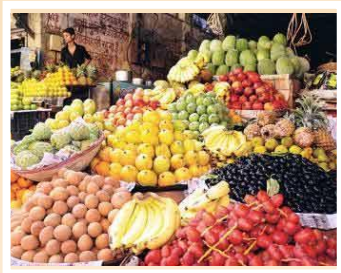
सत्यमेव जयते

# 10th STATISTICS DAY

## June 29, 2016








## THEME: AGRICULTURE AND FARMERS' WELFARE


GOVERNMENT OF INDIA

MINISTRY OF STATISTICS AND PROGRAMME IMPLEMENTATION

www.mospi.gov.in

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# Messages of Dignitaries

सत्यमेव जयते

राष्ट्रपति
भारत गणतंत्र
PRESIDENT
REPUBLIC OF INDIA

## MESSAGE

I am happy to learn that the Ministry of Statistics and Programme Implementation (MoSPI) is celebrating the 10th Statistics Day on June 29, 2016 to coincide with the birth anniversary of late Prof. Prasanta Chandra Mahalanobis, development planner, visionary, economist, physicist and renowned statistician.

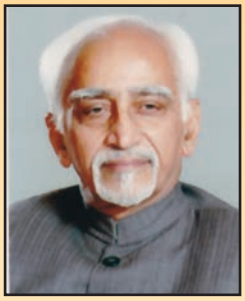
Statistics plays a very significant role in the process of making available appropriate, reliable and credible information for objective decision making. Statistics should be instrumental in making well-informed policies. Let us on this day aim to create awareness among the people, especially the youth, about the role of statistics in socio-economic planning and policy formulation by drawing inspiration from the vision of Professor Mahalanobis.

The theme for the Statistics Day 2016 "Agriculture and Farmers' Welfare" is extremely relevant in view of current emphasis on overall growth in the agro-sector.

On this occasion, I extend my greetings and felicitations to all Statisticians of India and wish the Statistics Day Celebrations every success.

(Pranab Mukherjee)

New Delhi
June 22, 2016



सत्यमेव जयते

भारत के उप-राष्ट्रपति
VICE-PRESIDENT OF INDIA

## MESSAGE

I am happy to know that Ministry of Statistics and Programme Implementation is celebrating the 10th Statistics Day on June 29, 2016 to commemorate the birth anniversary of Late Professor P.C. Mahalanobis, a pioneer in Indian Statistical System.

Availability of good statistics has an important role in the policy making system of the country. It paves the way for good governance. I am pleased that the Ministry has selected "Agriculture and Farmers' Welfare" as the theme for this Statistics Day. Farmers are the key to ensuring our Food Security. I hope this commemoration will be useful in improvement of statistical methods related to Agriculture Sector and contribute to improving the lives of our farmers.

I wish the commemoration of the 10th Statistics Day great success.

**(M. HAMID ANSARI)**

**New Delhi**
**21st June, 2016**

सत्यमेव जयते

प्रधान मंत्री

Prime Minister

## MESSAGE

I am happy to learn that the Ministry of Statistics and Programme Implementation is celebrating the 10th Statistics Day on 29th June, 2016 on the theme, "Agriculture Statistics and Farmers' Welfare."

I hope the Ministry will take this opportunity to formulate effective strategies for the collection and application of statistics related to the agriculture sector, with the primary objective of raising farmers' incomes.

On this occasion, I extend my best wishes to the Ministry of Statistics and Programme Implementation.

**(Narendra Modi)**

**New Delhi**
**26 June, 2016**

राधा मोहन सिंह
RADHA MOHAN SINGH

कृषि एवं किसान कल्याण मंत्री
भारत सरकार
MINISTER OF AGRICULTURE
& FARMERS WELFARE
GOVERNMENT OF INDIA

सत्यमेव जयते

D.O. No. 137/...../AM

22nd June, 2016

**MESSAGE**

On the occasion of the Statistics Day on 29th June, 2016, I extend my best wishes to the entire statistical fraternity and users and producers of official statistics. The celebration on this day all over the country is a befitting tribute to Late Prof. Prasanta Chandra Mahalanobis on his 123rd birth anniversary. Prof. Mahalanobis made pioneering contribution in the field of statistics and economic planning.

Our Government is committed to villages, poor and farmers. Rural people are largely dependent on agriculture for their sustenance. Ministry of Agriculture and Farmer's Welfare has initiated a number of schemes for increasing agricultural productivity and securing farmers' welfare namely Prime Minister Fasal Bima Yojana, National Agriculture Market, Soil Health Card to name a few. Importance of data to measure the effectiveness of these schemes needs no emphasis. Besides, our Ministry is also working on making all related data available to the farmers through web portals and mobile applications. In this context, I am very happy to see that "Agriculture and Farmers' Welfare" has been chosen as the theme for this year's Statistics Day. I hope efforts will be made throughout the year by statisticians all over the country to improve agricultural statistics and enrich farmers with all related data and information.

I take this opportunity to convey my warmest felicitations to the statistical community in India and wish Statistics Day celebrations, a great success.

Radha Mohan Singh

**(Radha Mohan Singh)**

Office : Room No. 120, Krishi Bhawan, New Delhi-110 001 Tel.: 23383370, 23782691 Fax : 23384129

जनरल (डा.) विजय कुमार सिंह
पी वी एस एम, ए वी एस एम, वाई एस एम (से.नि.)
**General (Dr.) Vijay Kumar Singh**
**PVSM, AVSM, YSM (Retd.)**

सत्यमेव जयते

राज्य मंत्री (स्वतंत्र प्रभार)
सांख्यिकी एवं कार्यक्रम कार्यान्वयन मंत्रालय एवं
विदेश राज्य मंत्री, भारत सरकार, नई दिल्ली
**Minister of State (Independent Charge) for Statistics & Programme Implementation and Minister of State for External Affairs Government of India, New Delhi**

# सन्देश

1. मुझे यह जानकर खुशी है कि सांख्यिकी और कार्यक्रम कार्यान्वयन मंत्रालय 29 जून 2016 को स्वर्गीय प्रोफेसर प्रशान्त चन्द्र महालनोबिस के 123वें जन्म दिवस को 10वें सांख्यिकी दिवस के रूप में मनाने जा रहा है । प्रोफेसर महालनोबिस, जिन्हें भारत में सांख्यिकी का जनक कहा जाता है, एक महान भारतीय सांख्यिकीविद् और वैज्ञानिक थे । भारतीय आर्थिक योजना तथा भारतीय सांख्यिकी संस्थान की स्थापना में उनके महत्वपूर्ण योगदान को भारत के इतिहास में हमेशा मील के पत्थर के रूप में याद किया जाएगा ।

2. यह जानकर प्रसन्नता हो रही है कि **'कृषि और कृषक कल्याण'** इस वर्ष की विषय-वस्तु है। बहुत दशकों पूर्व महात्मा गांधी ने कहा था 'कृषि भारतीय अर्थव्यवस्था की रीढ़ की हड्डी है'। स्थिति अब भी वही है, कृषि जो गांवों का मुख्य आधार है, वह आज भी समग्र अर्थव्यवस्था को लगभग स्थिर बनाए हुए है। हमारे देश में कामकाजी व्यक्तियों का लगभग 50% कृषि कार्य में लगा हुआ है तथा यह क्षेत्र देश की सकल मूल्यवृद्धि में लगभग 17% का योगदान देता है । इस क्षेत्र के लिए नीतियां बनाने तथा कल्याणकारी उपाय सुझाने में कृषि सांख्यिकी बहुत महत्वपूर्ण है । मुझे आशा है कि सांख्यिकी दिवस के अवसर पर होने वाले विचार-विमर्शों से विश्वसनीय, यथासमय तथा उपयोगी सांख्यिकी तैयार करने और उपलब्ध कराने के लिए नए विचार सामने आएंगे ।

3. मुझे पूरा विश्वास है कि सांख्यिकी दिवस समारोह देश की सांख्यिकी प्रणाली की महत्ता के बारे में लोगों को जागरूक बनाएगा तथा प्रोफेसर महालनोबिस की महान उपलब्धियों को जानने के लिए उन्हें प्रेरित करेगा । मैं सांख्यिकी दिवस समारोह की सफलता की कामना करता हूं ।

**23.06.2016**

101, Sardar Patel Bhawan, Parliament Street, New Delhi-110001
Tel: 011-23367245, 23340739, 23340884, Fax: 011-23340138

Residence: 36, Dr. A.P.J. Abdul Kalam Road, New Delhi-110011
Tel: 011-23794516, 23017056, Fax: 011-23013800

सत्यमेव जयते


भारत सरकार
सांख्यिकी एवं कार्यक्रम कार्यान्वयन मंत्रालय
राष्ट्रीय सांख्यिकीय आयोग सचिवालय
सरदार पटेल भवन, संसद मार्ग,
नई दिल्ली -110001
Government of India
Ministry of Statistics and Programme Implementation
National Statistical Commission Secretariat
Sardar Patel Bhavan, Sansad Marg
New Delhi-110001
E-mail : nsc-secretariat@nic.in



Dr. R.B. Barman
Chairman


# Message

I am happy to learn that the Ministry of Statistics and Programme Implementation is celebrating the 10th Statistics Day on June 29, 2016 commemorating the birth anniversary of Late Prof. P. C. Mahalanobis.

Prof. Mahalanobis was a legendary figure, a great statistician and promoter of talent, who had laid foundation for Official Statistics of the country with great distinction. I hope the present generation of statisticians would draw immense inspiration from the life and works of Professor Mahalanobis.

Official statistics help policy makers to take informed decisions on policies that impact all walks of life. Improved collection of data, sound statistical methods, advanced technologies improve quality and timeliness of collected statistics. This is most essential for assessing the progress of democratic process of the country.

The Statistics Day is an excellent opportunity to start a conversation between users and producers of statistics and data at all levels.The theme "Agriculture and Farmers Welfare" chosen for this year's Statistics Day is appropriate in the current scenario. A very large section of our people depend on agriculture for their livelihood because of which there is a pressing need to increase productivity for improving their welfare. I hope the theme will inspire collection of appropriate data and research towards this noble objective.

I wish the program a grand success.

**(Dr. R.B.Barman)**

# Contents

डॉ. टी. सी. ए. अनन्त
सचिव
DR. T.C.A. ANANT
SECRETARY

सत्यमेव जयते

स्वच्छ भारत
एक कदम स्वच्छता की ओर

भारत सरकार
Government of India
सांख्यिकी एवं कार्यक्रम कार्यान्वयन मंत्रालय
Ministry of Statistics and Programme Implementation
सरदार पटेल भवन,संसद मार्ग, नई दिल्ली –110001
Sardar Patel Bhavan, Sansad Marg, New Delhi- 110001
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## Preface

Statistics Day is celebrated every year on 29th June to commemorate the birth anniversary of Prof. P.C. Mahalanobis as a tribute to his exemplary contributions in the field of Statistics & Development Planning. The present Statistical System in the country owes a lot to the strong foundations laid by him in early fifties. The organisations like Indian Statistical Institute (ISI) and National Sample Survey Office (NSSO) are the outcome of the efforts of Prof. Mahalanobis to the National Statistical System in India. It was his deep interest in the development planning and understanding of the structure of Indian economy that led Prof. Mahalanaobis to be one of the architects of 2nd Five Year Plan in India.

2. Statistics Day provides an opportunity to all the stakeholders of the statistical system to take stock of the situation. It is also a time when we renew our commitment and resolve for scaling up our efforts towards building a robust and credible statistical system. The theme of this year's Statistics Day "***Agriculture and Farmers' Welfare"*** is very relevant in the present context, with the Government's emphasis on making farming viable, steady and sustainable. The recent schemes of the Government are aimed to scale up the progress of agriculture sector. It is important to measure the effects of all such schemes thus requiring immediate attention towards bridging the data gaps in this sector. Adequacy, credibility, timeliness and transparency are important ingredients of good statistics. These are essential for good governance and also to manage the effective delivery of basic services.

3. It is expected that systematic and sustained efforts in this regard would go a long way in improving and strengthening the statistical system of the country which will be a tribute to Prof. P.C. Mahalanobis in true sense.

**(T.C.A. Anant)**

**June, 2016**

# Life Sketch

**Prof. Prasanta Chandra Mahalanobis**
**Born: 29th June 1893**
**Died: 28th June 1972**

**P. C. Mahalanobis** was a well-known Indian statistician and scientist. Mahalanobis is greatly popular for introducing new methods of sampling. P.C Mahalanobis is remembered by Indians as an Indian scientist and as an applied statistician. His most significant contribution in the field of statistics was the Mahalanobis Distance. Besides these he had also made pioneering studies in the field of anthropometry and had founded the Indian Statistical Institute. He also contributed to the design of large scale sample surveys in India.

## Early life:

2. Mahalanobis belonged to a family of Bengali landed gentry who lived in Bikrampur (now in Bangladesh). His grandfather Gurucharan (1833–1916) moved to Calcutta in 1854 and built up a business, starting a chemist shop in 1860. Gurucharan was influenced by Debendranath Tagore (1817–1905), father of the Nobel poet, Rabindranath Tagore. Gurucharan was actively involved in social movements such as the Brahma Samaj, acting as its Treasurer and President. His house on 210 Cornwallis Street was the center of the Brahma Samaj. Gurucharan married a widow against social traditions. His elder son Subodhchandra (1867–1954) was the father of P. C. Mahalanobis. He was a distinguished educationist who studied physiology at Edinburgh University and later became a Professor at the Presidency College became head of the department of Physiology. Subodhchandra also became a member of the Senate of the Calcutta University. Born in the house at 210 Cornwallis Street, P. C. Mahalanobis grew up in a socially active family surrounded by intellectuals and reformers.

3. Mahalanobis received his early schooling at the Brahma Boys School in Calcutta graduating in 1908. He then joined the Presidency College, Calcutta and received a B.Sc. degree with honours in physics in 1912. He left for England in 1913 to join Cambridge. He however missed a train and stayed with a friend at King's College, Cambridge. He was impressed by the Chapel there and his host's friend M. A. Candeth suggested that he could try joining there, which he did. He did well in his studies, but also took an interest in cross-country walking and punting on the river. He interacted with the mathematical genius Srinivasa Ramanujan during the latter's time at Cambridge. After his Tripos in physics, Mahalanobis worked with C. T. R. Wilson at the Cavendish Laboratory. He took a short break and went to India and here he was introduced to the Principal of Presidency College and was invited to take classes in physics.

4. He went back to England and was introduced to the journal Biometrika. This interested him so much that he bought a complete set and took

them to India. He discovered the utility of statistics to problems in meteorology, anthropology and began working on it on his journey back to India.

5. In Calcutta, Mahalanobis met Nirmal kumari, daughter of Herambha chandra Maitra, a leading educationist and member of the Brahma Samaj. They married on 27 February 1923 although her father did not completely approve of it. The contention was partly due to Mahalanobis' opposition of various clauses in the membership of the student wing of the Brahma Samaj, including restraining members from drinking and smoking. Sir Nilratan Sircar, P. C. Mahalanobis' uncle took part in the wedding ceremony in place of the father of the bride.

