

## **Symposium on “Quality of Agricultural and Allied Statistics : Priority Actions Needed in the Light of National Statistical Commission Recommendations”**

Chairman : Prof. Prem Narain  
Convenors : Dr. A.K. Srivastava  
Shri M. Neelakantan

The Chairman introduced the topic of the symposium and impressed upon the importance of the symposium for official agricultural statistics. The Convenor briefly provided an orientation towards the symposium. The National Statistical Commission (NSC) 2001 has made recommendations spanning over various aspects of agricultural statistics. In this symposium some of the important aspects of the recommendations were identified and papers covering the areas of crop area and production, horticultural crops, land holding, agricultural and livestock census, fisheries statistics, agricultural prices were invited. Following papers were presented.

1. Sampling Plan for Crop Area and Land Use Statistics - *Randhir Singh and Anil Rai*
2. Recommendations of National Statistical Commission on Large Scale Agricultural Surveys : Pre-considerations for Implementation - *M.K. Srivastava*
3. Crop Area and Yield Statistics Through ICS Scheme - *A.K. Srivastava*
4. Estimation of Area and Production of Horticultural Crops - *HVL Bathla and G.K. Jha*
5. Marine Fishery Statistics System in India - Issues and Approaches - *M. Srinath*

There were discussions regarding not only these papers but views were expressed on various other aspects of NSC recommendations. For example, suggestions were made regarding improvements required in livestock statistics. In the presentations as well as discussions, various technical, methodological and operational issues were raised and suggestions made to tackle the problems in the implementation of the NSC recommendations.

Following recommendations were made.

1. The recommendations of NSC regarding estimation of crop area on the basis of 20% sample of villages for major crops may be followed quite efficiently. Minor crop area estimation can be improved by using GIS and Remote Sensing technology along with the survey data. However, complete Girdawari may be required for several purposes and should be followed in State wherever, it is working satisfactorily.
2. Keeping in view a number of intricate conceptual and methodological issues involved in effecting on integration of livestock census with agricultural census, the pilot study proposed by NSC need to be carefully designed to bring out optimal solutions to these issues. There is a need of analysis of existing data to develop an efficient sampling design, which could be tested in the pilot study. Such studies need to be taken up immediately so that the procedures of integration could be perfected and implemented in next round of Agricultural Census which will be conducted with reference year 2005-2006.
3. The recommendation of NSC regarding use of ICS data for working out a correction or adjustment factor should be followed. For this purpose, a statistical study should be taken up.
4. A methodological study needs to be taken up for estimation of horticultural crops, taking into account the strength of present knowledge based on available methodologies such as sample surveys, market arrivals etc. The experience and expertise of various departments such as IASRI, DES, NSSO, NHB should be utilized in this endeavour.
5. For marine fisheries statistics, efforts should be made for data acquisition and dissemination involving respective departments of maritime states dealing with marine fisheries and CMFRI. For this purpose, if need be, a national workshop may be organized for deliberating on the methodological aspects of data collection and logistic support for the data collection system and evolve appropriate strategy for developing a comprehensive marine fisheries statistics system.

Concluding remarks were made by the chairman, who observed that many of the issues raised in the symposium have already been deliberated in great detail by NSC. The methodological and operational issues, if any, need to be addressed in a coordinated manner by all concerned.

## Sampling Plan for Crop Area and Land Use Statistics

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### *Introduction*

Crop area statistics and land use statistics form the back bone of agricultural statistics system. With most parts of the country detailed cadastral survey maps and the permanent village reporting agency, the country has been able to maintain reliable and timely statistics over time. At present the statistics of crop area and land use are compiled with the help of village revenue agency commonly known as Patwari in the temporarily settled states of the country which cover about 86 per cent of area. In the permanently settled states of Kerala, Orissa and West Bengal, these statistics are obtained through a sample of 20 per cent villages under the scheme known as Establishment of an Agency for Reporting Agricultural Statistics (EARAS) which cover about 9 per cent area of the country. Remaining area mainly in the north eastern region still do not have a reporting system and they compile conventional crop estimates based on personal assessment of the village chowkidars. Besides about 7% of geographical area is still non reporting area mainly in North Eastern states where no statistics are reported.

In the states that have a Patwari agency a complete enumeration of all fields called Girdawari is made in every village during each crop season. In these states a sampling scheme known as Timely Reporting Scheme (TRS) is in operation under which the Patwari is required to complete Girdawari on a priority basis in a random sample of 20 per cent villages. In order to have proper supervision an independent scheme called Improvement of Crop Statistics (ICS) scheme is in operation under which a sample of about 10000 villages (8500 from TRS and 1500 from EARAS) is selected for intensive supervision. ICS scheme works as a watchdog in TRS and EARAS schemes.

Recently use of remote sensing technology for estimation of crop area and land use statistics has been attempted. In this regard a major project known as crop acreage and production estimation (CAPE) was initiated by department of Space during 1980s. More recently Indian Agricultural Statistics Research Institute has undertaken studies to integrate use of satellite data along with survey data for crop acreage estimation, crop yield estimation and crop yield modeling.

*Recommendations of the National Statistical Commission  
Regarding Crop Area Statistics*

National Statistical Commission has been looking at the means to improve the agricultural statistics of the country. The commission recommended that crop area forecast and final area estimates are based on the results of 20 per cent sample of TRS villages in temporary settled states and EARAS scheme villages in permanently settled states. The main recommendations for crop area statistics are:

1. As the data from a 20 per cent sample is large enough to estimate crop area with a sufficient degree of precision at the all-India, State and district levels, crop area forecasts and final area estimates issued by the Ministry of Agriculture should be based on the results of the 20 per cent TRS villages in the temporarily settled States and EARAS scheme villages in the permanently settled states. In the case of the North-Eastern States, Remote Sensing methodology should be used for this purpose after testing its viability.
2. The Patwari and the supervisors above him should be mandated to accord the highest priority to the work of the Girdawari and the patwari be spared, if necessary from other duties during the period of Girdawari.
3. The patwari and the primary staff employed in EARAS should be imparted systematic and periodic training and the fieldwork should be subjected to intensive supervision by the higher level revenue officials as well as by the technical staff.
4. For proper and timely conduct of the Girdawari, the concerned supervisory staff should be made accountable.
5. TRS and EARAS scheme should be regarded as programmes of national importance and the Government of India at the highest level should prevail upon the State Governments to give due priority to them, deploy adequate resources for the purpose and ensure proper conduct of field operations in time.

