CROP AREA AND PRODUCTION SURVEYS

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1. Introduction

India is primarily an agriculture-based country and its economy largely depends upon agriculture. Presently, contribution of agriculture is about one third of the national GDP and it provides employment to over seventy percent of Indian population in agriculture and allied activities. Therefore, our country's development largely depends upon the development of agriculture. The agricultural production information is very important for planning and allocation of resources to different sectors of agriculture. Agricultural statistics in India have a long tradition. Artha Shastra of Kautilya makes a mention of their collection as a part of the administrative system. During the Moghul period also some basic agricultural statistics were collected to meet the needs of revenue administration. Ain-e-Akbari is most important document which throws great light on the manner in which statistics were collected during the moghul period. After the Moghul period British rule started Ryotwari System was introduced during 18th Century to collect land revenue. In 1866, the British Government Initiated collection of agricltural statistics mainly as a byproduct of revenue administration and these reflected the then primary interest of the Government in the collection of land revenue. Subsequently, the emphasis shifted to crop forecasts designed primarily to serve the British trade interests. On a representation made by a leading firm of Liverpool, trading in wheat, the preparation of wheat forecast was taken up in 1884 and the land utilization statistics are available in the country since 1884. By 1900, oilseeds, rice cotton, jute indigo and sugarcane had also been added to the list of forecast crops.

The system of agricultural statistics generates valuable statistics on a vast number of parameters. Some of the very important statistics are land-use statistics and area under principal crops through the Timely Reporting Scheme (TRS) and also on complete enumeration basis, yield estimates through the General Crop Estimation Surveys (GCES), the scheme of Cost of Cultivation Studies (CCS), checks the reliability of TRS and yield estimates through the scheme of Improvement of Crop Statistics (ICS), cost of production estimates, agricultural wages, irrigation statistics, conducts Agricultural Census and Livestock Census on quinquennial basis, generates data on livestock products through the scheme of integrated Sample Survey (ISS), collects wholesale and retail prices, conducts market intelligence and observes rainfall and weather conditions.

2. Crop Area Statistics

The country can be divided into four broad categories with respect to collection of area statistics namely (i) temporarily settled states, (ii) permanently settled states, (iii) other regions and (iv) non-reporting areas.

Temporarily Settled States

The system of temporarily settlements was introduced in our country in 1892, with a view to fix land revenue for a period, which was subject to change at the time of the next settlement. Ordinarily, the interval between two settlements was 25 to 30 years. In order to determine the land revenue and to make estimates of production forecast detail statistics are to be collected about land revenue, land value etc. In temporarily settled areas the information on crop area statistics are collected by the village accountant or Patwari and are recorded in a register which is popularly known in northern India as Khasra. The village accountant has been called by different names in different parts of the country such as Karnam in South, Telatbi in Maharashtra, Karamchari in Bihar, lekhpal in Uttarpradesh *etc*. This category covers around 86% of total reported area of the country.

The crop area statistics collected by village accountant are on the basis of complete enumeration called girdawari. The village accountant is to visit each and every field of the village in each crop season and record the information such as area under different crops / land use categories and its status in standard forms called Khasra register. The work of village accountant is supervised by immediate superior officer known by the name of Quanungo in northern India. Most of the geographical areas of temporarily settled states are cadastrally surveyed and detailed maps are available in tehsil and district Headquarters. The statistics obtained by different village accountants are aggregated to get the crop area statistics at higher administrative units such as blocks, tehsils, district, states etc. This system of data collection is being followed in 18 states namely Andhra Pradesh, Assam (excluding hill districts). Bihar, Chattisgarh, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu Uttaranchal and Uttar Pradesh and 5 union territories Chandigarh , Dadra and Nagar Haveli, Daman & Due, Delhi and Pondichery.

Permanently Settled States

There are three states namely Kerala, Orissa and West Bengal which come under category of permanently settled states. In case of these states land revenue was permanently fixed and question of revision ordinarily did not arise. In these states there is no system of recording details of area statistics as there is no permanent revenue staff for a village like village accountant as in the case of temporarily settled area. Initially there was no uniform system of collecting area statistics in these regions. The police Chaukidar or village headman was usually providing the statistics on the basis of guess work which were quite unreliable. In order to improve the quality of these statistics in the permanently settled states, (Presently, the area statistics in these states are collected by specially appointed field staff under the scheme) a scheme known as "Establishment of Agency for Reporting Agricultural Statistics (EARAS)" was initiated in 1968-69. In the States covered by EARAS, the complete enumeration of all fields (survey numbers), *i.e*., girdawari is conducted every year in a random sample of 20% villages of the States, which are selected in such a way that during a period of 5 years, the entire state is covered. This category covers around 9% of total reported area of the country.