## Contributions to Statistics:

6. A chance meeting with Nelson Annandale, then the director of the Zoological Survey of India, at the 1920 Nagpur session of the Indian Science Congress led to a problem in anthropology. Annandale asked him to analyze anthropometric measurements of Anglo-Indians in Calcutta and this led to his first scientific paper in 1922. During the course of these studies he found a way of comparing and grouping populations using a multivariate distance measure. This measure, $D^2$, which is now named after him as Mahalanobis distance, is independent of measurement scale.

7. Inspired by *Biometrika* and mentored by Acharya Brajendra Nath Seal he started his statistical work. Initially he worked on analyzing university exam results, anthropometric measurements on Anglo-Indians of Calcutta and some meteorological problems. He also worked as a meteorologist for some time. In 1924, when he was working on the probable error of results of agricultural experiments, he met Ronald Fisher, with whom he established a life-long friendship. He also worked on schemes to prevent floods.

8. His most important contributions are related to large scale sample surveys. He introduced the concept of pilot surveys and advocated the usefulness of sampling methods. Early surveys began between 1937 to 1944 and included topics such as consumer expenditure, tea-drinking habits, public opinion, crop acreage and plant disease. Harold Hotelling wrote: "*No technique of random sample has, so far as I can find, been developed in the United States or elsewhere, which can compare in accuracy with that described by Professor Mahalanobis*" and Sir R. A. Fisher commented that "*The I.S.I. has taken the lead in the original development of the technique of sample surveys, the most potent fact finding process available to the administration*".

9. He introduced a method for estimating crop yields which involved statisticians sampling in the fields by cutting crops in a circle of diameter 4 feet. Others such as P. V. Sukhatme and V. G. Panse who began to work on crop surveys with the Indian Council of Agricultural Research and the Indian Agricultural Statistics Research Institute suggested that a survey system should make use of the existing administrative framework. The differences in opinion led to acrimony and there was little interaction between Mahalanobis and agricultural research in later years.

10 In later life, Mahalanobis as a member of the planning commission contributed prominently to newly independent India's five-year plans starting from the second. In the second five-year plan he emphasized industrialization on the basis of a two-sector model. His variant of Wassily Leontief's Input-output model, the Mahalanobis model, was employed in the Second Five Year Plan, which worked towards the rapid industrialization of India and with other colleagues at his institute, he played a key role in the development of a statistical infrastructure. He encouraged a project to assess deindustrialization in India and correct some previous census methodology errors and entrusted this project to Daniel Thorner.

11. Mahalanobis also had an abiding interest in cultural pursuits and served as secretary to

Rabindranath Tagore, particularly during the latter's foreign travels, and also worked at his Visva-Bharati University, for some time. He received one of the highest civilian awards, the Padma Vibhushan from the Government of India for his contribution to science and services to the country.

## Honours:

Weldon Medal from Oxford University (1944)

Fellow of the Royal Society, London (1945)

President of Indian Science Congress (1950)

Fellow of the Econometric Society, U.S.A. (1951)

Fellow of the Pakistan Statistical Association (1952)

Honorary Fellow of the Royal Statistical Society, U.K. (1954)

Sir Deviprasad Sarvadhikari Gold Medal (1957)

Foreign member of the Academy of Sciences of the USSR (1958)

Honorary Fellow of King's College, Cambridge (1959)

Fellow of the American Statistical Association (1961)

Durgaprasad Khaitan Gold Medal (1961)

Padma Vibhushan (1968)

Srinivasa Ramanujam Gold Medal (1968)

## Statistics Day:

12. Mahalanobis died on 28 June 1972, a day before his seventy-ninth birthday. Even at this age, he was still active doing research work and discharging his duties as the Secretary and Director of the Indian Statistical Institute and as the Honorary Statistical Advisor to the Cabinet of the Government of India. Even at such a ripe age he participated in his research work and discharged all his duties perfectly. In recognition of the notable contribution made by (Late) **Prof. Prasanta Chandra Mahalanobis in the fields of economic planning and statistical development in the post independent era, the Govt. of India has decided to designate 29th June every year, coinciding with his birth anniversary as the Statistics Day in the category of Special Day to be celebrated at the National Level vide Gazette Notification No. 146 dated 5th June, 2007.**

## Prof. P.C. Mahalanobis- Life Milestones

| Years | Important Events |
|---|---|
| 1893 | Born on 29th June in Bengal |
| 1908 | Completed schooling at Calcutta |
| 1912 | Graduated with Honours in Physics from Presidency College, Calcutta. |
| 1913-17 | Completed degree in Mathematics and Physics from King's College, Cambridge & was awarded senior research fellowship. His tutor, W.H. Macaulay, drew his attention to *Biometrika* that permanently changed the direction of his life. |
| 1917 | Prof. Seal of Deptt. of Philosophy in Calcutta University, invited Mahalanobis for analyzing examination results of the University |
| 1922 | His first paper on statistics entitled 'Anthropological Observations on Anglo-Indians of Calcutta, Part I: Male Stature', published in Records of the Indian Museum. |
| 1922-26 | He Held the post of Meteorologist in the Alipore Observatory. |
| 1924 | He made some important discoveries pertaining to the probable error of results of agricultural experiments. |
| 1926 | He met R.A. Fisher at the Rothamsted Experimental Station & was in touch with Fisher till his death. |
| 1926 | His work on prevention of floods in various regions of the country for Indian Government resulted in alleviation of the problem of flooding to a large extent. |
| 1927 | He made extensive statistical analyses of anthropometric data and closely examined Pearson's Coefficient of Racial Likeness (CRL) for measurement of biological affinities at Karl Pearson's laboratory in London |
| 1930 | His seminar paper on the *D-square* statistic entitled 'Tests and Measures of Group Divergence' was the basis of two large-scale anthropometric surveys in the United Provinces and Bengal. |
| 1931 | He founded Indian Statistical Institute, at Kolkata. Later by an act of the Indian Parliament, the Institute was declared as an 'Institution of National Importance' in 1959. |
| 1937 | He worked on large scale sample surveys with estimation of area and yield of jute crop in Bengal. He raised important and difficult philosophical questions on randomness and representativeness of a sample, which remain relevant and challenging even today. |
| 1944 | He received the Weldon Medal from Oxford University. |
| 1945 | Elected a Fellow of the Royal Society, London for large sampling surveys. |
| 1947-51 | He was Chairman of the United Nations Sub commission on Statistical Sampling. |
| 1950 | He established the National Sample Survey. |
| 1951-56 | He played a key role in formulating India's second five-year plan based on the four-sector model developed by him. |
| 1957 | He was Honorary President of the International Statistical Institute. |
| 1961 | He was elected a fellow of the American Statistical Association. |
| 1961-70 | He devised a statistical method, fractile graphical analysis, for comparison of socio-economic conditions of groups of people. This technique has now been used in many other branches of science. |
| 1968 | Received the Padma Vibhushan Award. |
| 1968-70 | He was Statistical Advisor to Government of India. |
| 1972 | Died on June 28, one day before his 79th birth day. |

# National Award for Outstanding and Meritorious Research Work in Statistics Constituted in the Honour of P. V. Sukhatme

# A Life Sketch

## PROF. P.V. SUKHATME- A Life Sketch

(27 July, 1911-28 January, 1997)

Pandurang Vasudeo Sukhatme was born to Vasudeo Hari Sukhatme and Styabhama Sukhatme on 27th July, 1911 in the village Budh, district Satara, 100 miles south of Pune. After completing his school education in Pune, he graduated in 1932 from Fergusson College with Mathematics as the principal subject and Physics as a subsidiary subject. During 1933-36 he studied at the University College, London and was awarded a Ph. D in 1936 and a D.Sc. Degree in 1939 for his work on bipartition functions. This work was published in the "Philosophical Transactions of the Royal Society of London, Series A", June, 1938.

2. Whilst in London, Prof. Sukhatme came under the influence of such eminent authorities in Statistics as R.A. Fisher, Jerzy Neyman and E.S. Pearson and did valuable research in Statistical Theory of Sampling, his two most significant contribution being, one to bipartitional functions under the guidance of R.A. fisher the other to sampling theory entitled "Contributions to the Theory of the Representative Method" under the guidance of J. Neyman and E.S. Pearson. The latter paper laid solid foundations for his subsequent pioneering research in the sampling theory of surveys and improvement of agricultural statistics which ushered in what may be appropriately termed as the Sukhatme era in the development of Agricultural Statistics in India and the World.

3. After P.V. Sukhatme returned to India, while searching for a University job, he had an interview with the Late Pandit Madan Mohan Malviya, Vice Chancellor, Banaras Hindu University. Though Panditji was satisfied with the brilliant career of P.V. Sukhatme and agreed to create a Department of Statistics in the University to accommodate him but he wanted to know from Sukhatme how a chair in Statistics would help our poor country-India. P.V. Sukhatme did not know how to answer this question nor did he join Banaras Hindu University but this question must have moved him sufficiently in determining his future life, particularly his fundamental work on nutrition.

4. During 1939-40, he was a Professor at the All India Institute of Hygiene and Public Health, Calcutta. In 1940 he joined ICAR as a Statistician, and was later on appointed as Statistical Advisor to the Council to head its Statistical Unit. On account of his dynamic leadership, following the path and tradition set by him, the statistical branch of ICAR eventually grew to become a full-fledged Institute (Indian Agricultural Statistics Research Institute) exclusively devoted to research in Agricultural Statistics. In the context of the Green Revolution, the importance of statistical techniques in agricultural research hardly needs any emphasis.

5. Prof. Sukhatme, as a founder of the Indian Society of Agricultural Statistics , devoted a good

deal of his time and energy to the popularization of statistical methods among the practitioners of agricultural, veterinary and related sciences. He served as the First Honorary Secretary of the Indian Society of Agricultural Statistics for a number of years. The Society owes him a lot for his continued valuable guidance as well as for shouldering the responsibility, as its President during 1991 and Executive President since 1970 till his demise. From its inception to 1963 he worked closely with Dr. Rajendra Prasad (Founder President of the Society), the then Minister for Food and Agriculture and later President of India.

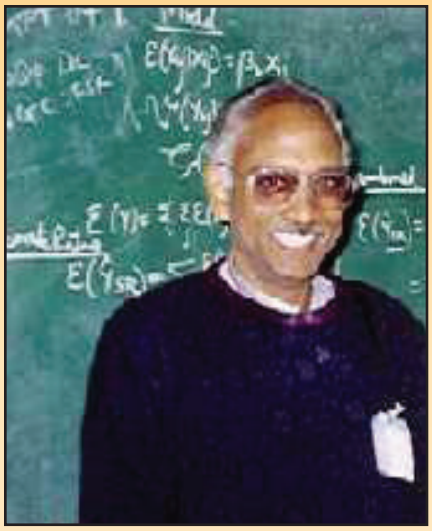
6. In 1951, he was a Visiting Professor at Iowa State University, Ames Lowa, USA where he completed his textbook on sampling. During 1952-70, he headed the Statistics Division of the Food & Agriculture Organization (FAO) of the United Nations in Rome. After retiring from the UN in 1971 he served as Regents Professor, University of California at Berkely and then settled in Pune, carrying out valuable work on nutrition at the Maharashtra Association for the Cultivation of Science. He authored several books on the various scientific topics of interest and published more than 200 research papers in reputed national and international journals.

7. Prof. Sukhatme was well known in the field of nutrition for the Sukhatme-Margen hypothesis which in plain language implies the following: at low levels of calorie intake, energy is used with greater metabolism efficiency and decreases as the intake increases over the homeostatic range.

8. He was awarded the Guy Medal by the Royal Statistical Society for his paper on nutrition which he presented to the Society in 1963, the B.C. Guha Memorial Lectureship of the Indian Science Congress Association in 1965 and the B.D. Tilak Lectureship of the Indian National Science Academy in 1982. Among the numerous other honours he had received, mention must be made of the Fellowship of the American Statistical Association, National Academy of Sciences, Allahabad, Indian Academy of Sciences, Bangalore and Indian National Science Academy, New Delhi. He was elected member of the International Statistical Institute, Netherlands and its Vice President in 1969-70. For his outstanding contribution to Science and Human Welfare, he was conferred the Padma Bhushan by the President of India in 1973. He was awarded the Hari Om Ashram Trust Award by the University Grants Commission in 1983. For the distinguished service to the cause of Statistics and its application to agriculture and allied fields, he was conferred with the honour of Sankhyiki Bhushan in 1989 by the Indian Society of Agricultural Statistics, New Delhi. He also received the P.C. Mahalanobis Award at the Jaipur Session of the Indian Science Congress Association.

9. Prof. Sukhatme expired on 28 January, 1997 at Pune. With the demise of Prof. Sukhatme, the Scientific Community in general and the Agricultural Scientists in particular has lost a great statistician, true advisor, dynamic leader, well-wisher of humanity and a renowned personality of international fame.

10. Recognising the contribution of Prof. P.V. Sukhatme to Statistics, the Government of India instituted a biennial National Award in Statistics in his memory for Senior Indian Statisticians for their significant and life time contribution in the field of Statistics.



# Career Sketch

**Dr. T. J. Rao**

Former Professor Indian Statistical Institute, Calcutta

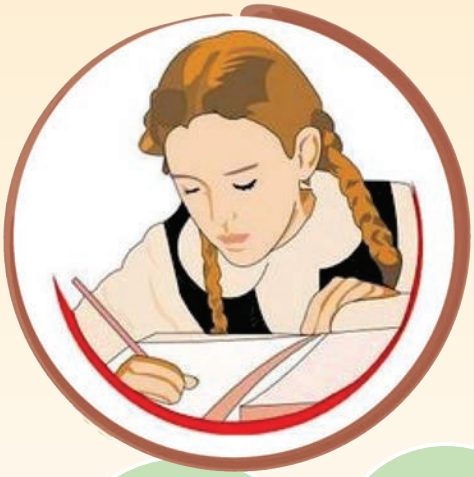
Prof. P.V. Sukhatme National Award 2016 is presented to Dr. T. J. Rao, former Professor Indian Statistical Institute (ISI) Kolkata and currently Adjunct Professor, C.R. Rao, **Advanced Institute of Mathematics, Statistics and Computer Science (AIMSCS)**, Hyderabad for his contribution to theoretical and applied Statistics as well as contribution to the Official Statistical System.

Born on 7th January 1943, Dr. T. J. Rao has several distinctions and honours to his credit, in fact, far too many to be named and described individually. For the sake of brevity, to cite only a few among them, he graduated with honours and did Masters in Mathematics from Andhra University. He also acquired Masters in Statistics from Indian Statistical Institute(ISI), Calcutta. He obtained his Ph.D. degree in the area of Sample Surveys from the Indian Statistical Institute, Calcutta in the year 1967 under the supervision of Late Professor M.N. Murthy.

His contributions in sampling theory, which include choice of optimum sampling strategies, intuitive derivation of optimum allocation of sample size in stratification, is user friendly and the justification for near optimum allocations is found to be useful in practical surveys. His recent work on Randomized Response Techniques which addresses privacy and confidentiality of respondents in this age of mobile and internet communications is noteworthy. He used super population models along with Godambe and Hanurav which resulted in several publications relating to the inference from finite population sampling and Horvitz Thompson estimator. His work on the construction of Unbiased Ratio, Product and Regression Estimators and utilization of auxiliary information in sample surveys and its practical implications is well recognised and followed up by many researchers .