*The Sampling Design*

If the recommendations of the National Statistical Commission are accepted for implementation regarding crop area statistics, then the sampling design for the 20 per cent sample need to be redefined. It is also important that all states implement this sampling scheme from a fixed time.

Sampling design preferably should be same for both TRS & EARAS states. The total area may be divided into 5 independent samples so that each year 20 per cent sample is enumerated and over a period of 5 years the complete enumeration of all the area is achieved. Each patwari/VLW should also have allocation in such a manner that every year he is to enumerate a 20 per cent

sample of the villages. To meet both these requirements a complete list of all the villages in the district is prepared such that all the villages in a revenue circle (probably enumerated by the same Patwari) are put together. Then a systematic sample with a interval of 5 is selected every year taking the initial starting unit as 1,2,3,4 & 5 in five years respectively. This will automatically generate 5 non-overlapping independent samples and the entire population can be covered in 5 years. This will enable to maintain continuity of data at an interval of 5 years for all villages. This will also enable the use of this information as frame for other studies.

*Land Use Statistics Through Integrated Modeling  
Using GIS and Remote Sensing*

Reliable crop area statistics for major crops can be obtained based on a sample of 20 per cent villages. Also reliable crop statistics for major crops can be obtained from remote sensing satellite data. However, crop area statistics for minor crops or short duration crops may not be reliable based on a sample of 20 per cent or the satellite data.

Keeping in view these factors Indian Agricultural Statistics Research Institute, New Delhi initiated a study entitled "Land use statistics through integrated modeling using GIS and remote sensing". The study has been undertaken in district Lalitpur of UP. In the study tehsils of the district are treated as strata. A sample of 20 villages has been selected from the district with proportional allocation of these villages using the Modified Dependent Areal Unit Sequential Technique. This technique is based on GIS technology and provides larger probability of selection to units which are at larger distance from the earlier selected unit compared to the neighbouring units. From these selected villages data has been collected by the field staff of the Institute for all the 3 seasons. These records were compared with the records obtained from the Patwaris to examine the reliability of patwari records. It has been observed from the study that there is no significant discrepancy between the patwari records and the records obtained by the field staff. This provides better confidence in the records maintained by the patwari.

To integrate the use of satellite data with the field survey, digital data from remote sensing satellite IRS-III has been used. The ground truth information for supervised classification has been collected during the same period. The satellite image has been classified and the village boundary map has been overlaid on the classified image. Area under different land use categories has been calculated using standard transformation technique. A suitable relationship/model between the satellite data and the ground survey data has been developed. Using this model/relationship area under different land use class of other villages can be predicted resulting in improved estimation of crop area.

### *Some Issues*

The crop area statistics can be obtained through a sample of 20 per cent villages, which can be available in time and can be used for forecasting/estimation of crop production. However, there are certain other areas where the Girdawari information is utilized by the temporary settled State Governments. These areas pertain to agricultural legislation regarding land ownership tenancy, land revenue/irrigation revenue etc. The Girdawari records are also used for providing relief to farmers in times of floods/drought, crop loans/Taccavi. The much awaited crop insurance scheme may also require complete Girdawari records for settling the insurance claims of the farmers.

### *Agricultural Legislation*

Agricultural legislation in early Mughal Empire and British period were based on economic needs to raise revenue. The coordinated effort for changing the economic conditions of peasants through legislative measures started after independence. The agricultural legislation were part of purposeful national effort for changing the socioeconomic structure of society, with the objective of attaining social equality and economic prosperity. The agrarian legislation pertaining to tenancy reforms is one of the important areas which is going to be affected if the complete Girdawari record is not maintained. The tenancy reforms pertain to ensure the security of tenure to the tenants to give them occupancy status on the condition of completing a given number of years on the same land. The security of tenure has 3 main elements (i) That the ejection of a tenant should not take place except with the provision of law (ii) That the land may be resumed by the owner for personal cultivation only and (iii) That in the event of resumption the tenant is to be assured of a minimum tenanted area in his possession. Under the tenancy reform measures, the law provides for the conferment of the ownership right on the tenants in respect of the non-resumable areas in several states. In all these states the complete Girdawari is quite important as States will need this data.

There are some other agricultural legislation like cultivation of fallow land, wasteland, utilization of land for production of food crops, use of improved seeds and manure. The Gujarat, Maharashtra and Karnataka Governments passed the cotton control act. Legislation on ground water aims to regulate and control the development of ground water to prevent over exploitation and deterioration in water quality, laws on rural debt cancellation, taccavi or government loans for agricultural purposes and credit for agriculture through cooperatives etc. These are some of the important legislation which require generally complete Girdawari for each field and each crop.

### *Revenue*

Most of the States are using the Girdawari records for land revenue or irrigation/canal revenue. With the development of agriculture and modernization, several new short duration crops are also being grown by farmers which are generally not covered in the land record manual for Girdawari. In some states collection of land revenue has been discontinued for certain categories of farmers hence there is need to have a re-look on manual for Girdawari.

### *Data Needs for Sub-sectors*

Sub-sectors relating to emerging areas of floriculture, tissue culture, mushroom culture etc. have become very important in terms of their contribution to GDP. Similarly data requirements for horticulture and other high value added produce are important.