Other Regions

The remaining eight states in North Eastern regions namely, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura and two other union territories namely, Andaman and Nicobar Islands and Lakshdweep do not have a proper reporting system, though states of Tripura and Skkim (except some minor pockets) are cadastrally

surveyed. In these regions compilation of area statistics are based on conventional methods in which estimates are reported by village choukidars on the basis of personal assessment. This category covers around 5% of total reported area of the country.

3. Timely Reporting Scheme (TRS)

In order to reduce the time-lag between the sowing and availability of estimates of area and harvesting of crops and availability of estimates of production, a Centrally sponsored scheme for Timely Reporting of Estimates of Area and Production of Principal Crops (TRS), was initiated by the Ministry of Agriculture and Irrigation in the year 1968-70. The basic objective of TRS is to reduce time lag for making available to area statistics of major crops in addition to providing the sample frame of selection of crop growing fields for crop cutting experiments in permanently settled states. Under the scheme, the villages in each stratum (tehsil/revenue inspector circle/patwari circle etc.) are divided into 5 independent non-overlapping sets, each comprising one fifth of the total number of villages. One set of randomly selected village is chosen for crop inspection on priority basis immediately after the sowing in each season are completed, but in advance of the period prescribed in the land records manuals for such crop inspection. The village crop area statements are submitted to higher authorities in stipulated date to estimate crop area statistics in advance for major crops. These estimates are further used for crop forecasting purposes. The sampled villages under TRS are selected from temporary area in such a way that the entire temporarily settled parts of the country are covered over a period of five years.

The TRS provides for recording the area under irrigation as well as area under high yielding varieties in the selected villages. Besides ensuring accuracy and timeliness of the enumeration of the area under crops, statistical staff under the scheme is required to inspect the fieldwork of crop cutting experiments and ensure timely dispatch of the returns. This scheme has been taken up in a phased manner in different States beginning with Uttar Pradesh and Maharashtra.

4. Establishment of an Agency for Reporting of Agricultural Statistics Scheme (EARAS)

In the states of Kerala, Orissa and West Bengal a scheme similar to TRS was introduced with same objectives of obtaining area estimates based on 20% sample for use of both by Center and States. Here also, it was envisaged that complete enumeration of fields for area figures would be available for all villages over a period of five years as in case of TRS.

5. System of Data Collection for Area Estimation

In the states where land record are maintained (temporary settled) the village accountant is in-charge of a village or a group villages for carrying out field to field crop inspection in each crop season for an agricultural year to record the crop area and land utilization statistics. He is supposed to record the crop details related to area and land utilization in Khasra register. After the completion of entries for each survey number of the village a abstract of area sown under different crops "Jinswar statement" is prepared and sent to next higher official in the revenue hierarchy. At the end of each agricultural year a land utilization area statistics are compiled and abstract is sent to related higher official. The crop wise and land utilization wise area statistics obtained from different villages are

aggregated at the revenue circle, tehsil and district levels. The district wise area statistics are sent to State Agricultural Statistics Authority (SASA), which is generally Director of Statistical Bureau or the Director of Agriculture or the Director of Land Records. The state level aggregation is done by SASA and forwarded to Directorate of Economics and Statistics (DES), Ministry of Agriculture & Cooperation, Govt. of India, which is the nodal agency for releasing the state level and the all India level estimates.

In order to improve the timeliness and quality of Agricultural Statistics, Ministry of Agriculture and Cooperation, Govt. of India introduced TRS and EARAS. Area enumeration under TRS has to be completed on priority basis in a random sample of 20% of the villages during each crop season in a state. EARAS was introduced as a sequel to TRS in the non-land record states namely Kerala, Orissa and West Bengal. This scheme provides for setting up whole time agency to cover 20% of villages every year so that all the villages of a state are covered in 5 years. In the sample villages under this scheme, the crop area is to be reported on the basis of complete enumeration.

