other materials required for fishing,
- (c) efficiency of different fishing practices,
- (d) efficiency of different types of craft and gear,
- (e) marketing, storage, transport and refrigeration,
- (f) the economics of fish industries, manufactured fish products and by-products,
- (g) sources of supply of finance and volume of indebtedness of fishermen,
- (h) consumption of fish by fishermen and confishermen, and
- (i) economic and sociological conditions of population engaged in fishing and related industries.

(ii) *Continuous sample surveys :*

- (a) catches of inland and marine fish.

C. Data requiring controlled experiments and observation over a long period of time :

- (i) Data on biological factors.

It is obvious that no statistics is being collected as per above scheme except some regarding items in A(ii), B(ii), and (C). As regards B(ii) the Committee pointed out :

"The difficulties in the collection of primary statistics of landings are well-known. A complete enumeration of all the daily catches of an individual fisherman is obviously impossible but even the application of the sampling method is beset with difficulties because of the various types and practices of fishing and the uneven and scattered nature of the distribution of the industry."

It has already been mentioned that a pilot survey with the object of estimating marine fish catches, is being undertaken on the Malabar Coast under the auspices of the I.C.A.R. The technique of sampling adopted for this survey, with the boat as the sampling unit, may not be suitable for inland fisheries. It is necessary to evolve special sampling techniques for the estimation of catches of inland fisheries and pilot scheme with this object should be organized immediately. Such a pilot survey may be carried out in the State of West Bengal in view of its prominent position in the inland fisheries of India. This survey may be carried out through an organization which has previous experience in handling problems of a similar nature and has sufficient acquaintance with the local conditions, such as the Indian Statistical Institute at Calcutta.

As soon as the appropriate techniques are developed the surveys should be extended to other States and statistics of production should be obtained for the country as a whole with convenient break-ups at regional levels."

The I.C.A.R. was already carrying out pilot surveys with the object of estimating marine fish catches and since then developed necessary sampling techniques. Regular sample surveys are now being carried out in the coastal belt of villages to estimate the marine fish production. But no such schemes regarding Inland fisheries have been undertaken excepting some isolated attempts for evolving suitable sampling techniques by the Indian Statistical Institute (I.S.I.) in West Bengal during 1960-1961 and the Agricultural Statistics Division of the Directorate of National Sample Survey (N.S.S.) in Orissa during 1962-63.

This paper briefly discusses the broad results obtained from the above studies carried out by I.S.I. and N.S.S. It also suggests certain lines of approach based on experiences already obtained and on a-priori grounds, for obtaining statistics on Inland fish production.

Pilot studies on fish catch in Inland waters : As already referred, only two pilot studies are known to have so far been carried out for the estimation of fish catch in inland waters, namely, (i) [the try out

experiments of West Bengal in 1960-61 and (ii) the pilot studies of Orissa in 1962-63. A brief account of the special features of these studies along with some broad results have been furnished in the Appendices A/1 and A/2. We shall here discuss the merits of these investigations and draw the lessons they have to offer.

The West Bengal studies have given us some acquaintance with the field problems. The sample was seriously disturbed and no estimation has been attempted on it. The results obtained are merely some broad indications of the variability of the character under study in different stages of sampling. The Orissa surveys were on the other hand successfully carried out and have thrown up some estimates however tentative, and on the whole give a better perspective on the total problem. Our observations will therefore dwell mainly on the Orissa experiments.

Physical limitations to an investigation of fish catch on the spot.

In the Orissa Scheme, an individual investigator must have found his work difficult to manage, especially in view of the extensive area that he was expected to cover. Attending the bulk catches on a scheduled date would have been physically impossible, if several of them took place simultaneously (not unusual at the proper season). It is true that the average number of water-units worked out to be only six per village in Orissa, the same for West Bengal being much higher. Thus, even if the scheme has been feasible in Orissa, it can hardly be adopted for some of the States like, West Bengal, Kerala etc.

