Pilot Study for Developing State Level Estimates of Crop Area and Production on the basis of Sample sizes Recommended by Prof. Vaidyanathan Committee Report- Gujarat State

S.S. Kalamkar, S. R. Bhaiya, M. Swain & H. Sharma

With the support of
Directorate of Agriculture, Government of Gujarat and
National Sample Survey Organization, Ahmedabad

Part of a research study undertaken in five states of India by

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Disclaimer

This report presents the information related to process of data collection and crop cutting experiments in India in order to document as well as to make reader more clear about the system and process, which is heavily based on published reports including IASRI report. The sources of data are cited and acknowledged.

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Foreword

Agriculture with its allied sectors (viz. horticulture, animal husbandry. fishery, forestry etc.) is the largest livelihood provider making significant contribution to the national Gross Domestic Product in India. In this context, agricultural statistics has great importance for the planners for planning of most important economic policies for betterment of the people of the country. Therefore, lack of quality agricultural statistics may lead to misallocation of scarce resources and policy formulations that fail to resolve critical development problems. As such generation of timely, reliable and quality agricultural statistics assumes importance for policy planning and administrative decision making. Reviewing and upgrading mechanism for continuous generation of timely and reliable agricultural statistics therefore is of paramount importance. Two major approaches for development of appropriate methodologies for generation of agricultural statistics are (a) complete enumeration, and (b) sample survey. Sample survey is generally adopted because it provides cost effective, timely, precise and quality output. The two major components of agricultural statistics are the estimate of crop area and crop yield whereas estimates of crop production are obtained by multiplication of area estimates by corresponding yield estimates.

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/Union Territory (UTs) under the National Programme of Crop Estimation Survey (CCEs). At present, over 95 per cent of the production of foodgrains is estimated on the basis of yield rates obtained from the CCE conducted on scientific basis spread over 29 States/UTs. The Directorate of Economics and Statistics (DES) releases the 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 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 the technique of stratified multi-Stage random sampling.

During past few agricultural years, a total number of approximately 9,00,000 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 CCEs 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 overcome this problem, 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 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 Committees recommendation to strengthen the existing system, the Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, GOI had decided to conduct a pilot sample survey through IASRI, New Delhi. Accordingly, this project was assigned to IASRI, New Delhi 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 covering five states of India (Assam, Gujarat, Karnataka, Orissa and Uttar Pradesh). Under this study, it was proposed (a) to develop the sampling methodology for estimation of State-wise crop area and crop yields for major food grain crops; (b) to see the adequacy/ feasibility of the sample sizes at different stages of sample selection for obtaining the estimates with suitable precision; (c) to explore the feasibility of using Personal Digital Assistant (PDA) and Global Positioning System (GPS) device in data collection work and (d) to carry out statistical comparison of data collected through Paper and Computer Assisted Personal Interview (i.e. PAPI and CAPI) in few selected tehsils. The study was conducted in the State of Gujarat covering 900 villages and conducted the 5321 CCEs across the villages.

Despite of various constraints faced during the planning and execution of field work, Centre has completed the project within time frame and as per methodology suggested by the IASRI, New Delhi. The study has come out with the suitable policy implications. I hope findings of the study would be useful for policy makers, funding agency and administrators of this programme.

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The study on "Pilot Study for Developing State Level Estimates of Crop Area and Production on the basis of Sample sizes Recommended by Prof. Vaidyanathan Committee Report- Gujarat State" has been carried out at the Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar (Gujarat), as desired by the **Directorate of Agriculture, Government of Gujarat, Gandhinagar** and the **Indian Council Agricultural Research (ICAR) Indian Agricultural Statistical Research Institute (IASRI)', New Delhi**. This project was sponsored by the Directorate of Economics and Statistics (DES), Ministry of Agriculture and Farmers Welfare (MOA&FW), Government of India to ICAR-IASRI, New Delhi. AERC has acted as a partner Institute and undertaken the field data collection work of the project in the state of Gujarat, as desired by the Government of Gujarat and IASRI, New Delhi.