6. System of Data Collection for Yield Estimation

The sampling design generally adopted for the Crop Estimation Surveys is one of Stratified Multi-Stage Random Sampling, with tehsils/taluks/revenue inspector circles/C.D., Blocks/anchals, *etc*. as strata and revenue village within a stratum as first stage unit of sampling, survey number / field within each selected village as sampling unit at the second stage and experimental plot of a specified shape and size as the ultimate unit of sampling. Details of sampling designs and its related procedures are provided in Annexure-III. In each selected primary unit generally two survey numbers/fields growing the experimental crop are selected for conducting crop-cutting experiments. However, in Dadra and Nagar Haveli three fields are selected instead of two.

Generally, 80-120 experiments are conducted for a crop in a major district where a district is considered as major for a given crop of the area under the crop in the district exceeds 80,000 hectares or lies between 40,000 and 80,000 hectares but exceeds the average area per district in the State. Otherwise, district is considered a minor for a given crop. Experiments in minor districts are so adjusted that the precision of the estimates is fairly high and the workload on the field staff is manageable. On an average, about 44 or 46 experiments are planned in a minor district. The number of experiments allotted to a district is distributed among the strata within the district roughly in proportion to the area under the crop in the stratum. Generally, the crop cutting is done in a plot of size 5m x 5m size for most of the crops in most of the states. However, in UP the shape of the plot is of an equilateral triangle of size 10 meters and in West Bengal a circular plot of radius 1.745 meters is taken for crop cut.

The average yield is obtained after harvesting, threshing, weighing and recording the weight of the produce from the selected plots. In a sub-sample of experiments further processing of the harvested produce is done to determine the percentage recovery of dried grains or the marketable grain of the produce depending on the nature of the crop.

In the case of three non-land record states i.e. Kerala, Orissa and West Bengal both area and yield are estimated on the basis of sample surveys. The crop cutting experiments are planned in a sub-sample of the primary units selected for the purpose of area enumeration.

The general procedure of selecting sampling units remains same at different stages as in that of other states. However, some special features of these states need to be mentioned specifically.

In Kerala block/city corporation or municipalities with an area of 10 Sq- Kms. and above are treated as separate stratum. Municipalities with an area of less than 10 Sq. Kms. are merged with adjoining blocks and treated as a single stratum. These blocks are divided into a number of Investigator Zones depending on the area of a block, nature of land, etc. City Corporation area is divided into three Investigator Zones. Each municipality with an area more than 10 Sq. Kms. is treated as a single Investigator Zone. The number of crop cutting experiments conducted in each Investigator Zone is six per season for paddy, three each for Coconut and Banana and two each for Tapioca, Arecanut, Cashewnut, Pepper, Plantain and Jackfruit in an agricultural year. In a municipal area having separate Investigator Zone, 10 crop-cutting experiments are conducted in respect of paddy per season and 5 for Coconut per year. For City Corporation areas, six experiments for paddy per season and five for coconut per year in one Investigator Zone are conducted.

7. System for Crop Forecasting

The advance estimates of crop area and production are released with respect to principal food and non-food crops (food grain, oilseeds, sugarcane, fibres etc.), which covers nearly 87% of agricultural output. Four forecasts are issued, first in middle of September, the second in January, the third towards the end of March and fourth by the end of May.

The advance estimates released in September are related to Kharif crops, which is mostly based on reports submitted by states based on visual observation of the field officials. The second forecast which covers both Kharif and Rabi and released in January by taking into account additional information obtained from various sources including agricultural inputs, incidence of pests and diseases, weekly reports from state government regarding area coverage, conditions of standing crops etc. Presently estimates obtained through Remote Sensing are also considered at this stage. The third forecast, which is made in March, the estimates of Kharif and Rabi seasons are revised based on information received from sources such as Market Intelligence Units, Meteorological Department and the Crop Weather Watch Group (CWWG). The forecast made by the end of May is based on actual figures supplied by State Agricultural Statistics Authorities (SASAs) using yield estimates obtained through GCES. In addition to these four forecasts, the DES, MOA provides final estimates in December. The fully revised estimates are obtained in the next crop year in the following December in which all delayed information are incorporated and all India crop statistics are released.

The National Crop Forecasting Centre (NCFC) was setup by Ministry of Agriculture with the objective of examining existing mechanism of making forecasts and developing more objective technique. However, the HCFC need to strengthen the crop forecasting system of the country by incorporating more objective techniques and models based on sound statistical techniques.