As a matter of fact, a lot of catches must have been missed altogether, as is evident from an abrupt lowering (of the order of 50%) in the estimates of 1962-63 against that of 1961-62, the latter being based on interviews. In fact, doubt has been expressed about the completeness of catch data for 1962-63 in the report itself. It has also been suspected that owners/operators might have postponed their catches in order to evade the investigation. On the other hand, they might as well have taken a catch without the knowledge of the investigator. The personal presence of the investigator on the spot thus ensures at best an accuracy in those units as were successfully attended, while whole units may have been missed altogether, leaving us wiser in the matter of pennies alone. Quality of data collected through an interview method may not thus be necessarily worse than a so-called objective spot enumeration, not fully under one's control. On the other hand, if we presume that owners would have a tendency to suppress rather than exaggerate the quantity of catches and

consider that there would be some lapses in recall, the 1961-62 figure itself is likely to have been an underestimate, in which case the fall in 1962-63 compared to 1961-62, would be much more than 50%.

It is here emphasised, that errors of ascertainment at the unit level is a greater danger than the incidence of large sampling errors, the latter being amenable to control by a proper designing of the survey. All these point out to the need of making the investigators' total coverage relatively small, so that he is in a position to revisit each village at reasonably short intervals. An unreasonable load may tend to make the investigator desperate and casual in his work, passing on data collected through personal enquiries as one based on actual observation on the spot.

The Orissa enquiry was confined to ponds, tanks and swamps only, while rivers and streams forming estuaries have been left out as relatively un-important. So far as West Bengal is concerned, rivers, beels and large tracts flooded by rivers in spate during the monsoon months, are known to have considerable contribution towards total catch. Any survey in West Bengal would have to cover these sources as well, which will bring up a lot of difficult problems.

The Concept of Area Under Water. The concept of effective water surface as the unit of reference adopted in the Orissa studies, seems to be completely un-realistic, in as much as :—

- (i) its determination must be highly subjective and grossly inaccurate
- (ii) it introduces an additional and large element of error in the estimation of water area and hence in the estimated outturn.

It may be presumed that the investigator on reaching the selected tank, takes a measure of the water surface as he finds on that day, enquires about the maximum and minimum levels that the water reaches and then makes an approximate guess of the surface area that would be assumed at each stage (unless he happens to be present at one of them). Mean of the maximum and minimum which was accepted as the average measure of water area is, however, likely to be overestimated, as the high level is usually maintained for only a short spell and quickly falls at first, slowing down gradually.

For purposes of estimation, it should be enough and certainly more practical to go by the firmer concept of gross geographical area bounded by raised banks where they exist or by the periphery of the catchment area, as can be fairly recognised and thus amenable to

verification by another observer. Most of the tanks are cadastral survey plots identifiable and shown on the maps. It does not matter if catch-yield is made to refer to a gross area, all of which may not be under water at the time or at any time, and no attempt is made to ascertain the yield-rate per unit of net water area. A firmer basis of reference will more than offset the doubtful prospects of reducing variability, which an effective unit of area as the basis of reference may apparently offer.

Errors of Estimation. Total catch in Orissa was estimated by a double sampling procedure, in which the independent character, namely the area under water was estimated by a stratified two stage sampling. A smaller sub-sample was employed for the estimation of catch yield per unit/per acre. The computation of sampling errors would necessarily be subject to a number of theoretical assumptions, a good many of which may or may not have been satisfied. The safest and best procedure would be to split up the total sample into several subsamples of independent first stage units. Error of the estimate could then be worked out from these sub-sample estimates, and thus independent of these initial assumptions.

Stages of Sampling. In the Orissa sample, contribution (towards variance) of villages in the second stage was found to be more important than that from "Panchayats" which were selected in the first stage possibly on grounds of operational facilities. An unistage sample with villages completely enumerated as in Orissa or by selecting tanks in the second stage when work load per village must be kept small, as was done in West Bengal, seems to be more justified.

Cost of Operations. It appears that the money cost of field operations for estimating total catch for the three districts taken as a whole with a standard error of 10% would be rather high. This does not take into consideration the question of non-sampling errors or ascertainment bias, which would not be controlled by increasing the sample size.