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We thank all the field investigators/field staff who have collected the field data in very short period of time. Thanks to staff of BJVM, Vallabh Vidyanagar; field staff of NSSO, AERC and CCS for executing the field work as suggested by IASRI and completing the data collection and data entry work well within stipulated time period.

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Project Leader

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Abbreviations

AE	Area Enumeration
AERC	Agro Economic Research Centre
AIG	Agricultural Information Group
AWiFS	Advanced Wide Field Sensor
AY	Agricultural Year
CAPE	Crop Acreage and Production Estimation
CAPI	Computer Assisted Personal Interviewing
CCE	Crop Cutting Experiment
CCEs	Crop Cutting Experiments
CES FV	Crop Estimation surveys on Fruits & Vegetables
DES	Directorate of Economics & Statistics
DMI	Directorate of Marketing and Inspection
EARAS	Establishment of an Agency for Reporting Agricultural Statistics
FASAL	Forecasting Agricultural Output using Space Agro meteorology and Land-Based Observations
FOD	Field Operations Division
FS	Field Study
FSU	First Stage Unit
GCA	Gross Cropped Area
GCES	General Crop Estimation Survey
GCESs	General Crop Estimation Surveys
GDP	Gross Domestic Product
GIS	Geographical Information System
GPS	Global Positioning System
IASRI	Indian Agriculture Statistical Research Institute
ICAR	Indian Council of Agricultural Research
ICAR-IASRI	ICAR-Indian Agricultural Statistics Research Institute
ICS	Improvement of Crop Statistics Scheme
IEG	Institute of Economic Growth
IMD	Indian Meteorological Department
INCOIS	Indian National Centre for Ocean Information Services
ISI	Indian Statistical Institute
ISRO	Indian Space Research Organisation
LAI	Leaf Area Index
LUS	Land Use Statistics
MAPI	Mobile Assisted Personal Interview
MoA & FW	Ministry of Agriculture and Farmers Welfare
MoES	Ministry of Earth Sciences

MoU	Memorandum of Understanding
NAIS	National Agricultural Insurance Scheme
NCCF	National Centre for Crop Forecasting
NCFC	National Crop Forecasting Centre
NCSC	National Crop Statistics Centre
NCSC	National Crop Statistics Centre
NHB	National Horticulture Board
NRSACs	National Remote Sensing Application Centres
NRSC	National Remote Sensing Center
NSC	National Statistical Commission
NSS	National Sample Survey
NSSO	National Sample Survey Organization
PAPI	Paper Assisted Personal Interviewing
PC	Personal Computer
PDA	Personal Digital Assistant
PFZ	Potential Fishing Zones
PI	Principal Investigator
PMC	Project Management Committee
PMFBY	Pradhan Mantri Fasal BimaYojna
RS	Remote Sensing
SAC	Space Applications Centre
SAG	Statistical Analysis Group
SAR	Synthetic Aperture Radar
SASA	State Agricultural Statistics Authority
SASPP	Strengthening of Agricultural Statistics and Policy Formulation
SDDS	Special Data Dissemination Standards
SRSACs	State Remote Sensing Application Centres
SRSWOR	Simple Random Sampling Without Replacement
SSU	Second Stage Unit
TRS	Timely Reporting Scheme
TSU	Third Stage Unit
VAO	Village Assessment Officer/ Patwari

Executive Summary

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1. Introduction

Agriculture with its allied sectors is the largest livelihood provider making significant contribution to the national Gross Domestic Product in India. Thus, agricultural statistics has great importance for the planners for planning of most important economic policies for betterment of the people of the country. Therefore, lack of quality agricultural statistics may lead to misallocation of scarce resources and policy formulations that fail to resolve critical development problems. As such generation of timely, reliable and quality agricultural statistics assumes importance for policy planning and administrative decision making. Reviewing and upgrading mechanism for continuous generation of timely and reliable agricultural statistics therefore is of paramount importance. Two major approaches for development of appropriate methodologies for generation of agricultural statistics are (a) complete enumeration, and (b) sample survey. Sample survey is generally adopted because it provides cost effective, timely, precise and quality output. The two major components of agricultural statistics are the estimate of crop area and crop yield whereas estimates of crop production are obtained by multiplication of area estimates by corresponding yield estimates.

