Estimation of Crop Area and Yield at State and National level based on reduced sample sizes

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Abstract

The estimates of area and yield rate of agricultural crops assume prime importance in agricultural statistics. The crop area statistics are collected on complete enumeration basis in land record States and in non-land record States like West Bengal, Odisha and Kerala, area statistics are collected through sample survey. The estimates of yield rates of principal food and non-food crops are obtained on the basis of Crop Cutting Experiments (CCE). During the past few years, a total number of approximately nine lakh CCE covering 52 food and 16 non crops were planned in different States. The number of CCEs is on the rise and leads to different types of non sampling errors, which affect data quality. To tackle such problem, Government of India constituted Vaidyanathan Committee to revamp the system covering 90 thousand CCE in 15 thousand villages. This paper attempts to highlight the detail study and methodology to be followed for improvement of existing system.

Introduction

Agriculture plays a vital role in the Indian economy. Over 70 per cent of the rural households depend on agriculture as their principal means of livelihood. Agriculture along with fisheries and forestry accounts for one-third of the nation's Gross Domestic Product (GDP) and is its single largest contributor. Agricultural exports constitute a fifth of the total exports of the country. In view of the predominant position of the Agricultural Sector, collection and maintenance of Agricultural Statistics assume great importance. India has a well-established and internationally acknowledged Agricultural Statistics System. It is a decentralized system with the State Governments – State Agricultural Statistics Authorities (SASAs) to be more specific – playing a major role in the collection and compilation of Agricultural Statistics at the State level while the Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare (DESMOA) at the Centre is the pivotal agency for such compilation at the all-India level. The other principal data-gathering agencies involved are the National Sample Survey Office (NSSO) under Ministry of Statistics and Program Implementation, Government of India and the State Directorates of Economics and Statistics (DESs). The Agricultural Statistics System is very comprehensive and provides data on a wide range of topics such as crop area and production, land use,

irrigation, land holdings, agricultural prices and market intelligence, livestock, fisheries, forestry, etc. It has been subjected to review several times since independence so as to make it adaptive to contemporary changes in agricultural practices.

From the point of view of collection of crop area statistics, the States in the country are divided into three broader categories: i) States and Union Territories (UTs) which have been cadastrally surveyed and where area and land use statistics are built up as part of the land records maintained by the revenue agencies (referred to as "Land Record States" or "Temporarily Settled States"). The system of land record is being followed in large number of states and UTs. These States/UTs account for about 86% of reporting area; ii) the states where area statistics are collected on the basis of sample surveys (normally known as "Non land Record States" or "Permanently Settled States" which are three in number viz. Kerala, Odisha and West Bengal). A scheme for Establishment of Agency for Reporting Agricultural Statistics (EARAS) has been introduced in these three states which envisages, inter-alia, either the estimation of areas by complete enumeration or through sample surveys in a sufficiently large sample of 20% villages/ investigators zones. These states accounts for about 9% of reporting area; and iii) in hilly districts of Assam, the rest of the states in North-Eastern Region, Sikkim, Goa, UTs of Andaman & Nicobar Islands, Daman & Diu and Lakshadweep where no reporting agency had been functioning, the work of collection of Agricultural Statistics is entrusted with the village headmen (5%).While the crop area statistics are collected on complete enumeration basis in respect of states in category (i) above, on ad-hoc methods based on impressionistic approach in case of states in category (iii) above, a scheme for Establishment of Agency for Reporting Agricultural Statistics (EARAS) has been introduced in the three states in category (ii) above.