He has participated in several National and International conferences and published 114 papers, and articles in leading Journals like Journal of Royal Statistics Society, Journal of American Statistics Association, Sankhya, Journal of Statistics, Planning and Information, Journal of Official Statistics etc. As a nominee of Indian Statistical Institute (ISI) in the National Sample Survey Office (NSSO) Governing Council (GC) for many years (1995-2004) especially as the chairman of the Governing Council (GC) during 2001-2004, he contributed to the Indian Official Statistics. He is currently an active member of various Research / Technical Advisory Committees of various organizations/universities including National Statistical Commission. He had been on the Editorial Advisory Board of Sarvekshana, the NSSO Journal, Associate Editor of Statistics Canada, Co Editor and Managing Editor of *Samkhya, Ser.* B etc.

# Essay Writing Competition - 2016 For Post-Graduate Students of Statistics



# On-the-Spot Essay Writing Competition- 2016 for Post Graduate Students of Statistics

During the year 2005, to commemorate the birth anniversary of Prof P. C. Mahalanobis falling on June 29th, the Ministry decided to organize an annual On the Spot Essay Competition at the all India level, for the Post Graduate Students of Statistics studying in the recognized Universities/Colleges. It was an open competition and the students were required to write an essay on one of the given topics. The winners are felicitated on Statistics Day i.e.29th June. As per the scheme, in all, 11 prizes are given away every year viz., one first Prize, two second Prizes, three third Prizes and five Consolation Prizes.

2. During 2016, the Competition was held at the all India level on 14th February, 2016 at various centres /offices of the NSSO (FOD). The Students were given the option to write an essay on one of the following topics:

A. What, in your view, is "Official Statistics" and what effective and useful role can it play with regard to (i) informed public debate; (ii) policy formulation; and (iii) assessment of impacts of Government Policies and Programmes.

B. What, according to you, is "Official Statistics" and what potential and useful role can modern and ever evolving 'Information and Communications Technology (ICT)' play in enhancing the role of Statistics/Official Statistics in supporting the successful and effective implementation of Governmental Programmes.

3. The following are the 11 Winners of the Annual on-the-Spot Essay writing Competition 2016:

| Position | Name of Candidate | Name of College/University |
|---|---|---|
| **First Prize** | Saumya Pandey | Banaras Hindu University, Varanasi, U.P. |
| **Second Prize** | Twinkle Moothedan | Department of Statistics, Cochin University of Science and Technology, Kochi. |
| | Shyama Gupta | Amity Institute of Applied Sciences, Amity University |
| **Third Prize** | Meghana Gupta | Banaras Hindu University, Varanasi, U.P. |
| | Eram Mariya | Aligarh Muslim University, U.P. |
| | Priyanka Pandey | Babasaheb Bhimrao Ambedkar University, Lucknow |
| **Consolation Prize** | Sayed Isa Shakirali | Department of Statistics ,University of Mumbai |
| | Durga Vasudevan | Department of Statistics, Cochin University of Science and Technology, Kochi |
| | Pragya Sinha | Banaras Hindu University, Varanasi, U.P. |
| | Kanika Grover | Amity institute of Applied Sciences, Amity University |
| | Neeraj Narayan | Banaras Hindu University, Varanasi, U.P. |

# Theme
# Statistics Day 2016
# Agriculture
# and
# Farmers' Welfare

# Theme Paper
# Agricultural Statistics in India: Issues and Challenges
# Ministry of Agriculture and Farmers Welfare

## Agriculture in the Indian Economy

Agriculture and allied activities remain the major source of livelihood for nearly half of the Indian population. The share of agriculture in employment was 48.9 per cent of the workforce [National Sample Survey Office (NSSO), 2011-12] while its share in the Gross Domestic Product (GDP) was 16.3 per cent in 2014-15 (First Revised Estimates) at constant (2011-12) prices. The sector is critical for food security and inclusive growth. It has been observed, especially from the development experience in Brazil, Russia, India, China (BRIC) countries, that one percentage point growth in agriculture is at least two to three times more effective in reducing poverty than the same magnitude of growth emanating from non-agriculture sector. Agriculture, thus, occupies the centre stage in the Indian economy and any situational change in this sector, positive or negative, has a multiplier effect on the entire economy.

## Significance of Agricultural Statistics

2. The critical role of agriculture in Indian economy underlines the need for major interventions with the aim of improving agricultural productivity on a sustainable basis. Given the competing demands for the limited resource envelope, it is important to ensure that interventions are effective and outcome oriented. This necessitates existence of a robust agricultural statistics system which, with its crop and horticultural statistical indicators, would enable to identify the areas of improvement along with the quantum of effort required and, thus, ensure that interventions are properly targeted. Besides improving agricultural productivity, the advance estimates pertaining to area and production, generated by the agricultural statistical system, act as an early warning system and assist in demand supply management so as to have price stability and achieve the goals of food security. It provides critical inputs for taking important policy decisions with respect to import, procurement, public distribution etc. and protect consumers against the inflationary expectations. As such, availability of reliable and timely crop estimates is of paramount importance to the planners, administrators, policy makers and research scholars.

3. Given this backdrop, Agricultural Statistical System has to play a key role in improving farmers' welfare and enhancing food security in the country. It is well known that India has a well-established and internationally recognized Agricultural Statistics System. The Indian Agricultural Statistics System has a decentralised structure with State Agricultural Statistics Authorities (SASAs) playing a major role in collection and compilation of Agricultural Statistics at the State level while the Directorate

of Economics and Statistics in the Ministry of Agriculture and Farmers Welfare 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 Organisation (NSSO) and the State Directorates of Economics and Statistics (DESs). Ministry of Agriculture and Farmers Welfare has also set up Mahalanobis National Crop Forecast Centre (MNCFC) in 2012 to provide in-season crop forecasts and assessment of drought situation using state of the art remote sensing techniques and methodologies developed by Indian Space Research Organisation (ISRO).

## Present System for Agriculture Statistics:

4. Government of India has a statistically sound system of estimation of crop area, production and yield. For every agricultural year (July-June), the Directorate of Economics & Statistics (DES), Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare releases four Advance Estimates (AE) followed by Final Estimates of production of major agricultural crops of the country. Each of these five estimates are available State-wise and at the national level for the 27 identified crops. The time of release and period covered under each of these estimates are as under:-

- First Advance Estimates are released in September when Kharif sowing is generally over. These cover only Kharif crops.
- Second Advance Estimates are normally released in February of the following year when Rabi sowing is also over. The second advance estimates cover Kharif as well as Rabi crops. These take into account; (i) firmed up figures on Kharif area coverage; (ii) partly available data on crop cutting experiments for yield assessment of Kharif crops and (iii) tentative figures on area coverage of Rabi crops.
- Third Advance Estimates incorporate revised data on area coverage for Rabi crops and better yield estimates of Kharif crops. These are released in April-May.
- Fourth Advance Estimates are released in July-August of the next agricultural year. By this time fully firmed up data on area as well as yield of Kharif and Rabi crops are supposed to be available with the States. As such, Fourth Advance Estimates are expected to be very close to the Final Estimates.
- Final Estimates are released about seven months after the Fourth Advance Estimates in February of the subsequent year. This allows sufficient time to States to take into account even the delayed information while finalizing area and yield estimates of various crops.
- No revision in the State level data is accepted after release of Final Estimates.

5. The present system allows Government to get an assessment of State-wise area, production and yield of major crops within the shortest time after the sowing of crops in a season is over. The very purpose of having a series of four successive estimates during the year is that the estimates of agricultural production in the country may be refined and improved as the year progresses and better, firmer data on sowing and yields become available. Even, though the estimates are periodically revised, the preliminary estimates for Kharif released in September and those for Rabi, released in February are very crucial for timely policy decisions related to import, export and pricing.

## Primary Data and Preparation of Estimates by States/UTs

6. The agricultural estimates at all-India level are prepared on the basis of crop-wise data on area, production and yield furnished by State Governments. For this purpose, the State Governments have designated one of their Departments viz. Departments of Agriculture/ Land Records or Directorate of Economics & Statistics as State Agricultural Statistics Authority (SASA). SASAs finalize State level estimates on the basis of district-wise data on area, production and yield. At district level, there is a system of effective collaboration between the officials of SASA and Revenue Department.

7. The district level estimates of production of different crops are obtained as a product of area coverage and average yield of respective crops in a district. For assessment of area coverage, a comprehensive system has been laid down in each State/UT. Under the above system, the primary worker of Revenue Department i.e. Patwari/Lekhpal visits each field/survey number and records the crop sown and area during Kharif as well as Rabi seasons. For this purpose, a sample of 20% villages is selected in such a way that over a period of 5 years, all the villages in a State/ UT are covered. For each of the 20% villages selected in the sample for a particular year, the Patwari prepares a Village Abstract indicating total area under different crops in the particular village. The area figures are progressively added over blocks/circles/tehsils/district to arrive at total crop composition in the sample villages in a district. Five times the total area figures of the sample villages gives the crop-wise area estimates in the particular district.

8. For assessment of crop-wise yield, the Crop Cutting Experiments (CCEs) are conducted under the General Crop Estimation Surveys (GCES) of States/UTs. The CCEs are also conducted by the Revenue Authorities. The number of CCEs for different crops are in proportion to the area under respective crops in a district. For CCEs, a multi-stage stratified random sampling is adopted. The average yield of all the CCEs on a crop in the particular district is taken as the yield for the district.

## Forecasting Agricultural output using Space Agro-meteorology and Land based observations (FASAL)

9. A Central Sector Scheme, "Forecasting Agricultural output using Space Agro-

meteorology and Land based observations (FASAL)" is a major alternative source of data on selected crops. This is being implemented with the help of partner organizations viz., India Meteorological Department (IMD), New Delhi, Space Application Centre (SAC), Ahmedabad, Mahalanobis National Crops Forecast Centre (MNCFC) and Institute of Economic Growth (IEG), New Delhi. Under the scheme, release of multiple-in-season forecasts is envisaged at National, State and District levels based on Remote Sensing, Agromet and Econometric models in respect of 11 major crops namely, (i) Rice (Kharif & Rabi), (ii) Jowar (Kharif & Rabi), (iii) Maize, (iv) Bajra, (v) Jute, (vi) Ragi, (vii) Cotton, (viii) Sugarcane, (ix) Groundnut (Kharif & Rabi), (x) Rapeseed & Mustard and (xi) Wheat.

10. Since 2011, operationlisation of crop forecasts and drought assessment through Remote Sensing methodology, developed by ISRO, is being done by the MNCFC. At present, the MNCFC is providing Remote Sensing technology based forecast for major producing States as well as All India level in respect of 8 important crops viz. (i) Rice (Kharif/Rabi), (ii) Wheat, (iii) Rapeseed & Mustard, (iv) Cotton, (v) Jute, (vi) Sugarcane, (vii) Jowar and (viii) Potato. The forecast generated by MNCFC are based on the yield models developed by IMD and the area coverage based on Remote Sensing technology.

11. Institute of Economic Growth (IEG), one of the partner organizations of the FASAL scheme, has been providing State/National level forecast of area, yield and production for selected Kharif and Rabi crops based on econometric models. These are provided at two stages for each season, pre-sowing (F0) and sowing (F1). The variables used in the model include crop price (expected), substitute crop price (expected), irrigated area, previous year's area and rainfall in the sowing season. IEG has been providing forecast for 12 crops namely (i) Rice, (ii) Bajra, (iii) Cotton, (iv) Groundnut, (v) Jowar, (vi) Jute, (vii) Maize, (viii) Soyabean, (ix) Arhar, (x) Moong, (xi) Urad and (xii) Sugarcane for Kharif season and 9 crops namely (i) Rice, (ii) Groundnut, (iii) Jowar, (iv) Rapeseed & Mustard, (v) Maize, (vi) Wheat, (vii) Gram, (viii) Potato and (ix) Onion for Rabi season.

## Crop Weather Watch Group (CWWG)

12. In order to keep a watch on the factors impacting agricultural production, a Crop Weather Watch Group (CWWG) consisting of representatives from all concerned Divisions of DAC&FW and other Ministries/Departments has been constituted. The CWWG meetings, held every week, deliberate on (i) Weather and rainfall situation/(ii) Progressive sowing position of crops/(iii) Water storage in major reservoirs/(iv) Availability of inputs such as seeds, fertilizers/(v) Pest and disease situation/(vi) Market arrivals and price situation/(vii) Procurement and (viii) Import / Export position, etc.

## Validation of State Level Estimates

13. While finalizing all-India level estimates, the crop-wise data on area, production and yield received from State Governments are thoroughly scrutinized on the basis of information from alternative sources on State-wise and crop-wise area, production and yield, weather, rainfall, pest/disease situation, previous crop-wise trends of area, production and yield in the respective States as well as commodity-wise trends in prices, procurements etc.

## Expert Committee on Agricultural Statistics

14. To improve the system for generating reliable data on agriculture statistics, the National Statistical Commission (NSC) had recommended a review of the performance of the current schemes for improvement of crop statistics, identify their deficiencies and suggest measures to improve them. Accordingly, the Ministry of Agriculture constituted a Committee under the chairmanship of Prof. A. Vaidyanathan, a renowned Agricultural Economist. The Committee had the mandate to review the performance of the schemes for improvement of crop statistics, assess the potential of Remote Sensing (RS) techniques to collect land use and crop statistics, and suggest an institutional framework for improvement of Agricultural Statistics.

15. In its Report (2011), the Committee observed that the present system of collection of Agricultural Statistics, based on complete enumeration in a sample of 20% (120000 out of approx. 600000) villages, is based on statistically sound principles. If properly implemented, the system should generate estimates at the State and National levels within acceptable margin of statistical error.

16. In calling attention to its shortcomings, the Committee noted that Patwari, who is a functionary of the Revenue Department, is also the primary worker for Agriculture Statistics. However, since Patwaris are entrusted with multiple responsibilities by Revenue Authorities, they are unable to devote proper attention to Agricultural Statistics work. Consequently, the existing system is often not able to provide agriculture data of reliable quality. The Committee further observed that:

(i) While the present system can continue to be implemented by State Governments for generating district and sub-district level estimates for planning, policy formulation at disaggregated level and implementation of National Agricultural Insurance Scheme (NAIS), etc., there is an urgent need for radical restructuring of the system to provide reliable and timely estimates of crop-wise area and yield at National and State level.

(ii) In view of heavy workload with the primary worker of Revenue Department, the Committee recommended that State Statistical Agencies may use the dedicated staff and supervisors for field work for preparation of National and State level estimates. This would

ensure quality in the primary data on area coverage collected from villages and CCEs for estimation of yield.

(iii) Regarding use of Remote Sensing technique, the Committee recommended that present RS programme should be expanded and reorganized to provide reliable and validated in-season forecasts and end-season estimates of area for wider range of crops at State and National level and plot level data on land use. The system must be complementary to, rather than a substitute for, improving conventional method of collecting Agricultural Statistics.

17. As explained earlier, DAC&FW has already set up Mahalanobis National Crop Forecast Centre (MNCFC) under the FASAL scheme of DES, with focus on generating estimates of area and yield of more crops based upon latest remote sensing technology. As of now the MNCFC is giving area, yield and production forecast for 8 crops.