### *Conclusion*

The major crop area can be estimated using a 20 per cent sample quite efficiently. Minor crop area estimation can be improved by using GIS and remote sensing technology along with the survey data. However, complete Girdawari records may be required for several other purposes like land ownership/tenancy, crop loan/taccavi, drought and flood relief and insurance claim under the insurance scheme etc.

## **Recommendations of National Statistical Commission on Large Scale Agricultural Surveys : Pre-considerations for Implementation**

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The paper brings out the issues that are required to be considered before the recommendations of National Statistical Commission (NSC) on national level periodic surveys in the field of Agriculture. In particular, the recommendation on Agricultural Census (AC), Livestock Census (LSC) and Land Holding Survey (LHS) are examined.

As a backdrop, it is noted that Agricultural Census in temporarily settled areas (land record States) is carried out primarily through retabulation of land

record through the objective is to get *de facto* rather than *de jure* position. In Phase-I of the Census, which is carried out in all the villages, a frame of operational holding is prepared which is used for estimation of number and area of holdings in various size groups according to gender and social status. Detailed information is collected from all holdings in 20% selected villages. Tehsil level estimates are prepared using the multipliers derived on the basis of Phase-I data. In States other than land record States, in both the phases data is collected through inquiry approach. Sampling proportions, however, vary from State to State. Two stage sampling used in these States includes selection at village level and holding level. LSC is complete count of animals by age, sex, breed following household inquiry. In decennial LHS, the information similar to those in AC and LSC are collected using the standard NSS methodology of selecting households from first stage units (FSU) in both urban and rural areas.

Both AC and LSC have been criticized for timeliness and quality. Additional criticism on AC is levied on the basis of findings of ICS that Girdawari is not completed in time by Patwaris. Non-adherence to the reference dates and non-completion of census operations by States is yet another criticism of LSC. It is noted that proper manuals for concepts, definitions and procedures are also not available for reference.

In this backdrop the NSC has recommended that both AC and LSC henceforth be conducted in only 20% villages. It is also proposed that two surveys be integrated and synchronized with LHS. Further, LHS should be used as a quality check on data collected from AC and LSC. However, considering the complicated nature of administrative and technical issues involved in the Census operation, the NSC has recommended that a pilot study should be conducted before effecting an integration of AC and LSC. The Commission has also hoped that the computerization of land records will help in conduct of Agricultural Census in future.

Though the recommendations appear appealing on the face of it, there is a need to consider several issues before these, except perhaps undertaking of Pilot Study, are taken up for implementation. The following key considerations would need to be made before a change is introduced in an stabilized system.

- (a) What would be the definition of operational holding for the integrated version of AC and LSC? An integration would call for deviation from existing definition to an FAO type of definition which would facilitate collection of data on purely livestock holding, purely land holding and mixture of livestock and land holdings.
- (b) Whether the integrated survey will be confined to only rural area or urban holdings will also be counted ?
- (c) An approach for capturing institutional holding like Government farms, tea gardens, cooperative farms and temple land and nomadic livestock is to be decided.

- (d) What should be optimal size of the schedule so that it is free response-fatigue and consequential reporting bias? It is expected that if information is to be collected in one go on all the items currently included in AC or LSC, the time required for the interview may be 3 to 4 hours. It is pertinent to note that there is an increasing demand for inclusion of additional items, e.g., marketable surplus in AC and species-wise information in LSC for biodiversity mapping. The Commission itself has recommended for inclusion of questions on household size and household occupation.
- (e) Keeping in view the diversity of agricultural practices in various parts of the country, it is important to prepare a design with sufficient provisions for stratification of various types of holdings so that the breed-wise information on various types of animals could be estimated. Sampling of only 20% villages may not be sufficient.
- (f) The sampling design has to take into account the level at which the estimates with desired level of accuracy could be provided. The design of Integrated Sample Surveys for estimation of major livestock products needs data on livestock population at village level. There is increasing demand for village level data even from AC for decentralized planning.
- (g) It is estimated that if the integrated survey is to be carried out for all the holdings of selected 20% villages through household inquiry, costs will be exorbitantly high. With the present level of resource allocation only 5% of the holdings in the selected 20% villages could be surveyed.
- (h) It is also necessary to consider at this stage the agency who will be able to carry out a detailed sampling plan and will have the expertise and manpower to collect data through field inquiry. All the States do not have the desired level of expertise.
- (i) Mere synchronization of AC, LSC and LHS may not be sufficient for comparison of results. The concepts, definitions and sampling method of the three surveys also need to be harmonized so that at least district level comparisons could be made and appropriate correction factors could be built.
- (j) Computerization of Land Records *per se* is not going to help Agricultural Census. The present emphasis in computerization of land records is on recording ownership of land. Due care has not been taken to computerize the names of operational holder and the crops sown by him. Computerized Land Records could at best generate a draft frame for conducting the survey.

At this stage, there is a need that an inter-departmental group of experts should consider the above issues in detail and design a pilot study which will help in taking a decision in the light of above issue.

## Crop Area and Yield Statistics Through ICS Scheme

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### *Introduction*

During the decade of fifties and sixties, two parallel system of estimation of crop production, particularly for 7 major cereal crops, were in operation in the country. Sample surveys for estimation of area in the form of Land Utilisation Surveys (LUS) and crop yield in the form of Crop Yield Surveys (CYS) were initiated as integral part of multi-subject survey programme of National Sample Surveys (NSS) established in the year 1950 under the leadership of Prof. Mahalanobis. While the official estimates were based on complete field enumeration of crop acreage by the Land Revenue Agency of the State Governments and General Crop Estimation Surveys (GCES) for yield rate. Often the divergence between the two series of estimates was of considerable magnitude. As a result, in the year 1970-71, the Land Utilisation Survey and Crop Cutting Experiments undertaken as part of the normal rounds of NSS were dropped. However a specific programme of supervision was undertaken by the NSSO with the object of improving the state system of crop estimation through exercising statistical checks on area enumeration and conduct of crop cutting experiments in the states.