Alternative Approaches to the Problem of Estimating Inland Fish Catch

Special features of inland fishing. The technique for estimating the exploitation of marine fish through organised marketing centres or by a sampling of fishing boats or fishing enterprises cannot be adopted for inland fishing, for obvious reasons. In marine fishing, the coverage is confined to a limited belt along the coastal lines. For

inland waters, fishing is done not merely on boats but by fishermen working singly or in teams, using other equipments and devices as well. For rivers and estuaries, the fishing practice would more or less be in the same lines as in the case of marine exploitation. The coverage in such cases will be extensive, merging with areas covered by inland fishing in tanks and ponds. Deep inland, beyond marine fishing and even river-fishing zones, fishing enterprises are less organised, the operation being often an amphibian one, *i.e.*, on boats or on foot. For this region, a registration of boats and building up of a sampling frame does not seem to be feasible.

It may be noted here that unlike crop-yield estimates where the object is to measure the total produce standing on the field, fish catch is a measure of what the owner of a tank cares to exploit (and not its total produce), which depends on his personal reasons and other extraneous circumstances. For instance, catch may be very high in draught years when the ponds dry up and less in other or as and when the prices go up. Apart from the uncertainties in ascertainment, exploitations are therefore subject to large variations in time and current market fluctuations. A number of alternative approaches for the sampling of inland fish catch employing different sampling frames are however being discussed below, bringing out the advantages and disadvantages in each.

Sampling by units of exploited area. The pilot studies of West Bengal in 1960-61 and of Orissa in 1962-63 have both tried out sampling by units of water-area. The area/number of the inland water-units was to be estimated by a larger sample and the rate of exploited yield per unit of water-area was to be based on a sample of smaller size by interviews or by an 'on the spot' observation. Sampling by area units obviously is not applicable in case of marine catches or for that matter for rivers and estuaries. In fact rivers, estuaries and large water-surfaces like 'Beels' etc., similar to marine waters should perhaps be treated as a separate stratum altogether and sampled differently from tanks and ponds. It seems that the Estuarine waters should either be merged with Rivers or with Marine. In fact, many of the species of fish are common to rivers and estuaries on the one hand and between estuaries and seas on the other.

The determination of the number of and area under tanks and ponds, classified by their catchment sizes, seasonal depths and existing conditions, is by itself (apart from exploitations), an important job, as this furnishes the basic material for any developmental plan,

on which the type and quantum of aid needed for the promotion of fish culture would depend. For this purpose, "gross" area "engaged" by ponds and tanks rather than the effective water surface would be more relevant.

In the year 1944-45, a plot-wise complete enumeration of undivided Bengal was carried out (Ishaque's Report—Agricultural Statistics by Plot to Plot Enumeration in Bengal 1944-45), from which the area occupied by tanks, ponds, canals, beels and cadastral surveyed rivers at the Union level are available. The areas under such water units were also being systematically estimated by the Indian Statistical Institute as a bi-product of its seasonal land-utilisation surveys. While in the years prior to 1951 standard sized grids of a square shape were demarcated on the village maps and represented the ultimate sampling units, in latter years, clusters of a specified number of cadastral plots were adopted as the sampling units for estimating the percentage of area under different utilisations, water-areas of different kinds being one of them. The sample size was considerable and consistent results have been obtained from year to year which compares well with the complete enumeration figures of 1944-45, as will be seen below :—

Estimated acreage under tanks and ponds, canals, beels etc. for different years.

| <i>Survey</i> | <i>Year</i> | <i>Acreage (in 000) acres</i> | | |
|--------------------|-------------|-------------------------------|---------------|----------------|
| | | <i>autumn</i> | <i>winter</i> | <i>average</i> |
| (1) | (2) | (3) | (4) | (5) |
| Ishaque's C.E., | 1944-45 | — | — | 1276 |
| Bengal crop survey | 1947-48 | 1030 | 1105 | 1068 |
| | 1948-49 | 868 | 1060 | 964 |
| | 1949-50 | 1157 | 1169 | 1163 |
| NSS-Special | 1661-62 | 1217 | 1528 | 1372 |
| | 1962-63 | 1396 | 1576 | 1486 |
| | 1963-64 | 1528 | 1353 | 1440 |