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/Union Territory (UTs) under the National Programme of Crop Estimation Survey (CCEs), At present, over 95 per cent of the production of food grains is estimated on the basis of yield rates obtained from the CCE conducted on scientific basis spread over 29 States/UTs. The Directorate of Economics and Statistics (DES) release 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 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 the technique of stratified multi-Stage random sampling.

During past few agricultural years, a total number of approximately 9,00,000 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 CCEs 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 overcome this problem, 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 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 Committees recommendation to strengthen the existing system, the Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, GOI has decided to conduct a pilot sample survey through IASRI, New Delhi. Accordingly, this project was assigned to IASRI, New Delhi 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 covering five states of India (Assam, Gujarat, Karnataka, Orissa and Uttar Pradesh). Under this study, it was proposed to develop the sampling methodology for estimation of State-wise crop area and crop yields for major food grain crops; to see the adequacy/ feasibility of the sample sizes at different stages of sample selection for obtaining the estimates with suitable precision; to explore the feasibility of using Personal Digital Assistant (PDA) and Global Positioning System (GPS) device in data collection work and to carry out statistical comparison of data collected through Paper and Computer Assisted Personal Interview (i.e. PAPI and CAPI) in few selected tehsils.

2. Data and Methodology:

The study was conducted in 900 selected villages of Gujarat from all the eight agro-climatic zones and 33 districts of the state and conducted the 5321 CCEs across the villages. For the estimation of average yield, stratified four stage random sampling design was used. Every district in the Gujarat was sampled in the study. Within a district, a suitable number of tehsils were selected by Simple Random Sampling Without Replacement (SRSWOR). From each district, 50 per cent of the tehsils were selected by SRSWOR. This was followed by allocation of the villages to the selected tehsils in proportion to their GCA. Accordingly, total 900 villages from all 33 districts of the state were covered under the experiment. Survey period was agriculture year 2016-17 (June 1, 2016 to May 31, 2017). The six types enumeration schedules were canvased in the selected villages and selected survey numbers. Each selected survey number was visited by the investigator for plot to plot crop area enumeration in kharif and rabi seasons. The irrigation status of the selected crop was recorded at the time of area enumeration. MAPI (Mobile Assisted Personal Interview Version 4.1) provided by the IASRI, New Delhi was used for data collection in 12 villages of Gandhinagar district.

3. Field Observations:

- Though most of the farmers were cooperative, few farmers were not allowing field staff to enter in to the field as they argue that crop gets disturbed/damaged. As there was not substitution permitted for village as well as selected survey numbers, we had to pursue the selected farmer for selected CCEs. After continuous follow- up, somehow field staff managed to conduct the CCEs.
- In few cases, harvest of whole crop on selected plot was done by farmers, thus output of the entire field was recorded and yield for plot size under study was calculated.
- In few cases, respondents were not cooperative to provide the necessary information. So field staff had to pursue the selected respondent for the same.
- Due to some family conflicts, the 5×5 plot demarcations were removed frequently.
- In some selected villages in Saurashtra region of Gujarat, Cotton is the only crop sown during Kharif season by selected 100 survey numbers.
- Selected Village with Sole Crop, Fodder, no crop grown during crop season
- In four selected villages in Kutch region of Gujarat, no agriculture crop was sown during Kharif season of 2016.
- In some villages, only one food grain/oilseed crop was sown by selected 100 survey numbers.
- Farmers expressed hurriedness/ bored due to very large number of questions asked to them. This created difficulties in deriving the key inputs from of them which are relevant for the CCE experiments.