18. Based on the interactions with the State Governments (SASAs) for implementation of recommendations of Prof. Vaidyanathan Committee, it was concluded that:

(i) The States are fully aware of the constraint in collection of primary data on area coverage and yield assessment through Revenue Department. They supported the idea of providing dedicated staff for primary collection of data and their supervision required for ensuring reliability in the primary/ villages-level data.

(ii) As the States in any case require disaggregated data on land use, area and yield etc. for district and sub-district level planning, implementation of Agricultural Insurance Scheme, etc., they need to collect data from a sample of 1,20,000 villages as in the present.

(iii) The State level agricultural estimates based upon a larger sample of 1,20,000 Timely Reporting Scheme (TRS)/ Establishment of an agency for Reporting Agricultural Statistics (EARAS) villages are bound to differ from the corresponding estimates prepared on the basis of data collected from only 15000 villages all over the country. The States, therefore, were not agreeable to the Committee's suggestion for preparing two sets of State/level estimates recommended by Prof. Vaidyanathan Committee.

(iv) While Prof. Vaidyanathan Committee suggested collection of data on 10 major crops in each State, the national level estimates based on aggregation of State-wise estimates of only 10 major crops cannot reflect total production of a particular crop in the country.

(v) The present system gives State-wise and all-India estimates of area, production and yield of 27 principal

crops. From a sample of only 15,000 villages and 100 survey numbers per village suggested the Committee, it would not be possible to get reliable estimates at State and all-India level for some localized crops with minor area coverage.

## Way Forward

19. A sample of 20% villages for preparation of estimates at district, State and National level is adequate for keeping the sampling error within permissible limits. The major challenge in the present system as also pointed out by Prof. Vaidyanathan Committee is the inadequate quality of primary data on area and yield collected by Patwari who is over-burdened due to large jurisdiction and multiple responsibilities assigned to him. This leads to lack of confidence of users in the reliability and credibility of agricultural estimates. The State Governments also subscribe to the view that dependence on Patwari for collection of village level data is the main reason for the quality issues in the primary data. Thus, the confidence of users in the quality of agricultural estimates can be enhanced by ensuring quality in the primary data used for preparation of these estimates.

20. Considering the views/suggestions of State Governments mentioned above, the most practical solution to the problem rests in continuing with the present system of collection of agricultural data from sample of 120000 villages. The way forward for improving the Agricultural Statistics would be to deploy an exclusive field functionary for collection of primary data from the field. However, the field functionary engaged by State Agriculture Departments will have to work in close coordination with the Patwari, the village level worker of Revenue Department. The Government of India is already providing support to land record States under the TRS and the staff engaged under TRS can be utilized for supervision of the primary work done by the field functionaries. In the States covered under EARAS, the Agricultural Statistics work is already being done by especially recruited field investigators.

## Estimation of Horticulture Crops

21. Fruits and vegetables account for nearly 90 per cent of total horticulture production in the country. India is now the second largest producer of fruits and vegetables in the world and is the leader in several horticultural crops, namely, mango, banana, papaya, cashewnut, arecanut, potato and okra. However the nature of horticulture crops being such it is not easy to make assessment of their production. These crops, especially, vegetables are grown in small plots, fields or in the back of the houses and do not have single harvesting in most of the cases which makes their assessment difficult. Many horticulture crops have multiple pickings in a single season. Similarly, many fruit trees are scattered which do not count for assessment.

22. In view of above difficulties several research studies were taken up by agricultural scientists in the past. Then a Central Sector

Plan Scheme namely, Crop Estimation Survey of Fruits & Vegetables (CES-F&V) - a component of Improvement of Agricultural Statistics Scheme, was initiated in 1982-83. The scheme envisaged the generation of area and productivity estimates using sampling and estimation methodology evolved by Indian Agricultural Statistics Research Institute (IASRI). It was implemented in 11 States covering selected crops- 7 fruit crops (Apple, Mango, Citrus, Pineapple, Grapes, Banana and Guava) and 7 vegetable crops (Potato, Cabbage, Cauliflower, Onion, Tomato, Ginger and Turmeric). However, the National Statistical Commission (NSC) observed that the methodology adopted for estimating the production of horticultural crops should be developed taking into account information from all sources, including market arrivals, exports and growers associations.

23. In view of this, the Scheme was discontinued from 2013-14 and a new alternative methodology was developed by IASRI. The new methodology is now being tried out on pilot basis in 6 States under the project CHAMAN of Department of Agriculture, Cooperation & Farmers Welfare.

## Coordinated programme on Horticulture Assessment and Management using Geoinformatics (CHAMAN)

24. The Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare under the Mission for Integrated Development of Horticulture (MIDH) has launched a project called CHAMAN. The programme has the objective to develop and firm up scientific methodology for estimation of area and production of horticulture crops. It has two main components namely: (1) Remote sensing (RS) Technology and (2) Sample Survey (SS) methodology for estimation of area and production of horticultural crops.

25. The Remote Sensing aspect of the proposed programme is being implemented by Mahalanobis National Crop Forecast Centre (MNCFC) and has the following components:

(i) Area and Production assessment of seven major horticultural crops in major states;

(ii) Remote sensing for developmental studies like site suitability and post-harvest infrastructure development; and

(iii) Detailed scientific field level research studies for developing technology for crop identification, yield modelling and disease assessment for other horticulture crops.

## Area Assessment

26. Area assessment will be carried out for selected crops in the selected districts of major States. The crops will be selected based on

the production share, as indicated in the Table below.

**Table: Crop Selection from Various States**

| Crop Type | Crop | State (Districts) |
|---|---|---|
| Fruit | Banana | Tamil Nadu, Andhra Pradesh , Maharashtra , Gujarat, Karnataka |
| | Mango | UP, Gujarat, Karnataka, Andhra Pradesh, Bihar |
| | Citrus | Andhra Pradesh, Maharashtra, Punjab, MP, Gujarat |
| Vegetables | Potato | UP, Bihar, WB, Gujarat, Punjab |
| | Onion | Maharashtra, Gujarat, MP, Karnataka, Bihar |
| | Tomato | Andhra Pradesh , Odisha, Karnataka, MP, WB, Bihar |
| Spices | Chilli | Andhra Pradesh, Karnataka, WB, MP, Odisha |

## Production Assessment

27. For production forecasting, yield modelling has to be carried out. India Meteorological Department, under FASAL project, develops district-level, empirical agro-meteorological yield models for different crops. Similar procedures will be followed for yield forecasting of vegetable crops.

## Estimation of Area and Production of Main Horticulture Crops using Sample Survey Techniques

28. This component is being implemented by the Indian Agricultural Statistics Research Institute (IASRI) as "Study to test the developed alternative methodology for estimation of area and production of horticultural crops". The study will be taken up in eight States namely, Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu, Gujarat, Madhya Pradesh, Haryana and Himachal Pradesh. In each of the States, about 40 per cent districts out of the total number of districts covering about 70-80 per cent of the total area under fruits and vegetables in the entire State and two districts from rest of the districts covering about 20-30 per cent of the total area under fruits and vegetables in the entire State will be undertaken for the study.

## Objectives of the Study:

(i) To test the developed alternative methodology for estimation of acreage under each major fruit and vegetable crops

(ii) To test the developed alternative methodology for estimation of yield rates and total production of major fruit and vegetable crops grown in the State

(iii) To validate the accuracy of estimates of area under major fruits and vegetables using

Remote sensing techniques with the area estimates using complete enumeration

The sampling design being adopted for the survey is stratified multistage random sampling.

29. The study would be completed by 2016-17. Successful completion of CHAMAN project would lead to evolution of two scientific methodologies based on two different approaches, namely, remote sensing techniques and sample survey. This would overcome the deficiencies observed in the earlier schemes. Further, the two approaches would complement each other in developing robust estimates for area and production under horticulture crops.

# AGRICULTURE AND FARMERS' WELFARE IN INDIA: ROLE OF STATISTICS

Food and Agriculture Organisation of the United Nations

## 1. Introduction

About half of the Indian population earn their livelihood directly and indirectly from agriculture. It also supports the largest proportion of population who are poor (measured by any methods) in absolute and relative terms. This high level of dependency on agriculture clearly implies that if we want to achieve development goals as outlined in the Sustainable Development Goals (SDGs, 2015-2030), we need to bring transformation in the agricultural sector. This realization is reflected in Prime Minister's vision of achieving the target of doubling the income of the farmers by 2022.[1]

In the above backdrop, this paper attempts to understand the major features and challenges of Indian agriculture and the role and contribution of statistical systems in enhancing farmer welfare through agricultural development.

## 2. Indian Agriculture: Features and Challenges

While the contribution of agriculture to GDP fell from 28.3 % in 1993-94 to 13.9 % in 2013-14, it continues to support half of the work force in the country (the employment share declined from 64.85% during 1993-94 to 48.9 % in 2011-12) (NITI Aayog, 2015; GOI and OUP 2014). Even more importantly, the poorest of the poor are still dependent on agriculture for their livelihoods. To improve the livelihoods of this large proportion of population and transform their lives by achieving the SDGs is a challenging task. The strategies for that have to focus undoubtedly on bringing transformation to the agricultural sector.

Some of the major issues in Indian agriculture that emerges out of several studies covering different regions and time periods are discussed below. These observations are supported and monitored by data and information provided by a well-established and competent statistical system evolved over the last seven decades based on robust scientific principles and time tested protocols. The six major features of Indian agriculture which is widely discussed in literature are briefly presented below.

### 2.1 Small size of holdings

Small holders (less than 2.0 hectares) constitute 83% of total landholdings and cultivate 42% of operated land (Chand, R., Prasanna, P.A.L., Aruna, S, 2011). This acts as a major constraint in availing the benefits of economies of scale in access to and utilization of major inputs (land, labour, human and machine, irrigation, fertilizer, credit, technology) and realizing remunerative prices from markets for their produce(Harriss-

1 The details of this announcement and an analysis of the possibilities of achieving this can be found in Chandrasekhar, S., Mehrotra, N (2016). Available at http://www.livemint.com/Politics/ibdSw1oYBh27Towb1X3qjN/Govt-sets-up-panel-to-lay-out-plan-for-doubling-farm-incomes.htmlhttp://www.epw.in/system/files/pdf/2016_51/18/Doubling_Farmers%27_Incomes_by_2022_0.pdf

White (2004) ; Agarwal, B (2011)). Hence, though their performance with respect to production parameters are superior, small size of land holding prevents them from realizing enough returns to move out from the vicious circle of poverty to prosperity (Chand.*et.al*, 2011; Hazell., 2011). The outcome of this differential access is evident from the fact that consumption expenditure of marginal and small farmers exceeds their estimated income by a significant margin, and they seem to cover the deficits by borrowing or other means (NCEUS, 2008). This further exacerbates their situation as poor households and in the aggregate level results in higher levels of incidence of poverty when compared to medium and large farmers. (*ibid*., 2008).

## 2.2 Low productivity levels

Even with considerable investments in technology generation, transfer of technology and various forms of input and output support programmes and policies, the productivity levels in majority of important crops remain very low compared with Global productivity levels. In the case of major cereals like wheat and rice, India's yield levels are lower by 46 % and 39 % respectively when compared to China (GOI, 2016). Although the nature and extent of various constraints vary, India needs to focus its efforts in bridging yield gaps.

## 2.3 Shrinking land and water resource base

Fueled by rapid industrialization, urbanization and climate change, the resource base critical for agricultural production (primarily land and water available for cultivation) is shrinking at an alarming rate (GOI, 2016). When compared with China and Brazil, India uses two to four times more water to produce one unit of major food crop (Chapagain, A. K.., Hoekstra, A. Y, 2008). This clearly will have serious implications in the sustainability and production potential of agricultural systems eroding the foundations of food and nutritional security. (FAO and Earthscan, 2011).

## 2.4 Climate Change and Associated Risk and Vulnerability

Studies have shown that changing climate (inadequate and unequal distribution of rainfall, rise and fluctuations in temperature, raising sea levels, increase in the frequency of natural calamities etc.) has adverse effects on the agricultural production systems threatening food and nutritional security of vulnerable communities, particularly the small holders (Swaminathan, M.S., Rengalakshmi, R, 2016). Rural communities in affected areas are vulnerable to the risk of increased crop failure, loss of livestock, depletion of marine and aquaculture resources and forests (Dev, M.S., 2012). Though the nature and extent of impact may vary with regions and communities, farming community, particularly small holders are the ones who are more vulnerable and risk prone.

## 2.5 Segmentation of agricultural markets

The levels of segmentation of agriculture markets for outputs erode the benefits through competition, efficient resource allocation, specialization in subsectors and fewer intermediaries. This creates wide gaps in farm gate and wholesale prices and between wholesale and retail prices resulting in welfare losses for producers as well as consumers

(GOI, 2016).

## 2.6 Changes in dietary patterns

Studies examining patterns and trends in dietary composition of various groups of population over time has shown that there has been a diversification of Indian diets away from cereals to high value products like milk and meat products, vegetables and fruits- essentially, a shift from carbohydrate dominated to protein dominated diet (Pingali, P. 2006; Dev, 2012; Gaiha, R., Kaicker, N., Imai, K., Kulkarni, S.V., Thapa, G, 2013). This shift in the dietary composition offers huge potential for smallholders who contribute significantly towards diversification to high value crops to increase their returns from cultivation (Dev, 2012; Birthal, P.S., Joshi.P K, Narayanan, A.V,2011).

## 3. Evolution of Indian Agricultural Statistics Systems

The Indian Statistical System has contributed to the progress and development of agriculture sector in a very significant way. These contributions are synonymous with the achievement of Prof. P. C. Mahalanobis whose visionary leadership made possible the establishment of a sound and scientifically designed statistical system to make remarkable contributions to the progress of the nation.

Soon after independence, the National Income Committee formed under Chairmanship of Prof. Mahalanobis, recognised the need for setting up institutions to meet the needs of information for planning (GOI, 1951). The formation of national agencies, such as the National Sample Survey (NSS) in 1950 and the Central Statistical Organisation (CSO) in 1951 were feathers in the cap of Indian Statistical System.[2] The second Five Year Plan (1956-61) model prepared by P. C. Mahalanobis, based on statistical model, gave equal importance to consumer goods and producer goods industry, with an emphasis on village and cottage industries as well as increasing the supply of fertilizers, pesticides, machinery and equipment for agriculture (Mahalanobis, 1961).