So far as the estimation of water-area classified under specified categories is concerned, such independent large scale surveys can furnish this important data, merely as a bi-product at very little or no additional cost. This would give an objective estimate of the water areas of different categories. For some of the characters linked up with the owner/operator, a sub-sample of units may be chosen and the data collected by an 'on the spot' observation or by a personal interview of the respective owners/operators of the water-units. The latter was in fact given a trial in the West Bengal Studies of 1960-61 and apart from small casualties was found to be feasible in practice. Thus the area estimation may be based on an objective method while the operational particulars including exploitations may be obtained through interviews.

Sampling by units of exploitation agencies

(a) *Fishermen units.* Sampling through individual fishermen which was considered by the technical committee as one of the likely approaches, but discarded as un-practicable was however tried out by the Indian Statistical Institute in 1962-63 for first hand experiences. The enumeration of a sample of specified fisherman-days, by accompanying him personally in his daily activity presented insurmountable difficulties. The scheme was eventually abandoned on receiving disconcerting reports from a number of reliable investigators. The task of contacting and fixing up an appointment with a fisherman who would engage in fishing on a particular day is tremendously difficult, and seemed to be beyond the scope of an outside investigator, specially a mobile one, as is employed in the Institute's usual surveys.

(b) *Operating household units.* On the other hand, the data may also be collected through a sample of households owning or operating tanks. An 'on the spot' observation of all catches in all tanks possessed by them appears to be equally difficult.

A fully objective investigation by witnessing the catch with one's own eyes did not seem to be practicable and it was felt that personal interview of the fisherman or of the possessing household shortly after the incident, would be the next best source of information. In fact, in enquiries, where a large number of investigators are engaged, the decision should be taken not on the basis of what an exceptionally diligent and conscientious worker might do, but what an average but trained one is capable of doing. Interviewing a sample of individual 'fisherman'-units or of 'operating-household' units, would thus be

a near-objective and practical course. It may be noted here that in listing of fishermen defined *not* by their caste, but by their actual activities, a complete enumeration of all households in the village would have to be undertaken.

Sampling through selling units. Exploitation data may also be collected through fish stalls or vendors retailing fish. At this source, there may be an opportunity to classify the commodity into marine, river-estuarine or catches from tanks and ponds with some degree of reliance. It is however pretty difficult to ensure that any list of selling units constituting the sampling frame would be really complete, especially in view of the un-licensed vendors and petty hawkers.

Sampling through consuming units. A household to household interview for data relating to fish consumption using a short reference period and a very recent one, is perhaps the most exhaustive accounting of fish exploitation, excluding consumptions in the non-household sector. The question of carryover from year to year and net imports will have of course to be kept in mind. The much debated question of biased reporting on food items generally, will of course be there. But a series of estimates would in any case bring out the year to year trends. Besides, a parallel survey for exploitation through household interviews should check up against non-marine, non-riverine supply of fish, *i.e.*, exploitation from tanks and ponds. If the consumption is recorded separately for each species, some sort of apportioning the total among these different sources may perhaps be attempted. Since the households will not generally have the necessary knowledge for identifying the sources of supply, and again as some of the species are both riverine as well as marine or from tanks and ponds, such a classification is not expected to go very far. One has to go to the very sources of supply, immediate or higher up for necessary information.

A Two-fold programme for the estimation of water-area and quantities of fish exploited from different sources :

For an on-the-spot investigation of catch in tanks and ponds, the investigator has to remain stationed within a small coverage, for vigilance and maintaining an un-broken contact. This means employment of a large staff for whom there is not enough work for the year round. Such a scheme will therefore be too costly, unless it is integrated into a multipurpose scheme along with other enquiries. Taking

all these into consideration, a two-fold programme in the following lines may be suggested :—

Scheme (I) (a) Detailed particulars relating to the classification of water areas according to their size, depth and general conditions may be collected through a plot to plot enumeration in conjunction with seasonal land utilisation surveys (with due provision for urban areas).