### *Improvement of Crop Statistics Scheme*

The 'Improvement of Crop Statistics (ICS)' scheme was initiated by NSSO in the year 1973-74. Main objective of the scheme is to locate, through joint efforts of central and state authorities, the weakness in the state system of crop estimation in different states and suggest remedial measures to effect lasting improvements in the system. It also aims at providing technical guidance to States for organizing Crop Estimation Surveys. The scheme provides for exercising checks on the three basic aspects of crop statistics namely area enumeration, area aggregation and conduct of crop cutting experiments on an equal matching basis by the Central and State supervisory staff.

The scheme by its very nature evaluates and not aims at generating estimates of crop production in the country. Essentially, it serves as a watchdog on agricultural statistics system and helps in bringing out improvement in the system. The scheme is currently in operation in 19 land record states and UTs viz. A.P., Assam, Bihar, Chhatisgarh, Gujarat, Haryana, H.P., J&K, Jharkhand, Karnataka, M.P., Punjab, Rajasthan, Tamil Nadu, U.P., Uttaranchal, Delhi and Pondicherry and the 3 permanently settled states of Kerala, Orissa and W. Bengal.

### *Sampling Design Under ICS Scheme*

The sampling design for check on area enumeration is Stratified Multi Stage Random Sampling in which Taluks/CD blocks/group of Taluks in a district are taken as strata, villages within the stratum as FSUs and survey numbers within the village as the ultimate sampling units. The sample villages are selected from the list of TRS villages in a stratum for the current year following SRSWOR. Four clusters of five survey numbers each within a village are selected through circular systematic sampling. The selection of clusters of survey numbers made during the first season retained for sample check during the subsequent seasons. For sample check on area aggregation, there is no separate selection of sample villages. The check on area aggregation are carried out in the villages selected for area enumeration checks. For sample check on crop cutting experiments, the districts are taken as stratum. A minimum of 4 crop cutting experiments (cce) for a crop per district subject to a minimum of 2 cce in a village are selected for supervision. Sample villages are selected from the list of villages already selected for sample check on area enumeration and in which cce are planned under GCES. If the required number of villages are not available, additional villages to the extent of shortfall are selected from the remaining villages of GCES.

### *Check on Area Enumeration*

Activities envisaged under the area enumeration programme are intended to be a broad statistical check on area enumeration work carried out by the Patwaris/State Primary workers. The villages under ICS constitute a sub-sample of villages selected for TRS/EARAS wherein the crop area enumeration is done on a priority basis by the state primary workers.

The sample check involves locating selected survey numbers in the sample villages and recording the actual uses to which the land is put to by physical observation and noting down alongside corresponding entries reported by the Patwari in the basic village register.

The possible errors in recording area figures that may occur in crop area enumeration by the primary worker are

- (i) Missing of crops actually sown in the field specifically, short duration crops which are grown and harvested between two official seasons.
- (ii) Reporting of crops not sown in the field and
- (iii) Inaccurate assessment of area under crops.

### *Check on Area Aggregation*

Besides the spot check on area enumeration, verification is attempted in the very same 10,000 villages with a view to ascertain the extent of accuracy of the

crop wise page totalling done by the Patwari/state primary worker as a part of their regular work of area enumeration so as to see how correctly they report the figures through crop abstracts. Sample check Programme on area aggregation brings to focus instances of the incidence of discrepancies in the crop abstracts and the impact of aggregation errors on crop area reporting.

#### *Check on Crop Cutting Experiments*

The sample check on crop cutting experiments is designed in a manner facilitating exercising technical supervision over the work of state primary worker charged with the responsibility of crop cutting experiments on various crops. The programme is oriented towards locating the weak and vulnerable areas in the conduct of crop cutting experiments and reporting crop yield. Mistakes, if any, committed by the primary worker in the entire process of the crop cutting experiments are corrected. Information is also collected on training received by the worker, supply of equipment for the conduct of crop cutting experiments, arrangement made for diriage experiments etc.

#### *ICS Data for Qualitative Assessment of Crop Statistics*

The data collected during the sample check under ICS is qualitative as well as quantitative in nature. It is of immense utility in studying deficiency in the system of crop statistics in various states. The ICS sample being a sub sample of the TRS villages, the observations of the ICS sample are fairly good indicator of the system in general prevailing in the state. The data therefore provides the magnitude of various deficiencies.

#### *ICS Data as an Alternative Source of Area and Yield Statistics*

Though the main objective of the scheme is to improve the system of collection of Agricultural Statistics in the States by finding out the deficiencies in the system, the sample observations could also be utilized for building estimates of crop area and yield. The estimates can be built up based on Supervisors' and Primary workers' entries for each crop. Also to measure the effect of Area Enumeration work, estimates of area of a crop are calculated on the basis of primary and supervisory figures collected during sample check on Area Enumeration. Average yield of the specified crops in the State based on the supervised experiments and their standard errors are also calculated following the same procedure as adopted by the States for General Crop Estimation Surveys (GCES). These estimates can be compared with the corresponding GCES estimates.