The National Sample Survey which later evolved as the National Sample Survey Organisation (NSSO), in 1972, was the brainchild of P. C. Mahalanobis. It pioneered in conducting sample surveys covering various social and economic facets of life through nation-wide surveys. The first round of survey which took place from October 1950 to March 1951, provided data on socio-economic characteristics of households under separate categories, i.e., general household particulars; agriculture and livestock, households industry, craft and trade; services and financial operations; and household consumer expenditure. (GOI, 2004). Altogether NSSO have published results on seventy one rounds on various socio-economic issues of importance to development. The Directorate

2 During the pre-independent period major efforts were carried out under the leadership of Prof. P.C. Mahalanobis on comparing agricultural data collected by long established mode of survey through plot-to-plot complete enumeration which was thought to give better results than sample surveys. One of the first experimentations in sample surveys was done for assessing area and yield of jute crop in Bengal in 1935. Subsequently during the Bengal famine of 1943, a sample survey of rice crop was started and compared with results of plot-to-plot enumeration simultaneously carried out by the Government Department in Bengal. The sample survey bore accurate results at costs less than one-tenth of that of plot-to-plot enumeration. Gradually statistical systems throughout the world came to embrace sample survey with grace.

of Economics and Statistics under Ministry of Agriculture has contributed significantly in providing forecasts and estimates of crop acreages and yields. A comprehensive scheme for the study of principal crops in India under Commission for Agricultural Costs and Prices collects detailed data on costs and returns realised by cultivators across 16 states covering wide range of crops (GOI, 2000). The data on costs and prices collected under this scheme continues to provide estimates of costs and returns from farming which form the basis of various price support mechanisms (Minimum Support Price and Procurement Price) to ensure the welfare of farming community while achieving the goals of food security.Data related to wages received by and paid by various categories of working class helps in construction of various indices to monitor living conditions of vulnerable sections and to take appropriate policy decisions and State interventions.

## 4. Indian Statistical systems in Modern Times: Challenges and Opportunities

In recent times, with the changing global order and economic systems of the world, where complexities of social systems have increased, statistical systems are facing increasing challenges and demands that is put upon it is coming from diverse sources and with increased frequency. First and foremost, India needs to focus on the features and challenges of agriculture production systems in a way that contributes directly towards improving the overall wellbeing of the farmers. In a country of diverse population, multiple social and linguistic identities as well as ecological diversities, enormous amount of accurate data and information collected and interpreted scientifically is required to understand the social and economic changes encompassing issues ranging from poverty and inequality, agriculture, food, health, education, industry, manufacturing and social mobility to formulate appropriate policies and strategies for intervention. Policies and strategies supported by relevant high quality and scientific data alone can bring transformations in agriculture and in essencethe livelihood of the bottom of the pyramid population. The major areas where statistical systems can contribute to bring the transformation in agricultural sector and in improving farmer's livelihood systems are briefly as under.

### 4.1 Better Forecasting:

Timely and accurate forecasting of weather and climatic parameters facilitates formulation of better adaptation strategies and support the farmers in their decision making process with respect to agricultural production. It can even save lives and livelihoods of millions of population living in areas which are ecologically fragile and vulnerable to natural calamities. In this light, India's forecasting capabilities need to cater to the wide range of agro-ecologies in which agricultural production happens with different levels and capabilities.

### 4.2 Methodologies to Assess Risk and Vulnerabilities to Climate Change:

Addressing the challenges raised by climate variability emerges as the most critical element in ensuring sustainable agricultural production systems to ensure food and nutritional security of

vulnerable population through better adaptation strategies. This demands highly competent and sophisticated risk and vulnerability assessment and strategies for adaptation. A synergy of existing statistical systems in various sectors along with competent analytical capabilities, complemented by collection of data on some specific climate change related factors, by and large, should be able to effectively address the challenges posed by climate change.

### 4.3 Tracking Price Trends and Volatility:

A dashboard of information generated by tracking spatial and temporal movements in prices and commodities in different markets in the country can educate farmers about their prospects in realising better returns while ensuring competition and fairtrade. The National Statistical System should be proactive in achieving these capabilities and provide useful information on timely basis which can improve decision regarding cropping pattern, marketing strategies, post-harvest handling and value addition strategies.

### 4.4 Export Import Scenarios:

In a globalised economy, comparative advantage plays a major role (subject to policy framework) in determining movement of commodities across geographies. Availability and access to reliable data, information, and the knowledge generated by analysing thosehelps evidence based decision and policy making process related to exports and imports. This facilitates reduction in inefficiencies and distortions through suitable export import policies and tariff regimes. The ultimate beneficiary will be the farming community who can avail opportunities to reap benefits of their comparative advantages, secure their food and nutritional security and at the same time protect themselves against price volatility and instability in international markets.

### 4.5 Measuring Welfare and Monitoring Impact

Assessing the impact of various development interventions is crucial to get the best out of scarce resources and competing demands. The surveys conducted by NSSO through several rounds covers a wide range of welfare indicators across diverse geographies and population. A meaningful combination of the results when put against relevant questions can facilitate formulation of suitable policies and appropriate interventions to bring out the poor and marginalised in the countryside, including farmers.

## 5. Global Perspective on Statistics in Agriculture

In a globalized world where barriers for flow and exchange of commodities and information are vanishing, and where nations are addressing the challenge of achieving growth with equity, our statistical systems should be well equipped to capture these complexities and its distributional patterns and welfare implications.

To achieve the SDGs, we need to focus our efforts on the most deprived and vulnerable population spread across various geographies, agro-ecologies, cultural and socio-economic landscapes. The basic requirement and necessary condition for such an act is a robust, scientific and high-

quality statistical information that can support analysis and informed policy decision making. This undoubtedly points to the importance of a global perspective of statistics on agriculture. The pace of agricultural growth has direct implication on the pace of eliminating poverty and hunger and ultimately achievements of our development goals. A statistical database on global agriculture, which is of high quality and having high standards of comparability that can capture the specificities and diversities of varied and complex agricultural production systems across the world can equip us with robust analysis and informed policy decisions in support of sustainable development. In the backdrop of a looming threat of climate change that can impact lives and livelihoods of millions of vulnerable population, a sustainable global statistical capacity to produce reliable and timely statistics and indicators measuring a country's progress, particularly of agricultural sector is a necessary condition to make planet earth a better place to live. This can facilitate reliable forecasting of weather and climatic events; better targeting and priority setting of our developmental interventions, equitable distribution of scarce resources, and technology transfer, to achieve the goals of eliminating poverty and hunger and achieve food and nutritional security. There can't be a better expression of this philosophy than the motto of the World Statistics Day, "Better Data. Better Lives"

## 6. Conclusion

In India, agriculture provides livelihoods to more than half of the country's population. Majority of the holdings are small (< 2ha). This results in lower levels of returns from cultivation and incidence of higher levels of poverty among small holders when compared to large cultivators. Hence, to improve the welfare of bottom of the pyramid population of the country we need to bring transformation in the agricultural sector.

As a science, in India, Statistics has contributed to the process of nation building in the formative years and later through massive efforts on data collection, estimation and analysis by national institutions. The availability of statistical data related to crop area, yield levels, input usage, cost of cultivation, income levels, consumption levels, food and nutritional security and all other facets of socio-economic life of farming community indicates impressive achievements of the Indian Statistical System.

It goes without saying that in an ever changing world, statistical systems are subjected to various challenges and demands. The National Statistical Systems should live up to these challenges by preserving achievements of the past and providing direction to policy making efforts to face new challenges and address the question of farmers' well being more effectively and comprehensively. It should take up the challenge of times by providing information and knowledge through better forecasting, developing methodologies to asses risk and vulnerabilities to climate change, effective and timely tracking of price trends and volatility, analyzing export-import scenarios for better decision making and measure welfare changes for better impact. An increased focus on the quality of data collected, using available data through more rigorous analytics, closer link between the

policy makers and 'number crunchers' not only at the central but also in state and lower levels, and above all further development of a decision making system that relies more on objective set of information that also addresses the longer term sustainability issues, in particular, of natural resources India has at its disposal, would go a long way in enhancing the contribution of statistics to agricultural development. Indian Statistical System has responded adequately to the challenges that it faced in the past and those of us who benefit from this system are confident that it will effectively face the challenges that are emerging and will emerge in the future.

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# District Level Crop Yield Estimation under Spatial Small Area Model

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## ABSTRACT

In this article we demonstrate an application of small area estimation technique to produce district level estimates of crop yield for three major crops of the State of Uttar Pradesh using the Improvement of Crop Statistics Scheme data and the auxiliary data from various secondary sources. In particular, we use a spatial model for small area estimation to improve the district level crop yield estimates. The results show improvement in the district level crop yield estimates due to use of spatial information in small area estimation.

**Keywords:** Crop cutting experiments, Improvement of Crop Statistics, District level estimates, Small area estimation, Spatial model.

## 1. INTRODUCTION

The crop yield (i.e., production per hectare of land) estimates are produced on the basis of scientifically designed crop cutting experiments (CCEs) conducted under the scheme of General Crop Estimation Surveys (GCES) in India. More than 800,000 CCEs are conducted annually for this purpose. The sample size gathered through GCES is sufficient for providing precise estimates of crop yield at district level. But, the procedure of conducting the CCEs are very tedious and time consuming which makes some of the enumerators not to follow the appropriate technique for CCEs and by virtue of that the data quality of the GCES goes beyond the desired limit. To improve the quality of data collected under the GCES, a scheme titled 'Improvement of Crop Statistics (ICS)' has been introduced by the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India and implemented by the National Sample Survey Office (NSSO) and the State Agricultural Statistics Authority (SASA) jointly. Under this scheme, quality check on the field operation of GCES is carried out by supervising around 30,000 CCE by NSSO and State Government supervisory officers. The findings of the ICS results reveal that the crop cutting experiments are generally not carried out properly resulting in data which lacks desired quality. Due to limitation of infrastructure and constraints of resources, there is a felt need to reduce the sample size under GCES drastically so that volume of work of the enumerator is reduced and also better supervision of the operation of CCE becomes possible leading to improvement in data quality. But, with the reduction of sample sizes the standard error of the estimates will increase. The reduced sample size is more of concern when aim is to produce estimates at district level since estimators based on the sample data from any particular district (also referred as area or small area) can be unstable. This problem of small sample size within the districts can be solved by using small area estimation (SAE) technique.

The SAE techniques are usually a model-based method where we use statistical models to link the variable of interest with auxiliary information, e.g. Census and Administrative data, for the small areas to define model-based estimators for these areas. See Pfeffermann (2002) and Rao (2003). The underlying models defining the small area estimators are referred as the small area models. These small area models are broadly classified as the area level (Fay and Herriot, 1979) and unit level small area model (Battese *et al.*, 1988). The area level small area models are used when auxiliary information is available only at area level. They relate small area direct estimates to area-specific covariates whereas the unit level small area models relate the unit values of a study variable to unit-specific covariates. Sud *et al.* (2012) applied SAE techniques under area level model to obtain estimates of average yield for paddy crop at small

area levels in the State of Uttar Pradesh in India by linking data generated under ICS scheme by NSSO and the Population Census. They find that the estimates generated through SAE method are reliable and more efficient than the direct estimate from ICS data alone. However, they used the EBLUP estimator under area level random effect model (Fay and Herriot, 1979).

In this paper we consider an application of spatial version of area level random effect (Petrucci and Salvati, 2005, Petrucci *et al.*, 2005 and Singh *et al.,* 2005) to produce the estimates of average yield of Rice, Wheat and Sugarcane crop at district level in the State of Uttar Pradesh in India using the data under ICS scheme and the auxiliary data from Population Census 2011 and Fertilizer Statistics 2010. Section 2 introduces data used for analysis and Section 3 describes the methodology applied in analysis. In Section 4 we compare small area estimates generated by two methods namely small area estimation technique with and without spatial information. Section 5 finally presents the main conclusions.

## 2. DATA DESCRIPTION

We use data under ICS scheme collected during the year 2010-11 for paddy, wheat and sugarcane crop for the State of Uttar Pradesh. In the State of Uttar Pradesh there are 70 districts; however supervision, on a sub-sample, of crop cutting experiments work under ICS scheme is carried out in 42 districts for rice, 51 districts for wheat and 29 districts for sugarcane. As a result, there is no sample data for the remaining districts. These non sample districts are also referred as the out of sample districts. Figure 1 shows the distribution of sample sizes in the sampled districts for the three crops i.e. rice, wheat and sugarcane. The area specific sample sizes for these respective sample districts for the three major crops range from minimum of 4 to maximum of 28 CCE with average of 11 CCE in case of rice, minimum of 4 and maximum of 18 CCE with average of 9 CCE in case of wheat and, minimum of 4 and maximum of 22 CCE with average of 10 CCE in case of sugarcane. A total of 442, 472 and 284 CCE are supervised for rice, wheat and sugarcane respectively for recording yield data in the State of Uttar Pradesh for district level. In a few districts the sample size is so small that the traditional survey estimation approaches lead to unstable district level estimates. In addition in the non-sampled districts we cannot produce estimate of crop yield due to unavailability of sample data. In SAE, covariates are taken from the Population Census 2011 and the fertilizer Statistics 2010. There are number of covariates available from these two sources. However, we did some exploratory data analysis, for example, first we segregated group of covariates with significant correlation with crop yield and then modelling. Finally, we used population density for Rice and Sugarcane and fertilizer consumption during rabi season for wheat as covariates in small area estimation.

## 3. METHODOLOGY

The Fay–Herriot model (Fay and Herriot, 1979) is widely used area level model in SAE. This model relates small area direct survey estimates to area-specific covariates. The SAE under this model is one of the most popular methods used by private and public agencies because of its flexibility in combining different sources of information and explaining different sources of errors. In this section we first elaborate SAE method under area-level Fay–Herriot model (Fay and Herriot, 1979), that is, the EBLUP under this model. We then introduce the Spatial-EBLUP (Petrucci and Salvati, 2005 and Singh *et al*., 2005) which takes into account the spatial structure of the data by modeling the random effects according to a SAR specification.

Let the population be divided into $D$ small areas (district in our application) or areas and we use a subscript $d$ to index the quantities related to district $d$ ($d$ = 1, 2,..., $D$). Let $\hat{\theta}_d$ denotes the direct survey estimate of unobservable population value $\theta_d$ for district $d$ ($d$ = 1, 2,..., $D$). Let $\mathbf{x}_d$ be the $p$-vector of known auxiliary variables, often obtained from various administrative and census records, related to

the population mean $\theta_d$. The simple area specific two stage model suggested by Fay and Herriot (1979) is, $\hat{\theta}_d = \theta_d + e_d$ and $\hat{\theta}_d = \mathbf{x}_d^T\boldsymbol{\beta} + u_d, d = 1,2,...,D$. (1)

We can express model (1) as an area level linear mixed model of form

$$\hat{\theta}_d = \mathbf{x}_d^T\boldsymbol{\beta} + u_d + e_d, d = 1,2,...,D. \quad (2)$$

Here $\beta$ is a *p*-vector of unknown fixed effect parameters, $u_d$s are independent and identically distributed normal random errors with E($u_d$) = 0 and *Var* ($u_d$ ) = $\sigma_u^2$ , and $e_d$s are independent sampling errors normally distributed with $E(e_d \mid q_d) = 0$ and $Var(e_d \mid q_d) = \sigma_d^2$. The two errors are independent of each other within and across areas. Usually, $\sigma_d^2$ is known while $\sigma_u^2$ is unknown and it is estimated from sample data. Methods of estimating $\sigma_u^2$ include maximum likelihood (ML) and restricted maximum likelihood (REML) under normality and the method of fitting constants without normality assumption (Rao, 2003). Let $\hat{\sigma}_u^2$ denotes estimate of $\sigma_u^2$. Then under model (2), the Empirical Best Linear Unbiased Predictor (EBLUP) of $\theta_d$ is given by

$$\hat{\theta}_d^{EBLUP} = \mathbf{x}_d^T\hat{\boldsymbol{\beta}} + \hat{\gamma}_d(\hat{\theta}_d - \mathbf{x}_d^T\hat{\boldsymbol{\beta}}) = \hat{\gamma}_d\hat{\theta}_d + (1-\hat{\gamma}_d)\mathbf{x}_d^T\hat{\boldsymbol{\beta}} \quad (3)$$

where $\hat{\gamma}_d = \dfrac{\hat{\sigma}_u^2}{(\sigma_u^2 + \hat{\sigma}_u^2)}$ and $\hat{\boldsymbol{\beta}}$ is the generalized least square estimate of $\boldsymbol{\beta}$. Note that $\hat{\theta}_d^{EBLUP}$ is a linear combination of direct estimate $\hat{\theta}_d$ and the model based regression synthetic estimate $\mathbf{x}_d^T\hat{\boldsymbol{\beta}}$ with weight $\hat{\gamma}_d$. Here $\hat{\gamma}_d$ is called the "shrinkage factor" since it 'shrinks' the direct estimator, $\hat{\theta}_d$ towards the synthetic estimator, $\mathbf{x}_d^T\hat{\boldsymbol{\beta}}$.