(b) For a sub-sample of plot-clusters, the respective owners/operators of all tanks/ponds in them, may be contacted and particulars relating to various operational measures and exploitation made during the season may be collected by interview method.

Scheme (II) (a) A fish consumption survey may be carried out by household interviews integrated with a current consumption survey during each season for the estimation of fish consumption, and a list of fish stalls or sources from which the fish was purchased may be collected for each household. In addition to weekly, monthly or whatever reference period is adopted for consumption data, actual procurements made on the day of visit itself may perhaps be collected on the spot for a sub-sample of households.

(b) A few fish stalls selected from those reported by the consuming households in the village (or block) may be interviewed for estimating the proportion of supply commanded by the different sources, marine, riverine etc. In some cases, it may be necessary to follow up to higher stage in the hierarchy of distribution in order to trace the real source of supply.

Estimates of water-area based on 1 (a) would be objective, while 1 (b) would give the yield of catch per unit of area exploited from tanks and ponds alone, based on interviews, *i.e.*, subjective. Schemes 2 (a) and 2 (b) jointly should give dimensional estimates of the supply from different sources, which is more than what we can hope for, under the present circumstances. Thus the two Schemes together will furnish not only the abstract aggregates for policy decisions and planning, a complete pattern of fish exploitation and its consumption by the different strata of our people will also come out. Any such scheme should, of course, be designed in independent interpenetrating net-work of sub-samples (Mahalanobis) for exercising control over the field work and estimating sampling errors.

B. Das¹⁰ : *Current status of fishery statistics in Orissa*

Reliable statistics of total catch of fish from Inland resources are not available at present beyond the rough estimates provided in the Report on the marketing of fish in the Indian Union. The figures given in the marketing report are however outdated. The available statistics of Inland fish production in the State are not quite satisfactory.

Statistics on the catch of Marine fisheries have been developed from the year 1950 onwards by the Central Marine Fisheries Research Station, Mandapam. It has a net-work of selected observation centres, operating under fishery survey assistants, spread on the East and West coasts of India which form the main source of supply of Marine fish. The data collected from these centres on actual catch, the trends of annual changes of fisheries are used for estimating the annual Marine fish landing. These data are analysed in detail and published in Indian Journal of Fisheries.

As regards Marine Fish, the Fisheries Development Adviser (FDA), Govt. of India, utilises the figures furnished by the Central Marine Fisheries Research Station. For Inland fish, however, the Fisheries Development Adviser estimates the same using the proportions of marketable surplus of inland fish to the total landings of Marine fish, as given in the Report on the marketing of fish in the Indian Union. These estimates are therefore open to doubt as the factors governing the resources of inland and marine fisheries may differ considerably. In view of these limitations in Fisheries Development Adviser's data, the Central Statistical Organisation, in their National Income Statistics (revised series of National Income Estimates for 1955-56 to 1959-60) utilised the information revealed in an ad hoc survey on marketing of fish during 1956 conducted by the Directorate of Marketing and Inspection. Advance estimates of available marketable surplus of fresh water fish by reorganised states were obtained from the Directorate of Marketing and Inspection. These figures relating to the year 1956 together with the corresponding figures for the year 1948 (as published in the marketing report) were used to interpolate and extrapolate the figures of marketable surplus of fresh water fish for all other years. This interpolation and extrapolation had been done linearly at all-India level, as the published

figures of 1948-49 were available on the basis of the old set up of States. For State-wise distribution of overall figures, the percentage distribution of total marketable surplus by States implicit in the unpublished data supplied by the Directorate of Marketing and Inspection was made use of for each of the years following the year 1956. According to these estimates, the production of Marine and Inland fish for Orissa for various years are as follows :

Estimates of Production of Marine and Inland Fish in Orissa (1000 tonnes)

| <i>Years</i> | <i>Marine fish</i> | <i>Inland fish</i> | <i>Total</i> |
|--------------------------|--------------------|--------------------|--------------|
| 1 | 2 | 3 | 4 |
| 1955-56 | 4 | 32 | 36 |
| 1956-57 | 16 | 33 | 49 |
| 1957-58 | 7 | 33 | 40 |
| 1958-59 | 5 | 35 | 40 |
| 1959-60 (preliminary) | 3 | 35 | 38 |

Source : National Income Statistics, C.S.O.