#### *Area Estimates*

An attempt has been made to compare the areas as estimated from the figures reported by the primary worker and the supervisor under the

scheme for ICS. The analysis enables to judge the deviation in estimates of area under crops. The Percentage difference of estimates of crop area at All India Level based on supervisor's entries and entries of State primary workers in the corresponding sampling unit of ICS are presented in the table as

**Table 1.** Percentage difference of area estimates

Sl.No.	Crop	1999-2000	1998-99	1997-98	1996-97	1995-96
1	2	3	4	5	6	7
1	Rice (Kh)	27.01	13.38	15.05	28.76	18.24
2	Rice (S)	21.21	23.38	43.22	35.31	40.22
3	Jowar (Kh)	9.57	23.48	3.57	2.57	-1.36
4	Jowar (R)	5.89	7.08	13.46	4.51	4.19
5	Bajra	4.19	11.64	5.32	4.23	4.42
6	Maize	12.23	8.13	9.23	12.89	8.23
7	Ragi	9.03	13.80	4.92	8.61	1.13
8	Wheat	25.01	32.69	21.03	11.35	9.34
9	Barley	14.29	2.07	9.82	-0.29	0
10	Gram	7.73	10.70	11.43	8.70	7.32

Note: Percentage is (Supervisor's - Patwari's)  $\times$  100/Patwari's

Table 1 brings to light revealing trend of under reporting of area, for all the ten major crops covered in the analysis. The trend has been persisting for long. The extent of deviations is noticed to be more than 10%. Rice and wheat account for nearly half of the total cropped area under food grains and about 3/4<sup>th</sup> of total food grains production in the country. Therefore, under estimation of area under these crops is a matter which requires serious consideration.

Estimates of yield rates for important crops based on sample check on crop cutting experiments under ICS scheme along with the percentage of standard errors are computed. NSSO has been impressing upon the states on the need for calculation of standard error. It is generally desired that yield rates should not have standard error of more than 2% for major crops and 5% for other crops at state level to ensure the reliability of estimates.

#### *Yield Estimates*

Even though the sample size of ICS is quite less in comparison to that of CES, a broad dimensional check can be made in the comparison. Percentage difference of estimates of yield rates under ICS and CES at All India Level are given in Table 2 for 5 years since 1995-96 for major crops.

**Table 2.** Percentage difference in yield estimates

Sl.No.	Crop	1999-2000	1998-99	1997-98	1996-97	1995-96
1	2	3	4	5	6	7
1	Rice(Kh)	3.61	3.20	2.29	4.06	-4.36
2	Rice (S)	-1.75	1.83	1.05	7.04	-2.79
3	Jowar (Kh)	4.23	4.32	-17.17	0.64	-8.42
4	Jowar (R)	12.68	1.22	-31.55	-2.41	-3.53
5	Bajra	8.16	28.79	9.90	-6.22	1.81
6	Maize	-16.03	-25.90	20.44	-15.42	5.64
7	Ragi	-2.90	-9.09	-12.96	-0.69	-3.58
8	Wheat	-3.54	-2.60	-12.75	1.78	0.08
9	Barley	-0.54	-1.27	-1.80	5.47	2.72
10	Gram	-2.46	-4.40	-1.98	-9.30	-0.86

Note: Percentage is  $(ICS-CES) \times 100/CES$

It can be seen that ICS estimates are less than those of CES estimates for most of the crops. The trend of under-reporting of yield by the States has been persisting over the years. This is quite opposite to the trend of over-reporting of area.

National Statistical Commission also critically examined the ICS programme and recognizing the potential of the data collected during supervision, recommended that a statistical study should be carried out to explore the feasibility of using ICS data for working out correction factor to calibrate the official estimates of crop area. In pursuance of this recommendation, an expert committee under the chairmanship of DG & CEO, NSSO has been constituted to evolve suitable methodology for obtaining correction factor on the basis of ICS data. The study in this regard is under progress.

## Estimation of Area and Production of Horticultural Crops

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### *Introduction*

India is the second largest producer of fruits and vegetables after China in the world. However, there is a tremendous untapped potential to improve the productivity and production of fruits, vegetables and flowers. In recent years,

horticulture sector has emerged as an important component of Indian economy owing to its vast export potential in the WTO regime. Consequently, new series on national accounts statistics have included some new fruits and flowers. The horticulture crops also provide better alternative for diversification of Indian agriculture in view of higher return. Keeping in view these facts, working group on horticulture set up by the Planning Commission for the X plan recommended an outlay of approximately Rs.12,000 crores for horticulture development during the plan as compared to Rs.1450 crores in the IX Five Year Plan.

Though India has emerged as a major producer of horticultural crops and the share of horticulture in Gross Domestic Product (GDP) of Agriculture Sector has increased, the database in this regard is weak, lacks authentic information and therefore does not provide suitable support for strategies for development.

#### *Present Status*

There are two main sources that generate statistics of production of horticultural crops. The first source is the Directorate of Economics & Statistics, Ministry of Agriculture (DESMOA), which generates through a Centrally Sponsored scheme, "Crop Estimation Survey on Fruits & Vegetables" for estimating area and production. So for this scheme is in operation only in 11 states and covers only seven fruits and seven vegetables. The fruit crops covered are mango, banana, apple, citrus, grapes, pineapple and guava. The vegetable and spice crops are potato, onion, tomato, cabbage, cauliflower, ginger and turmeric. The sampling methodology for the Centrally sponsored scheme was given by IASRI and follows a stratified three-stage random sampling design in the case of fruit crops, with village, orchard and fruit bearing tree as the sampling units at the successive stages. The sample size is usually 150 to 200 sample villages in each major fruit-growing district, five orchards per sample village and four fruit bearing trees per orchard. The number and weight of fruits gathered from the sampled trees is observed and recorded, which form the basis for yield estimation. The survey approach in the case of vegetable crops is somewhat more complex due to special features of cultivation of these crops especially the short duration of the crop and the number of pickings required to record the harvested produce. The results of the DESMOA survey are published in its "Report and Database of Pilot Scheme on Major Fruits and Vegetables".

The second source of horticultural statistics is the National Horticultural Board (NHB), which compiles and publishes estimates of area, production and prices of all important fruit and vegetable crops based on reports furnished by the State Directorates of Horticulture and Agriculture. The methodology followed by NHB for estimating area and production has not been clearly spelt out and is not scientifically sound. These estimates are apparently based on the informed assessment of local level officials dealing with horticulture and the reports of market arrivals in major wholesale fruit and vegetable markets.