In India, estimates of yield rates of principal food and non-food crops are obtained on the basis of Crop Cutting Experiments (CCEs)conducted in majority of States/UTs under the national program of crop estimation survey. At present, over 95 per cent of the production of food grains is estimated on the basis of yield rates obtained from the crop cutting experiments conducted on scientific basis spread over 29 States /UTs. The DES, MoA&FW, Government of India, releases estimates of area, production and yield in respect of principal crops of food grains, oilseeds, sugarcane, fibers and important commercial and horticulture crops. These crops all together account for nearly 87 per cent of agriculture output. The estimates of crop production are obtained by multiplication of area estimates by corresponding yield estimates. Therefore, the estimates of area and yield rates assume prime importance in the entire gamut of agricultural statistics. The need for timely, reliable and comprehensive statistics on area and crop production assumes special significance in

view of the vital role played by the Agricultural Sector in the Indian Economy. The primary responsibility for collection of statistics of land use and area under crops following prescribed procedures rests with the various State authorities. The yield rates of principal crops are estimated through general crop estimation survey (GCES) conducted by State agencies following scientific techniques of random sampling. During past few agricultural years, a total number of 9,00,000 (approximately) crop cutting experiments (CCEs) covering 52 food and 16 non-food crops were planned in different States/UTs as compared to 1,73,097 CCEs planned during 1973-74. The number of crop cutting experiment is on the rise and as such different types of non-sampling errors etc have affected the data quality. In order to overcome this problem, Improvement in Crop Statistics (ICS) scheme has been in operation but desired improvement in data quality is not forthcoming.

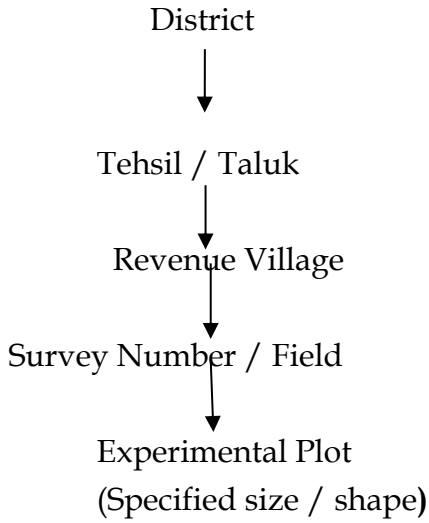
To tackle this problem, the Government of India had constituted a Committee on Improvement of Agricultural Statistics under the chairmanship of Professor A. Vaidyanathan. The Committee recommended to revamp the existing system by setting up of National Centre for Crop Statistics (NCSC) for generating reliable and unbiased estimates of land use, crop area and yield at the State and National level through enumeration of sample crops in a sample of 15,000 villages with 90,000 crop cutting experiments (CCEs). The broader objectives studied were to (i) review the problems in implementing the methodology and procedures prescribed for the collection/estimation of data on land use, cropping and yields and suggest measures to solve them; (ii) assess the potential of remote sensing techniques to collect these data and to indicate how to utilize this potential; and (iii) suggest institutional framework for Improvement of Agricultural Statistics. In order to implement the Professor Vaidyanathan Committee's recommendations to strengthen the existing system, a pilot study with the specific purpose of examining the reliability of estimates of crop area and crop production at state and national level on the basis of sample sizes recommended by the Vaidyanathan committee report was under taken by ICAR-Indian Agricultural Statistics Research Institute (ICAR-IASRI), New Delhi 12. The study is taken up with the objective to estimate the crop area and yield at the state and national level only for major food grain crops based on the sample sizes recommended by the Prof. Vaidyanathan committee report.

Area of Study and Methodology

Under this pilot study, the IACR-IASRI is considering5 states, preferably one each from Northern, Southern, Eastern, Western and Central region of the country which are Assam, Uttar Pradesh, Karnataka, Gujarat and Odisha. Among the states selected 4 states