The Central Statistical Organisation, comparable estimates of State Income gave the following figures on production and value of fish.

| | 1960-61 | | 1961-62 | | 1962-63 | |
|-------------|--------------------------------|--------------------------|--------------------------------|--------------------------|--------------------------------|--------------------------|
| | <i>Production (000 tonnes)</i> | <i>Value (Rs. lakhs)</i> | <i>Production (000 tonnes)</i> | <i>Value (Rs. lakhs)</i> | <i>Production (000 tonnes)</i> | <i>Value (Rs. lakhs)</i> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Inland fish | 25.06 | 486 | 25.06 | 552 | 25.06 | 576 |
| Marine fish | 6.31 | 46 | 8.44 | 70 | 8.09 | 70 |

These estimates were found in the C.S.O. operational notes. According to the report on the marketing of Fish in India (third edition), 1961, the estimated marketable surplus of fresh water fish in Orissa was 23.2 thousand metric tonnes. This estimate is based on the personal enquiries made in some markets in the State and, thus, gives a rough idea.

A pilot survey for estimation of fish catch in Orissa was conducted by the Directorate of National Sample Survey (Agricultural Statistics division) in the year 1962-63 in order to develop suitable sampling techniques for estimation of (i) number and areas of Ponds, Tanks and Swamps and (ii) total catch of fish from Ponds, Tanks and Swamps. The pilot survey covered 3 districts namely Cuttack, Sambalpur and Mayurbhanj. The Sampling design for the pilot survey was 2 stage stratified sampling in which the strata were subdivisions in each district. The survey revealed that there were nearly 48 thousand Ponds, 21 thousand Tanks and 12 thousand Swamps in these three districts. The total area under water in the 3 districts was estimated to be of the order of 43 thousand acres. The total catch of fish in 1962-1963 in the 3 districts put together was of the order of 500 tonnes. The overall catch per acre was about 26 pounds. Catch per acre in Cuttack district was 45 pounds, in Mayurbhanj 73 pounds and in Sambalpur, only 8 pounds. The pilot survey demonstrated the feasibility of employing sampling techniques for estimation of area under water and the total catch of fish by making use of the sampling techniques. With the help of the results of the survey, it was possible to obtain the sample size which would give estimate of desired precision. It was shown that a sample size of nearly 900 Grampanchayats with 2 villages per Grampanchayat was likely to yield estimates of water area with 5 per cent error.

In course of this survey, data on total catch during 1961-62 had also been obtained by enquiry method. By this method, the catch per acre for the three districts put together was of the order of 55 pounds. It was 105, 103 and 12 pounds per acre for Cuttack, Mayurbhanj and Sambalpur respectively. There is thus wide discrepancy between the two estimates, *i.e.*, the estimates based on actual catch for the year 1962-63 and the estimates based on the data collected by the enquiry method. It leads us to doubt if complete data on catch had been obtained in 1962-63 pilot survey.

Prior to the pilot survey in the year 1961-62, the State Directorate of Fisheries, Orissa had undertaken a detailed survey, though

not on a very scientific basis, for estimating the total water area, estimated area per Fisherman, water area with Fish culture, and the estimated water area dry in the Summer. This survey also provided some estimates of the number of Tanks, number of Fisherman, etc. This survey covered in all 3,697 sample villages from all the districts in the State. The sampling procedure was 2 stage. The first stage samples were the Blocks and the second stage were the villages. This survey revealed that the total estimated Inland water area of the State was 255860 acres.

Estimates of water area were obtained separately for each district and the per acre estimates of catch of fish as obtained from the pilot survey report of the Directorate of National Sample Survey were utilised for estimating the total Inland Fish production.