An approximately model unbiased estimate of mean squared error (MSE) of the EBLUP (3) is given by Prasad and Rao (1990) as follows.

$$MSE(\hat{\theta}_d^{EBLUP}) = g_{1d}(\hat{\sigma}_u^2) + g_{2d}(\hat{\sigma}_u^2) + 2g_{3d}(\hat{\sigma}_u^2)\hat{Var}\left(\hat{\sigma}_u^2\right), \quad (4)$$

where,

$$g_{1d}(\hat{\sigma}_u^2) = \hat{\gamma}_d\hat{\sigma}_d^2 \quad g_{2d}(\hat{\sigma}_u^2) = (1-\hat{\gamma}_d)^2\mathbf{x}_d^T\hat{V}(\hat{\boldsymbol{\beta}})\mathbf{x}_d$$

$$g_{2d}(\hat{\sigma}_u^2) = \left[\frac{\hat{\sigma}_d^4}{\left(\hat{\sigma}_d^2 + \hat{\sigma}_u^2\right)^3}\right]\sum_{d=1}^{D}\hat{Var}\left(\hat{\sigma}_u^2\right)$$

with $\hat{Var}\left(\hat{\sigma}_u^2\right) = 2D^{-2}\sum_{d=1}^{D}\left(\hat{\sigma}_d^2 + \hat{\sigma}_u^2\right)^2$ when estimating $\hat{\sigma}_u^2$ by the method of fitting constants.

In Section 2 we noticed that there are many out of sample districts in the data and the conventional approach for estimating small areas in this case is synthetic estimation, based on a suitable model fitted to the data from the sampled areas. This is equivalent to setting the area effect for out of sampled area to zero. Under model (2), the synthetic EBLUP predictor for $\theta_d$ is

$$\hat{\theta}_d^{SYN} = \mathbf{x}_d^T\hat{\boldsymbol{\beta}}. \quad (5)$$

This predictor is referred as the Synthetic EBLUP (hereafter denoted by SYN). Under model (2), the MSE estimate for the synthetic predictor (5) is

$$MSE(\hat{\theta}_d^{SYN}) = \mathbf{x}_d^T Var(\hat{\boldsymbol{\beta}})\mathbf{x}_d + \hat{\sigma}_u^2. \quad (6)$$

In model (2) the random area effects are considered to be independent. However, it is often reasonable to assume that the effects of neighbouring areas (defined, for example, by a contiguity criterion) are correlated, with the correlation decaying to zero as the distance between these areas increases. Consequently, small area models should allow for spatial correlation of area random effects. In order to take into account the correlation between neighbouring areas we consider the use of spatial models for random area effects. We consider a linear regression model with spatial dependence in the error structure. In particular, we assume a Simultaneous Autoregressive (SAR) error process, where the vector of random area effects $\boldsymbol{v} = (v_d)$ satisfies $\boldsymbol{v} = \rho\mathbf{W}\boldsymbol{v} + \boldsymbol{u}$ and $\rho$ is a spatial autoregressive coefficient, *W* is a proximity matrix of order *D* and $\boldsymbol{u} \sim N(0, \sigma_u^2\boldsymbol{I}_D)$. Since $\boldsymbol{v} = (\boldsymbol{I}_D - \rho\mathbf{W})^{-1}\boldsymbol{u}$

with $E(\boldsymbol{u})=0$ and $Var(\boldsymbol{u})=\sigma_u^2\boldsymbol{I}_D$, we have $E(\boldsymbol{v})=0$ and $Var(\boldsymbol{v})=\sigma_u^2[(\boldsymbol{I}_D-\rho\mathbf{W})(\boldsymbol{I}_D-\rho\mathbf{W}^T)]^{-1}=\Omega$. The $\mathbf{W}$ matrix describes how random effects from neighbouring areas are related, whereas $\rho$ defines the strength of this spatial relationship. The simplest way to define $\mathbf{W}$ is as a contiguity matrix. The elements of $\mathbf{W}$ take non-zero values only for those pairs of areas that are adjacent. Then the model (2) with spatially correlated errors is

$$\boldsymbol{\theta}=\mathbf{x}\boldsymbol{\beta}+\mathbf{z}(\boldsymbol{I}_D-\rho\mathbf{W})^{-1}\boldsymbol{u}+\mathbf{e}=\mathbf{x}\boldsymbol{\beta}+\mathbf{z}\boldsymbol{v}+\mathbf{e}. \quad (7)$$

The covariance matrix of the vector $\boldsymbol{\theta}$ is $\mathbf{V}=\mathbf{z}\Omega\mathbf{z}^T+\mathbf{R}$. In practice, the vector of parameters $\boldsymbol{\psi}=(\sigma_u^2,\rho)^T$ is unknown. Assuming normality of the random effects, the parameter vector $\sigma_u^2$ and $\rho$ can be estimated via ML as well as REML methods. Numerical approximations to either the ML or REML estimators $\hat{\sigma}_u^2$ and $\hat{\rho}$ can be obtained via a two-step procedure. At the first step, the Nelder-Mead algorithm is used to approximate these estimates. The second step then uses these approximations as starting values for a Fisher scoring algorithm. See Petrucci *et al.* (2005), Petrucci and Salvati (2005) for computational details. Replacing $\boldsymbol{\psi}=(\sigma_u^2,\rho)^T$ with an asymptotically consistent estimator $\hat{\boldsymbol{\psi}}=(\hat{\sigma}_u^2,\hat{\rho})^T$, and assuming that (7) holds, the spatial Empirical Best Linear Unbiased Predictor (Spatial-EBLUP or SEBLUP) of $\theta_d$ is

$$\hat{\theta}_d^{Spatial-EBLUP}=\mathbf{x}_d^T\hat{\boldsymbol{\beta}}^s+a_d^T\hat{v}, \text{ with } \hat{v}=\hat{\Omega}\mathbf{z}^T\hat{\mathbf{V}}^{-1}(y-\mathbf{x}\hat{\boldsymbol{\beta}}^s), \quad (8)$$

where $\hat{\boldsymbol{\beta}}^s=\left(\mathbf{x}^{\mathbf{T}}\hat{\mathbf{V}}^{-1}\mathbf{x}\right)^{-1}\left(\mathbf{x}^{\mathbf{T}}\hat{\mathbf{V}}^{-1}\mathbf{y}\right)$ is the EBLUE of $\boldsymbol{\beta}$ under model (7), $a_d$ is the $D$-vector $(0,\ldots,1,\ldots,0)^T$ with the 1 in the $d^{th}$ position $\hat{\Omega}=\hat{\sigma}_u^2[(\boldsymbol{I}_D-\hat{\rho}\mathbf{W})(\boldsymbol{I}_D-\hat{\rho}\mathbf{W}^T)]^{-1}$ and $\hat{\mathbf{V}}=\left\{\mathbf{z}\hat{\sigma}_u^2[(\boldsymbol{I}_D-\hat{\rho}\mathbf{W})(\boldsymbol{I}_D-\hat{\rho}\mathbf{W}^T)]^{-1}\mathbf{z}^T+diag(\sigma_{ed}^2)\right\}$.

For out of sampled areas, spatial Synthetic EBLUP (hereafter denoted by Spatial-SYN) of $\theta_d$ is

$$\hat{\theta}_d^{Spatial-SYN}=\mathbf{x}_d^T\hat{\boldsymbol{\beta}}^s. \quad (9)$$

Following Petrucci and Salvati (2005), an approximately unbiased estimator of the MSE of the SEBLUP (6) is

$$MSE(\hat{\theta}_d^{SEBLUP})=g_{1d}^{(s)}(\hat{\boldsymbol{\psi}})+g_{2d}^{(s)}(\hat{\boldsymbol{\psi}})+2g_{3d}^{(s)}(\hat{\boldsymbol{\psi}})-\mathbf{B}_d^{(s)T}(\hat{\boldsymbol{\psi}})\nabla g_{1d}^{(s)}(\hat{\boldsymbol{\psi}}), \quad (10)$$

where the first term $g_{1d}^{(s)}(\hat{\boldsymbol{\psi}})$ is due to the estimation of random area effects and is of order $O(1)$ while the second term $g_{2d}^{(s)}(\hat{\boldsymbol{\psi}})$ is due to the estimation of $\boldsymbol{\beta}$ and is of order $O(D^{-1})$ for large $D$. The third term $g_{3d}^{(s)}(\hat{\boldsymbol{\psi}})$ is due to the estimation of the variance component. Finally, the last term $\mathbf{B}_d^{(s)T}(\hat{\boldsymbol{\psi}})\nabla g_{1d}^{(s)}(\hat{\boldsymbol{\psi}})$ is bias when ML method of estimation is used for variance component. This term is negligible and thus ignored when REML or method of moment is used for parameter estimation. Various terms of (7) are: $g_{1d}^{(s)}(\hat{\boldsymbol{\psi}})=a_d^T\left(\hat{\Omega}-\hat{\Omega}\mathbf{z}^T\hat{\mathbf{V}}^{-1}\mathbf{z}\hat{\Omega}\right)a_d$,

$g_{2d}^{(s)}(\hat{\boldsymbol{\psi}})=\left(\mathbf{x}_d^T-\mathbf{c}_d^T\mathbf{x}\right)\left(\mathbf{x}^{\mathbf{T}}\hat{\mathbf{V}}^{-1}\mathbf{x}\right)^{-1}\left(\mathbf{x}_d^T-\mathbf{c}_d^T\mathbf{x}\right)^T$, and

$g_{3d}^{(s)}(\hat{\boldsymbol{\psi}})=tr\left\{\left(\nabla\mathbf{c}_d^T\right)\hat{\mathbf{V}}\left(\nabla\mathbf{c}_d\right)\hat{V}(\hat{\boldsymbol{\psi}})\right\}$,

with $\mathbf{c}_d^T=a_d^T\hat{\Omega}\mathbf{z}^T\hat{\mathbf{V}}^{-1}$, $\nabla\mathbf{c}_d^T=\partial\mathbf{c}_d^T/\partial\boldsymbol{\psi}$, $\hat{V}(\hat{\boldsymbol{\psi}})$ is the estimate of the asymptotic covariance matrix of $\hat{\boldsymbol{\psi}}$ defined by the inverse of the relevant observed information matrix and $\mathbf{B}_d^{(s)T}(\hat{\boldsymbol{\psi}})\nabla g_{1d}^{(s)}(\hat{\boldsymbol{\psi}})$ bias correction due to ML estimator of $\boldsymbol{\psi}$.

## 4. EMPIRICAL STUDY

In this section we report the results from analysis carried out to produce the district level crop yield estimates. We compare the spatial EBLUP (SEBLUP), the EBLUP and the direct estimator used to generate the district level crop yield estimates. We examine the usefulness of spatial information in producing the small area estimates. The analysis is carried out for three major crops (rice, wheat and sugarcane) using the ICS data of the State of Uttar Pradesh. We used SAE package of R-Software for our analysis. The values of yield estimates generated by using direct survey estimator, EBLUP and SEBLUP along with their percentage standard errors (%SE) are given in Table 1, 2 and 3 for rice, wheat and sugarcane crops respectively. The percentage standard error

(% SE) of the estimator $\hat{\theta}_d$ in district *d* is calculated as $\%SE_d = 100 \times \frac{SE(\hat{\theta}_d)}{\hat{\theta}_d}; d = 1,...,D.$

These results in Tables 1-3 clearly indicate that the SEBLUP method is providing better estimates than the usual EBLUP and the direct survey estimator. It can also be seen that there is a significant improvement in the %SE of the SEBLUP than the EBLUP and the direct estimates. Two points emerged from this analysis, (i) the small area estimate provides efficient and better estimates for crop yield as compared to the direct survey estimates, (ii) the use of spatial information improve the efficiency of small area estimates. For out of sample districts we produced the SEBLUP estimates. These out of sample districts are 30, 19 and 42 for rice, wheat and sugarcane respectively. The district level yield estimates for these out of sample districts produced using SEBLUP are reported in Table 4, 5 and 6 for rice, wheat and sugarcane respectively. It is noteworthy that in some districts %SE is high, in particular, for sugarcane. We observed that the number of out of sample districts in this case is 42, that is, more than sample districts. We used model fitted using data from 29 districts to predict yield for 42 districts. Similar problem was also observed in Rice and Wheat crops but since number of sample districts are more than the out of sample district prediction are little better

## 5. CONCLUSIONS

This paper demonstrated an application of small area estimation technique to produce reliable district level estimates of crop yield using CCE supervised under ICS scheme data combined with Covariates from secondary sources. Although the ICS supervised crop cutting experiments number only 30,000 in the entire country i.e. the sample size is very low, the collected data is of very high quality. The estimates generated using this data are expected to be relatively free from various sources of non-sampling errors. Hence, it is, therefore, recommended that wherever it is not possible to conduct adequate number of crop cutting experiments due to constraints of cost or infrastructure or both, small area estimation technique can be gainfully used to generate reliable estimates of crop yield based on a smaller sample to obtain more precise estimates than the direct survey estimates. The precision of these small area estimates can be enhanced by using spatial small area estimation technique.