falls under the TRS scheme and one state under EARAS Scheme and the hilly districts of Assam corresponds to "No Land Record" states. For crop area estimation IACR-IASRI has employed a stratified three stage sampling design and for the estimation of average yield, a stratified four stage random sampling design. Under this sampling design, within each State, district wise list of Tehsils/Taluks/RI Circles/CD Blocks/Anchals etc. (sampling frame) was prepared. Out of this frame, a random sample of Tehsils/Taluks/RI Circles/CD Blocks/Anchals etc. was selected at the first stage. At the second stage, list of villages among the selected Tehsils/Taluks/RI Circles/CD Blocks/Anchals etc. was prepared and a sample of revenue villages was selected. From each selected village, 100 survey numbers was selected randomly using equal probability without replacement sampling design in the form of clusters of 5 survey numbers and enumerated completely to estimate the crop area. The selected 100 survey numbers constitutes the crop wise frame for selection of plots for conduct of the crop cutting experiments. From the crop wise list of survey numbers 2 Survey numbers were randomly selected for the purpose of crop cutting experiment. In each selected village, 6 crop cutting experiments (CCEs) - 2 CCEs each on 3 major food grain crops is going to be conducted in an agricultural year in the Kharif and the Rabi season.

The sampling design has been indicated as follows:



As the survey is proposed to be conducted in 5 States, namely, Assam, Gujarat, Karnataka, Odisha and Uttar Pradesh and the recommended a sample size as per Prof. Vaidyana than committee report is of 15,000 villages throughout India, accordingly, on the basis of States gross cropped area, a sample of size 4,700 villages were allocated to these 5 States namely Assam (300 village), Gujarat (900 village), Karnataka (1000 village), Odisha (500 village) and Uttar Pradesh (2000 village). Accordingly, for area estimation 470000 Survey Numbers/Fields (= 4700 V x 100 Survey Numbers/Fields) have to be randomly

selected and their area under crop recorded. For yield estimation, a total of 4,700 V x 6 CCEs = 28,200 CCEs is proposed to be conducted in these 5 States. For data collection work paper based schedules/questionnaire were formulated to take into account the proposed methodology. Three schedules were developed. The data collection work was initiated in the states and filled in schedules were obtained at the state headquarters.

Implementation

The field data collection work for Kharif and Rabi season of AY 2015-16 in the four States namely Assam, Odisha, Uttar Pradesh, and Karnataka has been completed. To digitize the collected data, a data entry software was prepared. Trainings were imparted to the state officials of the 4 above mentioned states about the data entry operation using data entry software and data entry work is going on in all the 4 states. The data entry for crop area enumeration was almost over in all the 4 states. An Android based data collection software was developed under this project. The software is named as Mobile Assisted Personal Interviewing (MAPI) software. Using this MAPI software data collection work can be done using any android based smart phone or tablet and as it is based on Android version 4.1.The goal in application development is to create the best possible software in the least amount of time. This software is developed using Core java Technology. The Java platform is a suite of programs that facilitate developing and running programs written in the Java programming language. A Java platform will include an execution engine (called avirtual machine), a compiler and a set of libraries; there may also be additional servers and alternative libraries that depend on the requirements. Java is not specific to any processor oroperating system as Java platforms have been implemented for a wide variety of hardware and operating systems with a view to enable Java programs to run identically on all of them. Some glimpses of the MAPI software in the following figures:

Figure 1

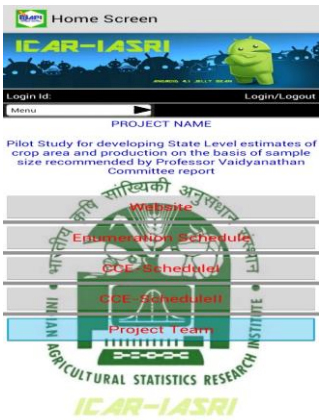


Figure 2

Figure 3

The MAPI software is deployed for primary data collection work in the state of Uttar Pradesh in two districts namely Pratapgarh and Bulandsahr for Rabi 2015-16. The data collection work will be done in two tehsils in all the selected villages in the two districts. For initiation of data entry work using MAPI software a Two days training cum workshop was organized during March 18-19, 2016 at IASRI for the field investigators and district officials of the two districts. The data collection work through MAPI software was completed and we received the data collected through that software whereas data collected through paper based surveys are still awaited.

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Food subsidy in India increase due to rising economic cost of handling food grains through procurement, distribution and storage as well as increase in procurements.

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