8. Co-ordination of Data Collection

The Field Operation Division of NSSO has the overall responsibility of assisting the States in developing suitable techniques for obtaining reliable and timely estimates,

providing technical guidance and ensuring adoption of uniform concepts, definitions and procedures in the Crop Estimation Survey (CES) in the States. It reviews the design, plan, details of implementation and the results of the surveys and, associates itself in the conduct of training camps organized for the States field staff and participates in the primary field work of exercising technical supervision.

9. Supervision of Data Collection

Supervision of fieldwork is an essential part of any large-scale sample survey for ensuring quality of data collected. A threefold approach is adopted in the States for supervision of crop cutting experiments planned under Crop Estimation Surveys. This includes

- supervision by the statistical staff of State Agricultural Statistics Authorities (SASAs),
- supervision by the Departmental staff *i.e*., by the supervisory officers of the Departments whose workers are responsible for the conduct of crop cutting experiments in the field, and
- supervision by the Technical personnel of the FOD of National Sample Survey Organisation.

In the States of Goa, Orissa, West Bengal and the UT of Pondicherry where the field work was conducted only by the staff of Statistics Department, the supervision was done by the Statistical staff only whereas in the case of Bihar, Himachal Pradesh, Union Territories of Dadra & Nagar Haveli and Daman & Diu, though there are other primary field agencies, the supervision was done by the State statistical staff only. Though supervision of the conduct of C.C. experiments in various states was in vogue since inception of Agricultural Statistical Wing from the year 1973-74 (Rabi) onwards, NSSO personnel are participating in the supervision by conducting sample check on crop cutting experiments in the post-harvest stages in a pre-assigned sample under the Scheme for Improvement of Crop Statistics (ICS) in 20 states and 2 Union Territories. Under this Scheme, State statistical staff also undertakes similar sample checks on a matching basis.

10. Applications of Remote Sensing and GIS Technology

In India, Indian Council of Agricultural Research (ICAR) and Indian space Research Organization (ISRO) jointly conducted the first multi-spectral air born study for identification of root-wilt disease in coconut in 1969.

The country level studies related to applications of remote sensing technologies were initiated after launch of IRS-IA satellite. Crop Acreage and Production Estimation (CAPE) was one of the important projects in this direction for estimation of crop area under wheat, rice, cotton, ground nut, sorghum& mustered. Apart from these national level projects, numbers of small studies have been carried out to develop methodologies for application of satellite data in various fields of agricultural and rural development by Department of Space. Some of these studies are by Dadhwal *et al.* (1985, 1991), *etc*. Several methodological studies related to estimation of crop area and production have been carried out at Indian Agricultural Statistics Research Institute (IASRI), New Delhi. Singh *et al*. (1992) used satellite data for stratification of crop area for the general crop estimation surveys and obtained more precise estimator of crop yield. Singh *et al.* (1999) also developed small area estimator of crop yield. Singh *et. al* .(2002) used satellite data

and the farmers eye estimate for developing a reliable crop yield model. Application of remote sensing and GIS technology for estimation of land use statistics using spatial models has been explored by Rai *et al.* (2004). Recently, a project entitled "Forecasting Agricultural Output Using Space, Agro-metrology and Land-based Observations (FASAL) has been launched under National Crop Forecasting Center (NCFC) of Ministry of Agriculture, to meet the requirements of timely nation wide and multi- crop reliable fore cast. A project has also been taken up jointly by IASRI New Delhi, Space Application Center (SAC) Ahamdabad and North-Eastern Space Application Center (NESAC) Shillong with the support of Directorate of Economic and Statistic of Meghalya state to explore the possibility of estimation of area and production of field crops by integration remote sensing technology, GIS and field survey. The result of all these studies are very encouraging and indicates that in future remote sensing and GIS has a great potential tool to improve the quality of area and production statistics of the country.