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## Table 1. District level yield estimates (gms/CCE plot area) of Rice crop for Uttar Pradesh for 2010-11.

| District | Yield | | | % SE | | | Yield | Yield | | | % SE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Direct | EBLUP | SEBLUP | Direct | EBLUP | SEBLUP | | Direct | EBLUP | SEBLUP | Direct | EBLUP | SEBLUP |
| Saharanpur | 17256 | 16984 | 17397 | 7.71 | 7.68 | 7.17 | Kaushambi | 17400 | 17045 | 16419 | 8.32 | 8.29 | 7.54 |
| M.Nagar | 19033 | 18918 | 18816 | 4.25 | 4.24 | 4.17 | Allahabad | 14830 | 14648 | 14611 | 13.84 | 13.36 | 10.88 |
| Bijnor | 15233 | 15033 | 15109 | 7.74 | 7.72 | 7.08 | Barabanki | 13743 | 13198 | 13824 | 17.09 | 16.72 | 11.53 |
| Moradabad | 16613 | 16506 | 15741 | 11.95 | 11.51 | 9.96 | Faizabad | 16021 | 15780 | 15738 | 10.33 | 10.16 | 8.61 |
| J.P. Nagar | 12050 | 12044 | 12113 | 2.61 | 2.6 | 2.57 | Ambedkarnagar | 18696 | 18608 | 18277 | 3.83 | 3.82 | 3.76 |
| Ghaziabad | 21833 | 27652 | 19985 | 15.01 | 10.92 | 14.61 | Sultanpur | 17438 | 16672 | 15843 | 12.07 | 12.01 | 9.32 |
| Buland Shahar | 14321 | 14125 | 13890 | 8.77 | 8.73 | 8.09 | Bahraich | 13543 | 13417 | 13490 | 7.89 | 7.86 | 7.27 |
| Aligarh | 6539 | 7111 | 10015 | 31.35 | 27.5 | 16.14 | Shrawasti | 13131 | 11816 | 12859 | 22.58 | 22.76 | 15.23 |
| Etah+Mainpuri | 15325 | 15385 | 15441 | 8.05 | 7.88 | 7.26 | Gonda | 11441 | 11388 | 12212 | 11.84 | 11.64 | 9.6 |
| Badaun | 15879 | 15521 | 15059 | 8.47 | 8.49 | 7.73 | Sidharthnagar | 13950 | 13663 | 13809 | 13.36 | 13.11 | 10.73 |
| Shahjahanpur | 18225 | 17475 | 16529 | 13.72 | 13.35 | 10.44 | Sant Kabir Nagar | 15592 | 15092 | 15140 | 17.06 | 16.3 | 12.31 |
| Khiri | 13833 | 13184 | 13854 | 13.85 | 13.93 | 10.97 | Maharajganj | 16010 | 15873 | 15635 | 6.28 | 6.26 | 5.97 |
| Sitapur | 13060 | 12739 | 13434 | 14.1 | 13.91 | 11.06 | Gorakhpur | 13688 | 13973 | 14202 | 15.78 | 14.68 | 10.98 |
| Hardoi | 14717 | 14001 | 14586 | 14.53 | 14.5 | 10.77 | Kushinagar | 13979 | 14009 | 14287 | 8.65 | 8.49 | 7.74 |
| Rai Bareilly | 14125 | 13920 | 14407 | 8.66 | 8.63 | 7.75 | Azamgarh | 11311 | 11327 | 11480 | 4.38 | 4.37 | 4.24 |
| Farrukhabad | 21967 | 16448 | 15941 | 26.44 | 25.99 | 13.67 | Mau | 12469 | 12843 | 12476 | 18.27 | 16.75 | 12.97 |
| Kannauj | 14950 | 14253 | 14982 | 15.36 | 15.18 | 11 | Balia | 9195 | 9311 | 9878 | 11.7 | 11.4 | 10.13 |
| Etawah | 24588 | 20101 | 17034 | 15.18 | 16.02 | 11.96 | Ghazipur | 12376 | 12388 | 12291 | 7.25 | 7.18 | 6.86 |
| Auraiya | 18242 | 14866 | 15769 | 23.69 | 24.03 | 13.64 | S.R.Nagar | 12700 | 12982 | 13181 | 10.87 | 10.41 | 9.35 |
| Kanpur® | 18081 | 15324 | 14946 | 20.11 | 20.61 | 14.55 | Mirzapur | 8763 | 8245 | 10238 | 41.72 | 38.45 | 20.5 |
| Kanpur(u) | 11319 | 11845 | 13120 | 16.43 | 15.11 | 11.42 | Sonbhadra | 6308 | 6038 | 8259 | 29.98 | 30.06 | 19.55 |

## Table 2. District level yield estimates (gms/CCE plot area) of wheat crop for Uttar Pradesh for 2010-11.

| District | Yield | | | % SE | | | District | Yield | | | % SE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Direct | EBLUP | SEBLUP | Direct | EBLUP | Direct | | Direct | EBLUP | SEBLUP | Direct | EBLUP | SEBLUP |
| Saharanpur | 15560 | 14999 | 15684 | 12.75 | 12.65 | 10.6 | Hamirpur | 9148 | 9148 | 10474 | 0.45 | 0.45 | 10.61 |
| M.Nagar | 16985 | 16950 | 16611 | 2.7 | 2.7 | 6.38 | Banda | 11284 | 11241 | 11315 | 4.3 | 4.3 | 4.18 |
| Bijnor | 14865 | 14272 | 13046 | 13.03 | 13.01 | 12.79 | Chitrakoot | 7506 | 7501 | 9662 | 2.75 | 2.75 | 16.47 |
| Moradabad | 13906 | 13870 | 13843 | 9.29 | 9.14 | 13.98 | Fatehpur | 13220 | 12995 | 13216 | 8.68 | 8.69 | 9.13 |
| J.P Nagar | 10175 | 10081 | 10895 | 13.99 | 13.8 | 7.78 | Kaushambi | 12544 | 12083 | 12302 | 19.44 | 18.89 | 10.97 |
| Meerut | 16700 | 16694 | 15077 | 1.72 | 1.72 | 9.14 | Allahabad | 10600 | 10610 | 11965 | 9.02 | 8.92 | 9.69 |
| Bagpat | 15788 | 15744 | 15533 | 3.43 | 3.42 | 3.37 | Barabanki | 15892 | 15728 | 15063 | 5.52 | 5.52 | 7.76 |
| Ghaziabad | 14050 | 17542 | 13886 | 17.33 | 13.21 | 10.42 | Faizabad | 13280 | 13160 | 12778 | 10.29 | 10.16 | 8.54 |
| Bulandshahar | 16919 | 16723 | 16761 | 5.44 | 5.45 | 2.68 | Ambedkarnagar | 12044 | 11866 | 12679 | 17.74 | 17.11 | 11.91 |
| Aligarh | 13154 | 12923 | 13649 | 14.19 | 13.51 | 9.41 | Sultanpur | 9351 | 9319 | 9382 | 14.85 | 14.57 | 2.19 |
| Hathras | 13363 | 11248 | 13398 | 41.75 | 37.35 | 6.42 | Bahraich | 11513 | 11367 | 11300 | 9.57 | 9.56 | 9.41 |
| Agra | 14335 | 14156 | 14714 | 10.3 | 10.17 | 10.24 | Balrampur | 8988 | 8791 | 9240 | 20.29 | 19.97 | 7.32 |
| Firozabad | 16883 | 16379 | 15512 | 10.76 | 10.69 | 8.36 | Siddrathnagar | 10281 | 10274 | 10564 | 4.37 | 4.36 | 16.58 |
| kansiramnagar | 14550 | 14553 | 14390 | 4.46 | 4.44 | 4.27 | Maharajganj | 14256 | 14228 | 13680 | 3.23 | 3.23 | 8.43 |
| Mainpuri | 18388 | 17428 | 14627 | 10.12 | 10.26 | 10.95 | Gorakhpur | 11938 | 12011 | 11981 | 11.26 | 10.96 | 2.38 |
| Badaun | 16038 | 15518 | 15939 | 9.71 | 9.76 | 2.8 | Kushinagar | 11679 | 11698 | 11767 | 8.42 | 8.31 | 7.67 |
| Shshjahanpur | 12729 | 12723 | 13753 | 5.54 | 5.51 | 9.53 | Deoria | 11786 | 11797 | 11871 | 7.04 | 6.98 | 6.9 |
| Sitapur | 10539 | 10519 | 10739 | 5.08 | 5.08 | 4.09 | Azamgarh | 11949 | 11947 | 11938 | 3.65 | 3.64 | 9.25 |
| Hardoi | 12675 | 12555 | 12731 | 7.14 | 7.14 | 6.3 | Balia | 13321 | 13283 | 12266 | 5.96 | 5.93 | 17.62 |
| Unnao | 13504 | 13049 | 13503 | 12.5 | 12.52 | 0.3 | Ghazipur | 9943 | 9958 | 11252 | 7.87 | 7.8 | 16.34 |
| Raibareilly | 10557 | 10524 | 10864 | 6.14 | 6.13 | 5.67 | Chandauli | 8900 | 8876 | 9319 | 10.47 | 10.39 | 9.03 |
| Etawah | 11717 | 11124 | 12543 | 19.89 | 19.71 | 10.55 | Varanasi | 10681 | 10704 | 11421 | 2.38 | 2.37 | 12.43 |
| Aurriya | 13200 | 12945 | 12888 | 9.65 | 9.66 | 6.57 | S.R.Nagar | 12067 | 12094 | 11951 | 4.52 | 4.5 | 4.42 |
| Kanpur(D) | 17713 | 16358 | 15591 | 12.67 | 12.96 | 8.61 | Mirzapur | 7713 | 7534 | 9172 | 25.38 | 24.87 | 16.25 |
| Jhansi | 12892 | 10866 | 12586 | 26.18 | 27.49 | 8.54 | Sonbhadra | 4967 | 4883 | 5216 | 24.76 | 24.75 | 8.24 |
| Lalitpur | 11500 | 10448 | 11483 | 19.54 | 20.31 | 3.91 | | | | | | | |

## Table 3. District level yield estimates (gms/CCE plot area) of Sugarcane crop for Uttar Pradesh for 2010-11.

| District | Yield | | | % SE | | | District | Yield | | | % SE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Direct | EBLUP | SEBLUP | Direct | EBLUP | SEBLUP | | Direct | EBLUP | SEBLUP | Direct | EBLUP | SEBLUP |
| Saharanpur | 15560 | 128546 | 138556 | 23.22 | 21.22 | 19.69 | Barabanki | 16038 | 75366 | 102398 | 35.55 | 30.63 | 22.54 |
| M.Nagar | 16985 | 136228 | 141221 | 10.87 | 10.61 | 10.23 | Faizabad | 12729 | 155410 | 152544 | 11.76 | 11.48 | 11.69 |
| Bijnore | 14865 | 110182 | 110586 | 23.45 | 21.88 | 21.8 | Bahraich | 10539 | 101962 | 102690 | 32.8 | 30.51 | 30.29 |
| Muradabad | 13906 | 75216.1 | 76210 | 38.95 | 27.81 | 27.45 | Balrampur | 12675 | 82256 | 102835 | 15.02 | 14.73 | 11.78 |
| Rampur | 10175 | 133211 | 134296 | 8.41 | 8.3 | 8.24 | Gonda | 13504 | 108348 | 109281 | 13.12 | 12.78 | 12.67 |
| Meerut | 16700 | 119689 | 133674 | 40.36 | 25.97 | 23.25 | Basti | 10557 | 86976 | 103127 | 24.5 | 21.94 | 18.5 |
| Baghpat | 15788 | 160367 | 165735 | 11.08 | 10.94 | 10.58 | Maharajganj | 11717 | 141447 | 145278 | 3.29 | 3.29 | 3.2 |
| Bulandshar | 14050 | 123911 | 125889 | 7.44 | 7.41 | 7.3 | Gorakhpur | 13200 | 122220 | 133102 | 23.29 | 19.24 | 17.67 |
| Mathura | 16919 | 136580 | 139892 | 5.95 | 5.95 | 5.81 | Kushinagar | 17713 | 136393 | 139429 | 8.76 | 8.54 | 8.36 |
| Bareilly | 13154 | 139917 | 144012 | 10.41 | 10.15 | 9.86 | Deoria | 12892 | 126231 | 145755 | 8.6 | 8.39 | 7.26 |
| Pilibhit | 13363 | 111760 | 121665 | 22.82 | 23.17 | 21.28 | Mau | 11500 | 148889 | 152082 | 3.36 | 3.35 | 3.28 |
| Shahjahanpur | 14335 | 89277.5 | 92747 | 38.74 | 33.63 | 32.38 | Jaunpur | 9148 | 178756 | 179878 | 19.05 | 18.16 | 18.04 |
| Khiri | 16883 | 135532 | 136961 | 5.64 | 5.67 | 5.61 | Varanasi | 11284 | 153410 | 207675 | 18.36 | 13.91 | 10.27 |
| Sitapur | 14550 | 72145.9 | 102106 | 23.17 | 21.52 | 15.21 | J.P.Nagar | 7506 | 102673 | 102998 | 45.84 | 35.16 | 35.05 |
| Hardoi | 18388 | 163052 | 167252 | 6.9 | 6.96 | 6.78 | | | | | | | |

**Table 4. District level yield estimates (gms/CCE plot area) of Rice crop for out of sample districts using Spatial EBLUP (SEBLUP).**

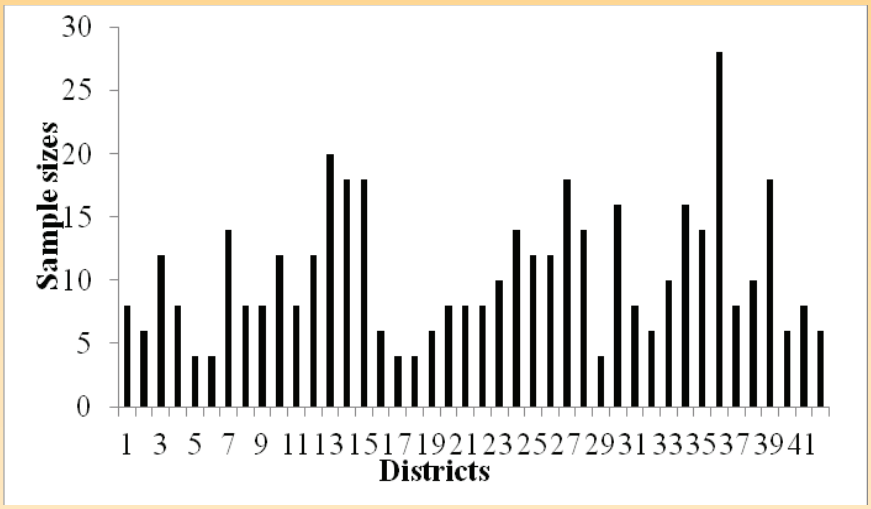
| Districts | Yield | % SE | Districts | Yield | % SE |
|---|---|---|---|---|---|
| Rampur | 14244 | 42.41 | Jaunpur | 14464 | 42.67 |
| Mathura | 13796 | 43.84 | Agra | 14426 | 41.88 |
| Bareilly | 14420 | 41.89 | Firozabad | 14366 | 42.05 |
| Pilibhit | 13531 | 44.77 | Bagpat | 14242 | 42.42 |
| Unnao | 13690 | 44.2 | Mahamaya nag | 13997 | 43.18 |
| Lucknow | 15747 | 38.74 | Baharich | 13859 | 43.61 |
| Banda | 13193 | 46.16 | Chandauli | 13834 | 43.69 |
| Fatehpur | 13618 | 44.46 | Kanshiram nagar | 13767 | 43.91 |
| Pratapgarh | 14003 | 43.16 | Mainpuri | 13685 | 44.18 |
| Balrampur | 13658 | 44.32 | Jhansi | 13175 | 46.13 |
| Basti | 14115 | 42.8 | Jalaun | 13117 | 46.58 |
| Varanasi | 16808 | 37 | Chitrakut | 13011 | 47.2 |
| Meerut | 14878 | 40.67 | Mahboba n | 12959 | 47.02 |
| Deoria | 14678 | 41.18 | Hamirpur | 12942 | 46.7 |
| G B Nagar | 14667 | 41.21 | Lalitpur | 12891 | 47.31 |