### *Deficiencies*

The production estimates of fruits and vegetables available from the DESMOA pilot survey are based on sound statistical methodology. However, the feeling of the National Statistical Commission is that the survey procedures are complex, time consuming and not cost-effective. It is also observed that the field staff does not always follow the procedures laid down for collection of data. Further, the survey is limited to 11 States and its extension to the remaining States will take a long time to the fact that many of them do not possess the necessary staff resources to carry out the fieldwork. Hence, the available all India estimates of area and production of various fruits and vegetables are not satisfactory.

The estimates furnished by the NHB relate to the entire country but they are of doubtful reliability being essentially based on subjective reports received from the ground-level staff. There is, in fact, considerable divergence between the NHB and the DESMOA estimates for the States and the crops covered.

### *Work Done at Indian Agricultural Statistics Research Institute (IASRI)*

IASRI, at the instance of the Ministry of Food and Agriculture initiated a series of pilot sampling investigations on important fresh fruits crops with a view to evolve a suitable sampling methodology for conduct of such surveys. These investigations were carried out in three phases. In the first phase, pilot sample surveys were carried out on single fruit crop grown in a compact region restricted to one or two districts only. These surveys were carried out on mangoes in Varanasi and Saharanpur districts of U.P. (1958-61), guavas in Allahabad district of U.P. (1958-63) and lime in Nellore district of Andhra Pradesh (1961-64). In the second phase, pilot sample surveys were carried out on a group of fruit crops grown in a compact region restricted to one or two districts only. These surveys were carried out on apples and four more temperate fruit crops in Nainital and Almora districts of U.P. and Mahasu district of Himachal Pradesh (1963-69) and on mangoes, litchis and bananas in Muzaffarpur districts of Bihar (1966-69). In the third phase, pilot sample surveys were carried out covering all the important fruit crops grown all over the State. These surveys were carried out in Andhra Pradesh (1965-67) and Tamil Nadu (1971-73).

As regards vegetable crops, IASRI conducted few pilot sample surveys to evolve a suitable sampling methodology for estimation of average yield and production of important vegetable crops at district level. These surveys were carried out in rural areas of Delhi (1964-67), Pune and Nasik district of Maharashtra State (1966-69) and Banglore district (1971-74) of Karnataka State etc.

The sampling methodology evolved through these surveys is being adopted under central scheme 'Crop Estimation Survey on Fruits & Vegetables'. Moreover, in case of vegetables, under usual survey approach the investigators have to visit the selected plots at the time of each picking for observing yield data. This involves considerable time and efforts resulting in more expenditure. Besides this it is difficult to observe all the pickings and it is not unlikely that few pickings are missed. It was therefore thought to examine the feasibility of estimation of production of vegetable crops based on partial harvest. Three such studies were conducted by the institute, the first for estimating the yield of cotton in Hissar district (1977) of Haryana State, the second and third relating to estimation of production of vegetable crops based on partial harvest during 1983 and 2000 respectively. On the basis of these surveys, methodology have been developed for estimation based on partial harvest. However, these results need to be tested in few more surveys before giving to it a final shape.

*The Recommendations of National Statistical Commission (NSC)  
with Regard to Horticultural Crops*

- (a) The methodology adopted in the pilot scheme of "Crop Estimation Survey on Fruits and Vegetables" should be reviewed and an alternative methodology for estimating the production of horticultural crops should be developed taking into account information flowing from all sources including market arrivals, exports and growers associations. Special studies required to establish the feasibility of such a methodology should be taken up by a team comprising representatives from Indian Agricultural Statistics Research Institute (IASRI), Directorate of Economics and Statistics, Ministry of Agriculture (DESMOA), Field Operations Division of National Sample Survey Organization (NSSO (FOD)) and from one or two major States growing horticultural crops. The alternative methodology should be tried out on a pilot basis before actually implementing it on a large scale.
- (b) A suitable methodology for estimating the production of crops such as mushroom, herbs and floriculture needs to be developed and this should be entrusted to the expert team comprising representatives from IASRI, DESMOA, NSSO (FOD) and from one or two major states growing these crops.

*Follow Up Action of NSC's Recommendations*

In view of the recommendations made by NSC, initiatives have been taken at IASRI in this direction. A project proposal relating to pilot sample survey to develop sampling methodology for estimation of area, production and productivity of important flowers on the basis of market arrivals data has been

submitted to Central Statistical Organization (CSO) for necessary funding. In this study, the primary data would be collected through enquiry from three flower mandis in Delhi by a suitable sampling design and also by actual enumeration of sampled flower growing villages of Delhi so that a comparison can be made regarding estimates of area under different types of flowers on the basis of these two sources.

A pilot study on the estimation of production of Mushroom at district level has also been submitted by IASRI to Directorate of Economics and Statistics for requisite financial support. In the proposed pilot survey, the primary data will be collected in Sonapat district of Haryana state pertaining to mushroom (*Agarius bisporus*) crop from growers selected through suitable sampling design by enquiry as well as efforts will also be made to develop an estimate of production on the basis of market arrival data.

Further, a project proposal with an objective to develop an alternative and cost effective methodology for estimating the production of horticultural crops by combining the survey data and the information flowing from different sources such as wholesale markets, growers associations, fruit and vegetable processing plants, export trade, farmers household consumption and losses data etc. have been submitted to Directorate of Economics and Statistics for requisite funds. This study will be carried out on pilot basis in two states namely Andhra Pradesh and Himachal Pradesh. In order to finalise the modalities of study a brainstorming session will be held by a team comprising representatives from IASRI, DESMOA, NSSO (FOD), growers association, State Horticultural Department, NHB, export agencies etc. The aim of this study is to develop a package scheme involving judicious combinations of different sources of information as well as various alternative approaches for providing reliable estimates of area and production of important fruits and vegetables at the state level.