11. Improvement of Crop Statistics (ICS)

In addition to the crop area estimates developed by the state government the National Sample Survey (NSS) use to develop area estimates based on sample surveys during its regular rounds of surveys. Estimates were obtained for the whole country and also for certain population zones. There used to be significant differences between two series of data on crop area statistics. In order to probe into these high differences a technical committee on crop statistics was set up in 1963. The committee favoured *inter alia* the estimates based on complete enumeration. As a consequence the NSS discontinued its land utilization surveys and also crop cutting experiments in 1970-71 under household surveys. Thereafter, the NSSO introduced the ICS scheme in 1973-74 with an objective of improving the quality of statistics through joint efforts of centre and state authorities. Currently the scheme is in operation in 20 states and two Union Territories of Delhi and Pondicherry. In this scheme an independent agency (NSSO) carries out the supervision and physical verification of girdwari in a sub-sample of four clusters of five survey numbers in each of the TRS sample villages. An assessment is made for extent of discrepancies between the entries of supervisor and girdwari completed by village accountant for each of the selected survey numbers in the sample. The supervisors for checking possible errors of aggregations also scrutinize the crop abstract of the village, which is prepared by patwaries. The permanently settled states are also covered under this scheme where a sub-sample of EARAS sample villages (survey number) is scrutinized following the same methodology as adopted for temporarily settled area. Generally, a total of 10,000 sample villages are covered by the ICS out of which 8,500 are in the temporarily settled states and 1,500 in the permanently settled states.

National Sample Survey Organization (NSSO) is mainly responsible for planning and operations of ICS by employing full time field staff for supervision. The responsibility of field supervision is shared by designated state agencies which are responsible for carrying out the field supervision in approximately half of the sampled villages. Major Issues Emerging from the ICS Scheme:

- The crop statements submitted by patwari are many times based on incomplete girdawaries.
- The village crop statements are not submitted in time and there are large percentages of non-response.

- The entries in the girdawaries are not correct at least for one third of survey numbers.
- Recording area under mixed crop is a major source of errors as it is not uniform across the states.
- Sometimes there is uncertainty of recording area under crop as area sown or area harvested. This leads to inaccurate estimation of area, if area sown is recorded as area under crop and there is no germination as expected.
- Area sown more than once is also responsible for some confusion about statistics of area under various crops.
- Inclusion of field ridges, bunds in measurements also result in accuracy, which may be higher in some of the cases.
- Due to introduction of new technology / varieties, number of short duration crops are grown and also, there is shift in cropping pattern towards value added crops which are not reflected properly in girdawari.
- It has been observed that field staff approved by the State Government do not strictly adhere to the prescribed procedures and thereby the survey estimates are subject to a variety of non-sampling errors.
- The errors are introduced mainly due to wrong selection of fields and duration of selected experimental plots. The use of defective instruments such as proper weighing machine introduces considerable amount of measurement errors.
- The state departments of revenue and agriculture, which are responsible for carrying out the survey, keeps these programmes on low priority and there is inadequate higher level of supervision and control of field operations. The "High Level Coordination Committee (HLCC) on Agricultural Statistics" in the states has little impact in improving the quality of data.
- In order to meet the requirements of getting estimates at block/village panchayat levels especially for crop insurance purposes some of the State increased the number of crop cutting experiments considerably. This imposes an enormous burden on the field agency, increases considerably the non-sampling errors, which results in further deterioration of quality of data collected through GCES. There is possibility of under estimation of yield rates in case of crop insurance due to local pressure from insured farmers where interest lies in depressing the crop yield.
- It has been a matter of great debate in the past as production statistics obtained by different sources/agencies are quite different. The problem is especially significant in case of cash crops like cotton, oilseeds etc
- Inadequate training is provided to the field staff for conducting the crop cutting experiments.
- Another important factor, which has bearing on the quality of production data is, the late time schedule fixed for certain crops in Kharif season in some states. In this case crop-cutting experiments are to be conducted before completion of the season due to early harvesting. Such situations have been arising in respect of Kharif crops like maize, jowar, bajra, groundnut, cotton, soyabean etc. in States like Gujarat, Haryana, Karnataka and M.P. Due to early harvesting of these crops, area under crop is generally under reported and hence production too.
- There is strong need to develop suitable forecasting models which integrate information from different sources on parameters related to crop production such as crop conditions, agro meteorology, water availability etc.
- No multi-dimensional models exists in which the information generated from different sources can be integrated.

- The flows of information from different generating agencies are not time bound and appropriate.
- The DES, MOA is loosing confidence of users group due to frequent changes in production figures specially most of the time differences in the forecasted estimates are huge. These differences create lot of confusion and doubt among users
- The present technique is mostly subjective and is not based on sound statistical technique.