While conducting the field work, data entry and analysis of data for all the districts of Gujarat, several problems are encountered. Few of those major problems and observations are highlighted as followed,

- One of the major problems encountered while conducting the survey as per recommendations lay out by Professor Vaidyanathan Committee Report is major crops. As per committee's recommendation, the pilot project aimed at generating only state and national level estimates but as per request of the sponsoring agency the objective was changed to produce district level area and yield estimates of major crop. The main problem encountered was the major crops at district level may not be the same as major crops at state level. At state level, wheat is treated as major crop but in many districts cotton and groundnut was found occupying most of the selected survey numbers in our study. As per PMC recommendations, only major food grain crops are to be considered in the study so many cash and other major crops at the district level got ignored and also covering all the crops are beyond the scope of the study as the budget is allocated only for 3 crops at state level (2 in Kharif and 1 in Rabi).
- As our staff is mainly involved in field survey for research studies and cost of cultivation surveys, and therefore, to execute the project in proper manner, several training programmes were organised for the staff of the Centre. However, staff of associated institutions could not match up with the same and thus initially faced the problem in conduct of the CCEs.

- One issue frequently raised by the field staff was the difficulties in conducting CCE. CCE requires high level cooperation and coordination between at least three agencies, viz. farmers, state agency like patwaris and data collectors. It requires multiple visits for selection, identification, fixing dates for harvest, harvesting etc. It is always uncertain to fulfil all these engagements. It also requires special equipment and specific skill. Over the years, there are shortcomings in these requirements in general and tremendous reluctance on the part of farmers for some valid reasons in particular. There are other technical problems as well. The plot for CCE is selected randomly and thereby falls anywhere in the field, need not be in the corner or boundary. As a result, it is difficult to keep a small plot separately for harvest. It is also likely to damage nearby crop. It is more difficult with the introduction of mechanization of harvesting, thrashing etc. The number of CCEs is also increasing to a large extent as demand of yield estimates at disaggregate level is also increasing. Therefore, lot of compromise has to be made in the field. These definitely give rise to doubt about its efficacy and quality of data generated through CCEs. It is high time to explore some alternative methodology to generate yield estimates by using modern technology. Although, Remote Sensing technique is being in use for quite some time, results are not very encouraging, especially in the case of yield estimation.
- Though most of the farmers were cooperative, few farmers were not allowing our field staff to enter in to the field as they argue that crop gets disturbed/damaged. After continuous follow-up, somehow field staff managed to conduct the CCEs.
- In few cases, harvest of whole crop on selected plot was done by farmer/s, thus we recorded particular plot output and calculated yield for plot size under study.
- In few cases, respondents were not cooperative to provide the necessary information as well as reluctant to permit us to plot CCE in selected plot area. As there was not substitution permitted for village as well as selected survey number, we had to pursue the selected farmer for selected CCEs.
- For about 35 villages, no land data was available on GOG website (https://anyror.gujarat.gov.in/). Thus, we have used land record available at selected villages, then we selected 100 survey numbers and then done census of same and subsequent crop and plot selection.
- Few selected Survey villages were with less than 100 survey numbers (Ahmedabad region- 04 villages; Vadodara region- 22 villages)
- The data collection is done by the field staff (experiment basis/contract basis) and thus we had to depend on them for accuracy and timeliness of data sets. Despite of training provided to them on field, field staff has tendency to look for another work while conducting present work, which has negative impact on data sets. Therefore, work of CCE should be undertaken from the permanent staff of any research institute or organization so that we can track and get it correct data if any mistake found in later stage in recording data.
- Initially there was wide variation between Longitude and Latitude recorded in MAPI Software and WhatsmyGPS.com. Even same village has reported

different GPS in MAPI software. IASRI noted the submission and provided the solution for data collection though MAPPI.