Lastly it can be concluded that some of the recent advances like Geographic Information System (GIS), remote sensing and global positioning system and small area estimation techniques can serve as potential and efficient tools for the improvement of statistics related to horticultural crops. The remote sensing technology can be thought of for obtaining estimates of area under horticultural crops at the national and some regional levels and is being tried by some of the state horticultural department for estimating area under fruit crops. The problem of geographical coverage and development of statistics at disaggregated level can be solved with the help of these techniques to a great extent.

## **Marine Fishery Statistical System in India – Issues and Approaches**

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### *Introduction*

It is well known that a good statistical system is essential for decision making and forming viable public policies. The National Statistical Commission set up by the Central Government under the Chairmanship of Dr. C. Rangarajan made a critical examination of the statistical system of various sectors in India and proposed many recommendations for revamping the existing system. The status of the statistical system in the fisheries sector, particularly the marine fisheries, has been reviewed and the commission suggested ways and means of improving the current system.

Marine fisheries is an important sector of the nation's economy supporting the livelihood of the millions of fisher-folk inhabiting the long coastline of India and those who are engaged in the related activities. The marine fisheries sector in India has witnessed a phenomenal growth during the last five decades both quantitatively and qualitatively. The subsistence fisheries during the early 50's produced about 0.5 million tonnes annually. Currently, the total production is of the order of about 2.3 million tonnes. This production has the estimated value of about Rs. 10,400 crore at the landing centre price and about Rs. 17,800 crore at the retail level. During the last year, the exports of marine fishery products earned about Rs. 5,300 crore as foreign exchange.

The increase in marine fish production is the result of improvements in the harvesting methods, increase in the fishing effort and extension of fishing into relatively deeper regions. Fleet size and operations underwent quantitative and qualitative changes. Traditional boats are being increasingly motorised and the mechanised sector operating with trawlers and gillnetters are resorting to multi-day fishing thus, contributing to increased fishing pressure. The increased effort over time and space, is the consequence of ever-increasing demand for marine food both from external and internal markets. This phenomenal growth also brought in its wake imbalances in the exploitation across the regions and among the resources. Besides, with production levels for most of the commercially important resources showing signs of attaining saturation levels, intersector conflicts increased due to competition to exploit the common resource. It is also felt that intensive fishing by the mechanized sector and indiscriminate fishing of juveniles and spawners has attained serious proportions. This has led to promulgation of fishing regulatory measures by most of the maritime states through closure of fishing during certain seasons.

The exploited fish population and the fishery dependent on them are highly dynamic that require regular monitoring and periodical stock assessment. The resource evaluation is essential for evolving appropriate management strategies for rational exploitation and long-term sustenance of the exploited stocks. The validity and efficiency of the management formulations depend on the quality of database of which information on the catch and fishing effort is an important component. Thus, the data on catch and the expended effort besides other fishery-related statistics (including socio-economic status, infrastructure etc.) are essential for effective management of the fisheries.

Monitoring and assessment of the exploited marine fishery resources of India is one of the major projects of the CMFRI. With this in view, the CMFRI has developed a multistage stratified random sampling design to collect the required information to estimate the marine fish landings along with effort expended and other biological information. Recognising the scientific validity of the sampling design, the FAO has recommended the same to all the developing countries for use in their fisheries statistical systems. The project provides resource-wise, region-wise and year-wise estimates of landings of the exploited stocks from the coastal waters of the Indian EEZ. The data is now exclusively used in the various research projects of the Institute dealing with fish stock assessment and fisheries management. For proper formulation of the sampling design and updating the sampling frame the Institute has also conducted all India fishermen census and frame surveys in the years 1973, 1980 and 1998. The census not only covered the details on the fish landing centers, craft and gear but also collects data on the marine fishermen population, their occupation, family status and the available infrastructure. The Institute has a strong database on the exploited marine fishery resources of the country and the National Marine Living Resources Data Centre (NMLRDC) is the repository of information that manages the database.

#### *Evolution of Marine Fisheries Statistical System*

In India the earliest reference to estimates of marine fish catch is traced in the report of marketing of fish in Indian Union. Data were not collected by any scientifically planned surveys but only by trade enquiries and similar evidences. Soon after its inception in 1947, Central Marine Fisheries Research Institute made attempts to evolve scientific methods of collecting marine fish catch statistics. In the beginning not much information was available on the marine fishing villages, landing centres, fishing crafts and gears which could form a frame for developing sampling plans. Besides, fishing practices differed from region to region and within regions from season to season. Keeping this in view the institute conduct a preliminary survey to collect such information as was required for formulating a sampling plan. In the formative years limited resource at the disposal of the Institute was another constraint in conducting large-scale

surveys. However, an attempt was made as early as 1948 to collect marine fish catch statistics in a planned way.

The Central Marine Fisheries Research Institute initiated collection of marine fish catch statistics through a multi-stage stratified sampling design in the west coast of India in 1959. The institute covers more than 1400 landings centres situated all along the coastal states with the help of 96 field staff. The Central Marine Fisheries Research Institute has published annual marine fish landings with state-wise and variety-wise composition from 1950 to 1993. In tune with the fast changing marine fisheries scenario, the scope, the structure and administration of the resource data collection is periodically modified. Also, the data collection system is reviewed annually in the Zonal Workshops held for the benefit of the field staff.

Fisheries is a State subject and the responsibility of monitoring and management for the coastal resources exploited in their territorial waters rests with the each State Government. In order to address the issues related to marine fisheries management the State Governments recognised the importance of marine fishery statistics. Until the mid-eighties, the State Governments were obtaining the required statistics from the CMFRI. With the expertise gained over the years, the Institute conducted training programmes from time to time in sampling methodology, data collection and analysis for the benefit of the fisheries departments of the State Governments.