The per acre catch for Cuttack district was utilised for all the coastal districts namely Cuttack, Puri, Balasore, and Ganjam. The per acre catch estimate of Mayurbhanj district was utilised for estimating the production of fish for Mayurbhanj, Keonjhar, Sundergarh and Dhenkanal districts. Since the estimate of catch per acre for Sambalpur district was found to be far too low, it was utilised for estimating the fish production in Sambalpur district alone. For the remaining districts of the State, the estimate of average catch per acre for these three districts have been used. Since it has been noticed that there is wide divergence in the estimates obtained by the method of actual catch for the year 1962-63 and by the enquiry method for the year 1961-62, separate estimates have been obtained for the State as a whole, utilising the two different sets of estimates of catch per acre. It was found that in Method 1, *i.e.*, the method of actual catch, the total estimate of Inland fish production in the State was only 4 thousand tonnes and in Method 2, *i.e.* by the enquiry method, the corresponding estimate was about 8 thousand tonnes. This however gives some idea of the magnitude of the inland fish production in the State. It may reasonably be stated that the total fresh water fish production in the State will not ordinarily exceed 10 thousand tonnes. The production of Chilka fish has been estimated at 4 thousand metric tonnes. The coast of Orissa is characterised by a large number of estuaries.

In addition to the Chilka lake, the estuaries are 7 in number, (1) Subarnarekha, (2) Chandipur (Budha Balanga river), (3) Dhamra (Baitarani; Brahmani), (4) Mahanadi, (5) Devi, (6) Rusikulya, (7) Bahuda. The estuarine fish has been estimated by the Directorate

of Fisheries at 5 thousand metric tonnes. Thus the total inland fish production in the State, comprising of the fresh water fish, Chilka fish and estuarine fish does not exceed 20 thousand metric tonnes. As against this estimate, the estimate of 35 thousand metric tonnes as given in the National Income of Statistics (revised series of National Income estimates) seems to be on the high side. It is essential that a committee may be set up to investigate and furnish some reliable estimate of inland fish production in the State.

The Statistical Abstract of Orissa gives figures on the export of fish from Chilka lake for various years. These are based on statement received from various cooperative societies and fish merchants engaged in export of fish from the Chilka lake. These exports amount only to 3 to 6 thousand tonnes per year as compared to the total estimated marketable surplus of inland fish which, according to the marketing report, comes to nearly 23 thousand tonnes per year. The Quarterly Bulletin of Statistics, Orissa, gives data on quantity of fish sold in Municipal markets and the average price per unit sold. These prices are apparently retail prices.

Only two-thirds of the population of Orissa are believed to have no objection to consuming fish. The per capita availability of fish for the entire population, and for the fish eating population, according to the marketing Report, was 4.25 pounds and 6.19 pounds respectively. Per capita fish consumption in Orissa is believed to be lower than the corresponding estimates for all India.

In order to improve the quality of Fishery statistics in Orissa, it is necessary to adopt scientific methods. The pilot survey conducted in the three districts has demonstrated the feasibility of employing sampling techniques for estimation of area under water and of the total catch of fish by making use of sampling techniques. The results indicate that a sample size of about 10% of the total number of villages in the State is likely to yield estimates of water area with about 5% error. For obtaining estimates of total catch with 10 per cent sampling error, it may be sufficient to limit the sample size to roughly 4% of the total number of villages. For getting precise estimates at the District level, however, the sample size will have to be substantially increased. A detailed survey, of the nature of the pilot survey which we already had, may be conducted in the state, in joint collaboration of the State Fisheries Directorate and the Directorate of Statistics. As regards Marine Fisheries, the estimates furnished by CMFRS may for the present be utilised.

It is also necessary to improve upon the sampling techniques being adopted by the CMFRS. The Fisheries Research Institute, Balugaon has been furnishing estimates of Chilka and Estuarine Fish production. The method adopted for these estimates should be examined and a proper procedure worked out for obtaining reliable estimates of Chilka and Estuarine fish.