- Since the survey numbers were not updated in land records of some districts, the records didn't match the field level situation. It was very difficult to trace the actual farmer/s of the selected plot. As a result, we had to put lot of efforts to reach the right plot as per sampling.
- There were a large number of dates mentioned in the schedules which farmers could not recall exactly, at some cases.
- It was felt that information on driage experiment may not be required for this pilot study.

The field staff have reported problems related data entry, which were as follows

- Due to relatively lengthy schedules, the field investigators were confused due to similar information appearing at many places of the schedules. They were of opinion that so many information/options in the schedules are not relevant for the CCE experiments. But they took more time and created confusion.
- In some cases, units of measurement were not mentioned. As a result, multiple units were used by the field staff, which made a difficult situation for supervisors and computer staff to rectify the data set and enter the date correctly.
- Preliminary village level information were repeated in Schedule I and II. Same data were needed to be entered twice. It was suggested to improve the software in such a manner that, once it is entered in one place, it should appear in other required locations.

4. About Selected Household, Crops and Crop Estimates

- The wheat was the major crop got selected for crop cutting experiments covering one fourth of total crop cutting experiments conducted in the State as it was grown by most of the farmers in Gujarat. Groundnut, bajra, tur and paddy were another major crops cultivated by the selected farmers. The other crops cultivated by the farmers were jowar, mung, maize, sesamum, urad, R&M, gram, and moth, while 1.2 per cent of households had not grown any crop on selected survey area.
- The crops sown during the early and late kharif season were paddy, jowar, bajara, maize, tur, moog, urad cotton and fodder crops. Wheat, gram, tobacco, castor and fodder crops were sown during rabi season while summer paddy, bajra and fodder crops were grown.
- On an average the age of the selected farmer household was estimated to be 51 years which was almost same in both the cases. Same the case of average education of cultivators which was estimated to be 6.6 years across crops.
- The crop-wise state level estimates indicate that the yield level of paddy crop was estimated to be 35.86 quintals per hectare, 27.35 quintals per hectare inbajra crop, 19.91 quintals per hectare of groundnut crop, 19 quintals per hectare in tur, 13.12 quintals per hectare for maize and around 8.5-8.5 quintals per hectare in case of mung and sesamum crop.
- While variation in area coverage across crops was estimated to be between 30-40 percent while yield variation was estimated to be highest of between

15-16 per cent in pulse crops (tur and mung) followed by in case of urad crop (9.3%). The lowest range of variation was estimated in groundnut crop.

- The variation in area was estimated to very high as compared to productivity level with exceptions of few cases.
- During the rabi season, wheat was the only crop was grown by the all the selected farmers of the selected sample households of selected villages of Gujarat, while gram crop was grown by selected respondents of only nine districts only. However, maize crop was grown in only three districts, while only one district was reported coverage of mung, rapeseed mustard and sasamum crop. It is very important to see limitation of coverage of crops which further limit the estimation of crop yield at district and state level.

- Professor Vaidyanathan Committee recommended a smaller sample, around 2 per cent of total villages, to generate area, yield & production estimates at state and national level. This project adopted same sample size, but attempted to generate district level estimates as requested by DES.
  - The problem of small sample became more acute as only 100 survey numbers in each selected village was covered instead of complete enumeration of the village.
  - Effectively, sample fraction becomes less than 1 per cent. As a result, many of the crops were either missed or less number of observations was available.
  - This project was also intended to cover only major food grain crops, which created another problem. Except in case of wheat during Rabi in season, no crop was found throughout the states as major.
  - It was also reported that even though particular crop was available in the selected village, but not available in the selected survey number.
  - Thus, many crops are missing and the data may not be proper representative of the crops grown in the district.
  - So, state level estimates could not be generated for most of the crops by simply adding district level estimates.