Fisheries Departments in various maritime states have been collecting statistics on marine fish landings. States such as, Maharashtra, Gujarat and Tamil Nadu are collecting statistics as per sampling designs either same or similar to that followed by Central Marine Fisheries Research Institute. In some states statistics are collected through Department staff who visit fixed centres and collect the data through enumeration. In view of the decision taken that the CMFRI no longer need to collect and disseminate marine fish production statistics, the Institute has reoriented its data collection system as a resource and fishery based system in the each coastal region. The state-wise production estimates are not made now, unless there is a specific request, which will be considered on a project mode, and costs shared. The respective State Governments collect the marine fish catch statistics and transmit the estimates to the Department of Animal Husbandry and Dairying (DAHD), Ministry of Agriculture, Government of India. The DAHD compiles the data and publishes the national marine fish production statistics.

#### *Recommendations of National Statistical Commission and CMFRI's Role*

Before role of CMFRI in the light of the recommendations of the National Statistical Commission is identified, a brief review of the efforts taken by the CMFRI in improving the marine fisheries statistical system is presented hereunder.

(a) CMFRI'S Efforts in Improving the System

Recognising the role of the Institute as the nodal organization for collection, analysis and dissemination of data on marine fisheries of India, a policy decision was taken by the Planning Commission at its meeting on 9 December, 1981, recommending that the Institute should organize a National Workshop on Marine Fisheries Data Acquisition and Dissemination. Accordingly, the Institute organized a workshop on acquisition and dissemination of data on marine living resources of Indian seas during 21-23 October 1982. The workshop deliberated on various aspects of marine fishery statistics and related matters. Based on the discussions and requirements of the various end-users different proformae were developed for data collection and reporting. The workshop also made recommendations on issues concerning the policies, priorities, strengthening of data collection systems, institutional support and data dissemination. Although, some of them were implemented, majority of the recommendations still remains to be acted upon by the agencies concerned. Some of the salient points from the recommendations are:

- Strengthening and expansion of the Fishery Data Centre of CMFRI as a centralized National Marine Living Resources Data Centre (NMLRDC).
- Observing the deep involvement of States, Department of Agriculture of the Union Government, ICAR and other public and private organizations, it was recommended to form an Expert Committee to guide the modalities of functioning and to foster linkages and provide advice for an effective and functional system for resources data collection.
- Strengthening of State Departments that was collecting marine fishery statistics with adequate administrative, technical and financial support.
- The system of data collection based on tested statistical design developed by CMFRI be followed by all the States and the data are recorded and maintained in the accepted proformae developed by the workshop.
- Conduct of periodical training to the staff of the State Departments.
- Increase in the sampling coverage.
- Development of computerized information system by CMFRI.

As already mentioned, the Institute has been continually updating its data collection system in tune with the changing marine fisheries scenario and also the revised perceptions about reporting the national level production statistics. The Institute has also imparted training to the officials of the maritime state departments as and when required. The Institute has developed a computerised information system on the exploited marine fishery resources supported by a state of the art hardware and software. The Institute has also established a National Marine Living Resources Data Centre (NMLRDC).

#### (b) The Commission's Observations and Recommendations

A multistage sample survey is used to estimate the fish production from the marine sector. The survey design developed by the Indian Agricultural Statistics Research Institute (IASRI) and the Central Marine Fisheries Research Institute (CMFRI) consists of sampling of landing sites of the fishing craft as well as sampling over time of the landings.

As regards marine fisheries statistics, the sample methodology in use is considered to be satisfactory. There is, however, a need for periodic review of sample size, stratification and intensity of data collection in view of the changes in the pattern of fish landings. There are also problems in the flow of data from States and consequently much delay in the compilation of all-India statistics.

It is observed that the present system is operating satisfactorily in the case of marine fisheries but a lot still needs to be done to evolve a suitable methodology with regard to inland fisheries. In the marine sector, there is a need to impart regular training to field staff and impose adequate supervision to ensure quality of data. Use of modern tools of Information Technology for data communication and storage will improve the quality and timeliness of fisheries statistics.

The Commission recommends that:

The survey design for estimating production of marine fisheries should be modified taking into account the current distribution of landing sites and the volume of catch at different sites. The field staff engaged in collection of data should be imparted regular training and their work should be adequately supervised.

#### (c) Proposed Approach and CMFRI's Role

For an efficient and viable marine fishery policy making the following information is required to be collected on a con

- Information on catch and effort statistics as a priority effort based on scientific principles of data collection under the guidance of a national agency.

- Processing and dissemination of information should be automated to speed up the collation and dissemination.
- Develop guidelines to standardise the collection on capture fishery production including post-harvest data and design of required survey forms.
- Increase the operational efficiency of the staff engaged in data collection by conducting training programmes from time to time.
- Conducting zonal workshops periodically for updating the methodologies and validating the production estimates.
- Creation of a centralised National Fisheries Information Centre and state level Fishery Data Centres. The Data Centres should be store house of information on various aspects of marine fisheries including catch, effort, fishing villages, landing centres, fishing harbours, infrastructure, marketing and socio-economic parameters.
- Foster linkages between the Fishery Data Centres and the National Fisheries Information Centre and the related data centres with the other national and state agencies through state of the art computerised networking system.
- Allocation of sufficient staff and funds for the data collection systems and maintenance of the Data Centres.

The CMFRI with its rich experience in marine fisheries research can play a pivotal role by offering its services by developing methodologies for marine fisheries data collection including catch statistics, socio-economic statistics, frame surveys. The institute will also be able to conduct training programmes in data collection methodology, analysis, compilation and reporting. The institute will also give guidance help in establishment of data centres advice on procurement of hardware and software support and also for training the staff.

Fishery management is the integrated process of information gathering, analysis, planning, consultation, decision-making, allocation of resources and formulation and implementation of regulations, as necessary, in order to ensure continued productivity of the resources for the overall benefit of the society. Thus, as rightly observed by the National Statistical Commission, there is an urgent need to strengthen and improve the marine fishery statistical system through concerted efforts of all the agencies concerned so that the information thus emanating from the system is used in management of the rich marine fishery resources of the country for ensuring better livelihood of the coastal rural folk.