5. Conclusions & Recommendations

Professor Vaidyanathan Committee reviewed the current Agricultural Statistical System and recommended reduced sample size to generate State and National level crop area and yield estimates of principal crops and to set up an independent agency to collect & process the field data. However, this project, even though constituted on the basis of the recommendations of Professor Vaidyanathan Committee, attempted to generate estimates at district level as requested by the funding agency.

- For area estimation, sample survey approach was considered based on enumeration of 100 survey numbers randomly selected from each selected village instead of complete enumeration of selected villages.
- With the given sample size, the major crops were captured in the selected villages, if it was available. For area enumeration one of the major issues

emerged was selection of 100 survey numbers in place of complete enumeration.

- While some difficulties were faced in executing the same as discussed earlier.
- From the observations of the project, it was therefore suggested that the stratum should be agro-climatic zones instead of districts in each state to generate state as well as national level estimates which was also recommended in the report by Prof. Vaidyanathan Committee and subsequently, district level estimates could be generated by using techniques like small area estimation (SAE).
- Another issue cropped up during survey was the concept of major crop. There was lot of confusions regarding definition of major crop. A crop, which is major at state level, may not be grown by all the districts or at village level. On the other hand, crops grown in the selected field may not be the major crop at district or state level. Due to this confusion coupled with smaller sample and non-coverage of entire village, many a times, important crops were missed or unimportant crops were covered. It is, therefore, advisable to pre-determine the crops to be covered in the survey and data may be collected only on these crops.
- In this project, it was observed that day by day, implementation of CCE is becoming difficult, due to shortage of trained personnel, lack of co-ordination between farmers and primary agencies, reluctance on the part of farmers and many other operational hazards. Further, mechanized harvesting is making it difficult to keep a small plot for separate harvesting.
- There is an increasing need of disaggregate level estimates of yield estimates (e.g. for the purpose of crop insurance etc.). This further requires an increasing number of CCEs to meet this demand to generate the reliable yield estimates at disaggregate level such as village and gram panchayat level. This clearly indicates an urgent need to explore new techniques to estimate yield rates using modern technologies in order to reduce the number of CCEs significantly. It is therefore suggested to explore recent survey estimation methodologies such as integration of data, combining of survey data, small area estimation etc. to meet such demands.
- One of the objectives of this project was to explore the feasibility of using PDA and GPS device in data collection work in few selected tehsils. Accordingly, ICAR-IASRI had developed the MAPI software and selected one district in Gujarat for field data collection using hand held devices like tablets with this software. MAPI can be used in smart phones or tablets and enabled field staff to collect data directly from the field and transmit to his supervisor or to processing center. It was observed that MAPI could reduce the time lag to a considerable extent as it eliminates some activities such as data entry, submission of schedule, table scrutiny, back references etc. As some of the validation like coverage, range etc. is part of this software, many of the mistakes could be detected and rectified at the field level itself. GPS fitted with the devices would enable the software to record the location of the field, which helps in to control and manage the field work more effectively and also ensures validity of the data. The device may also measure the field, if necessary using GPS. Another advantage of this system is to have images of the experimental field and store it. This opens up lot of opportunities. Images of standing

crop along with some auxiliary information could predict yield estimates though image analysis. This software could be customized for all others survey as well. It is, therefore, suggested that hand held devices with MAPI may be used for data collection in every survey in future.

- The major objective of the study was to generate the state level estimate of crop area and yield of the major crops under considerations. But due to change in sampling design to generate district level estimates as requested by the sponsoring agency, there was a problem while selection of major crops as it varies at disaggregate level i.e. districts, village etc. than that of the state. For generation of district level estimates, the stratum was shifted to districts from agro-climatic zones which summoned in the problem of major crops as well as small or no sample size is few districts. Due to this fact, the district level estimates for all the major crops for all the districts are not been generated. For generation of state level estimates from the proposed reduced sample size, we recommend use of Agro-climatic zone as stratum instead of districts.