**Table 5. District level yield estimates (gms/CCE plot area) of Wheat crop for out of sample districts using Spatial EBLUP (SEBLUP).**

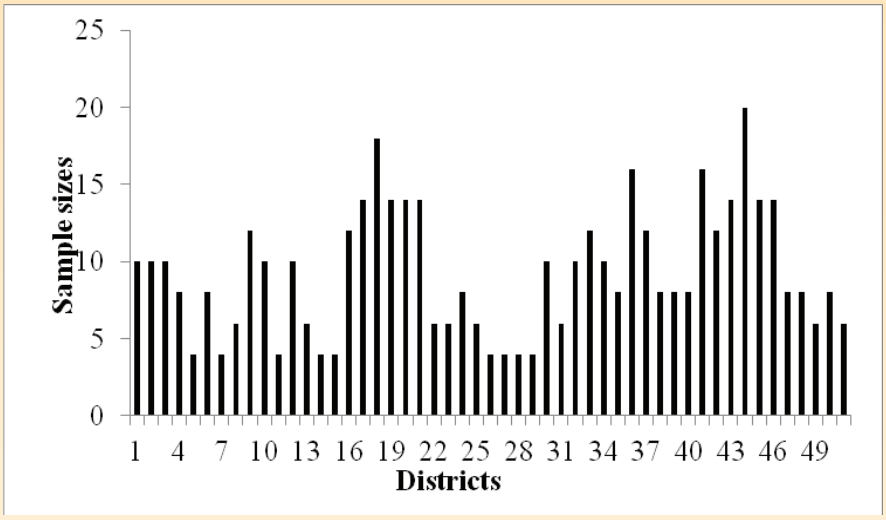
| Districts | Yield | % SE | Districts | Yield | % SE |
|---|---|---|---|---|---|
| G B Nagar | 9565 | 11.41 | Jalaun | 9676 | 25.6 |
| Mathura | 9692 | 27.68 | Mahoba n | 9523 | 6.05 |
| Bareilly | 9825 | 44.27 | Pratapgarh | 9660 | 23.61 |
| Pilibhit | 9742 | 33.98 | Shrawasti | 9523 | 6.06 |
| Shahjahanpur | 9884 | 51.38 | Gonda | 9738 | 33.39 |
| Lucknow | 9664 | 24.08 | Basti | 9691 | 27.57 |
| Rai Bareilly | 9692 | 27.71 | S.K.Nagar | 9616 | 18.01 |
| Farukhabad | 9783 | 39.05 | Maunathbhanjan | 9644 | 21.55 |
| Kannauj | 9658 | 23.33 | Jaunpur | 9727 | 32.07 |
| Kanpur(u) | 9836 | 45.59 | | | |

**Table 6. District level yield estimates (gms/CCE plot area) of Sugarcane crop for out of sample districts using Spatial EBLUP (SEBLUP).**

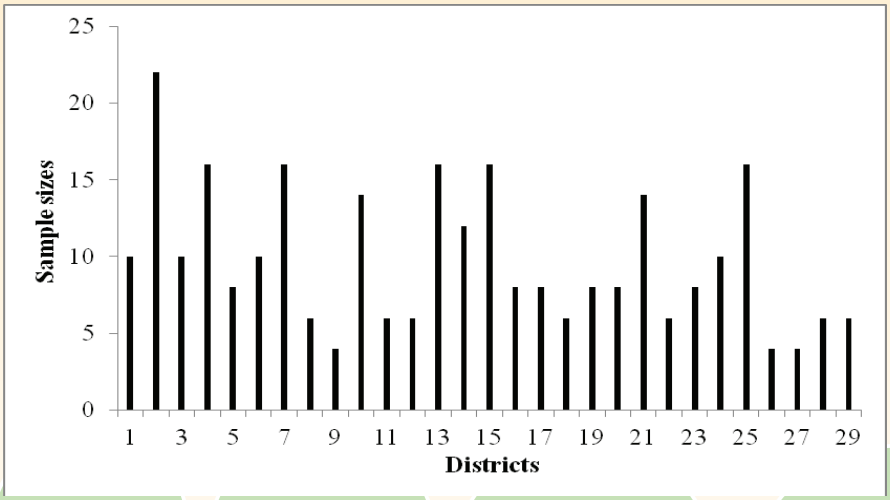
| Districts | Yield | % SE | Districts | Yield | % SE |
|---|---|---|---|---|---|
| Ghaziabad | 11249 | 12.16 | G B nagar | 9718 | 34.58 |
| Etah | 9817 | 17.87 | Agra | 9643 | 37.48 |
| Badaun | 9417 | 23.84 | Balia | 9640 | 35.98 |
| Unnao | 9416 | 27.46 | Gazipur | 9635 | 63.77 |
| Lucknow | 10051 | 24.56 | Firozabad | 9625 | 65.00 |
| Rai Bareilly | 9447 | 32.46 | Mahamaya Nag. | 9511 | 53.31 |
| Farrukhabad | 9519 | 29.87 | Baharich | 9468 | 47.92 |
| Kannauj | 9471 | 35.93 | Chandauli | 9461 | 48.75 |
| Etawah | 9417 | 38.14 | Kanshiram nagar | 9440 | 45.11 |
| Auraiya | 9416 | 44.83 | Mainpuri | 9415 | 44.46 |
| Kanpur® | 9389 | 42.12 | Mirzapur | 9351 | 43.04 |
| Kanpur(u) | 9846 | 44.13 | Jhansi | 9257 | 41.61 |
| Banda | 9263 | 47.06 | Jalaun | 9239 | 39.98 |
| Fatehpur | 9394 | 43.01 | Chitrakut | 9207 | 38.29 |
| Pratapgarh | 9513 | 42.8 | Mahboba n | 9191 | 36.5 |
| Kaushambi | 9537 | 41.76 | Sonbhadra | 9188 | 34.58 |
| Allahabad | 9641 | 40.57 | Hamirpur | 9186 | 32.56 |
| Ambedkarnagar | 9606 | 39.59 | Lalitpur | 9170 | 30.42 |
| Sultanpur | 9513 | 38.66 | Aligarh | 9598 | 27.6 |
| Shrawasti | 9327 | 37.84 | Sidharthnagar | 9528 | 25.17 |
| S K Nagar | 9615 | 41.6 | Ajamgarh | 9672 | 22.25 |
| S R Nagar | 9892 | 41.79 | | | |




(a)




(b)




(c)

**Figure 1. District wise sample sizes for (a) Rice (b) Wheat and (c) Sugarcane under ICS of Uttar Pradesh in 2010-11**

# Agriculture and Farmers' Welfare: Some observations based on National Sample Surveys with special emphasis on Situation Assessment Survey (SAS) of Agricultural Households

National Sample Survey office


## Summary

The importance of Agriculture in the Indian economy, by way of its contribution to GDP and as a livelihood provider to majority of the rural workforce was rightly represented by various socio economic surveys conducted by NSSO right from its inception. Earlier NSS surveys on Agriculture collected information on socio-economic conditions of the households engaged in agricultural activities. Even when other socio economic surveys like Employment and Unemployment, Debt and Investment are conducted, some special tabulation are made for cultivator households / agricultural labour households or persons who are self employed in agriculture. The Situation Assessment Survey (SAS) conducted in the beginning of this millennium was another milestone of NSS surveys on Agriculture. The second survey in the series of SAS was conducted after a gap of ten years in 2013 as part of NSS 70th round. This paper delves into some important features of Situation Assessment Surveys and discusses some key indicators of agricultural households based on the results of SAS 2013.


## 1. Introduction

*Agriculture and allied activities* is the largest livelihood provider in our country, especially in the rural areas. Even though its contribution to GDP declined over years, its important role in poverty alleviation by way of providing food security and employment and in keeping the balance between development and conservation of natural resources is still unquestionable. According to the latest survey on **Employment and Unemployment** conducted by NSSO during July 2011 – June 2012 in 68th round of NSS, about 64 percent of the total workers in rural India and 49 percent in the country as a whole were engaged in this sector. Exports of agricultural products accounted for about 12 percent of the total value of merchandise exports of the country during 2014-15.

## 2. Agriculture in National Sample Surveys (NSS)

2.1 At the time of inception of National Sample Survey, the Indian economy was literally agrarian with 51.81% of the GDP in 1950-51 at current prices contributed by *Agriculture and Allied Sector*. The need of having reliable and timely statistics on this important sector of Indian economy was recognised by our planners and policy makers. Agriculture as a survey topic was rightly represented in the subject coverage of initial NSS survey activities. Starting from the first round of NSS, '*Agriculture and Animal Husbandry*' was one of the topics for the socio economic surveys for the seven consecutive rounds and once again during 11th round of NSS. Following this, another survey titled 'Prices and Disposal of cereals by producer households' was carried out in NSS 15th round. Even when other socio economic surveys like Employment & Unemployment, Indebtedness etc were carried out, they were either separately canvassed for agricultural labour households and others (as in NSS 11th round and 12th round) or special tabulations were done for cultivator households.

2.2 A first detailed survey on economic conditions of agricultural households was attempted with the survey on 'Economic Conditions of small cultivator households' (Schedule 16.1) conducted in the rural areas during NSS 25th round (July 70- June 71). The survey collected detailed

information on the income and expenditure of the cultivator households from farm and non-farm activities, their assets holding position, status of indebtedness, their credit need, adoption of new technology in the field of agriculture and perception about their effectiveness in the farming process, other ancillary activities (both farm and non-farm) taken up by them, availability of work, willingness to take up work outside village etc. The schedule also had detailed blocks on consumer expenditure. This survey, though in a limited sense, can be considered as a precursor to the decennial 'Situation Assessment Surveys (SAS)' started with NSS 59th round (January 2003- December 2003).

## 2.3 Situation Assessment Survey of Farmers

2.3.1 At the beginning of this millennium, the Union Ministry of Agriculture had planned for a comprehensive assessment of the situation of farmers in the country. The areas of interest were their level of living as measured by consumer expenditure, income and productive assets, their indebtedness, farming practices and preferences, resource availability, their awareness of technological developments and access to modern technology in the field of agriculture. To meet these requirements, the Situation Assessment Survey of Farmers (SAS) was conducted by NSSO during January to December, 2003, as part of its 59th round. The survey was conducted only in the rural sector of the country. In all, 51,770 households spread over 6,638 villages were surveyed in the Central Sample. The survey was conducted in two visits and the sample households were visited twice to collect information pertaining to the agricultural activities of the two seasons (kharif and rabi) of the agricultural year July 2002 – June 2003. The data thus generated bridged, to a considerable extent, the data gap in the existing statistical system for providing needed input for *farmer oriented* policy formulation.

2.3.2 For the purpose of this survey, a farmer household was defined as one which had at least one farmer as a member. A farmer was understood to be a person who possessed some land and was engaged in agricultural activities on any part of that land during the last 365 days. Agricultural activity was taken to include cultivation of field and horticultural crops, growing of trees and plantations such as rubber, cashew, coconut, pepper, coffee, tea, etc; and animal husbandry, poultry, fishery, bee-keeping, vermiculture, sericulture, etc. Cultivator was meant to be a farmer who had been engaged in activities related to production of crops by tillage and ancillary jobs.

2.3.3 **Some Key results of SAS 2003:** The SAS 2003 estimated the number of farmer households in the country as 89.35 million which was about 60 percent of the estimated rural households in the country. About 66 percent of the farmer households reported to have possessed one hectare or less land at the time of the survey. The survey further found that the standard of living of the average farmer household measured in terms of total monthly consumer expenditure was not different from that of the average rural households at the all India level. 48.6 percent of the farmer households in the country were reported to be indebted at the time of the survey and the estimated prevalence of indebtedness among farmer households was highest in Andhra Pradesh (82.0%), followed by Tamil Nadu (74.5%) and Punjab (65.4%). More than 50% of indebted farmer households had taken loan for the purpose of capital or current expenditure in farm business. Such loans accounted for 584 rupees out of every 1000 rupees of outstanding loan. At all-India level, 40% of farmer households accessed various sources of information for Modern Technology for Farming.

2.3.4 SAS 2003 had a dedicated block to collect information about the general awareness/ perception and other aspects of farming. Based on the information collected through this block it was estimated that 27% of farmers did not like farming because it was not profitable. In all, 40% felt that,

given a choice, they would take up some other career. About 18% of farmer households knew what bio-fertilisers were and 29% understood what minimum support price meant. Only 8% had heard of the World Trade Organisation. Only 4% of farmer households had ever insured their crops and 57% did not know that crops could be insured.

## 3 The Situation Assessment Survey of Agricultural Households, NSS 70th round

3.1 SAS 2003 could provide valuable data on different aspects of situation of farmers that could be used for important policy formulations for farmers and farming sector in the country. The demand for updated data on the situation of farming community in the country necessitated conducting of *Situation Assessment Surveys* in regular intervals. Accordingly, on completion of 10 years after SAS 2003, NSSO conducted its second Situation Assessment Survey as part of NSS 70th round (January 2013 – December 2013) along with surveys of *Land and Livestock Holdings* and *Debt and Investment*.

3.2 As part of the preparatory work for the survey, the Working Group of NSS 70th round critically examined the definition of farmer and farmer household as followed in SAS 2003. This definition identified *farmer* as a person who possesses land and engages in one or more of a specified set of agricultural activities and the *farmer household* as the income generating unit. This definition of farmer households followed in NSS 59th round had kept all agricultural activities (nominal or substantial) of households, which did not possess and operate any land, outside the scope of the survey. Instead, if an agricultural production unit is defined as a unit which produces field crops, horticultural crops, poultry or the products of any other of the specified agricultural activities considered for 59th round survey, the requirement of land possession probably could be redundant and even inappropriate in some rare cases such as an agricultural enterprise growing orchids on an extensive roof of a large warehouse[1].

3.3 Recognizing the fact that significant agricultural activities can be conducted without possessing any land, the definition of farmer and farmer households followed in NSS 59th round was reviewed and the land possession as an eligibility criterion was dispensed with, replacing it with the concept of 'agricultural production unit' as one which produces field crops, horticultural crops, livestock or product of any other specified agricultural activities.

3.4 Accordingly, the survey was renamed as *Situation Assessment Survey of Agricultural Households* where an agricultural household is defined as a household receiving some income from agriculture activities (e.g. cultivation of field crops, horticultural crops, plantation, animal husbandry, poultry, fishery, piggery, bee-keeping, vermiculture, sericulture, etc.,) during last 365 days. However, household which were entirely agricultural labour household were to be excluded from the coverage. In this connection, it is also important to note that apart from agricultural labourers, households receiving income entirely from coastal fishing, activity of rural artisans and agricultural services were not considered as agricultural household and they were kept out of the scope of the survey as in the case of NSS 59th round. Agricultural activities of insignificant nature or agricultural activities done at a nominal scale were also decided not to be treated as agricultural activity for the purpose of the survey. In the 59th Round, farmers having insignificant farming activities like kitchen garden, etc. were excluded from the coverage. The additional condition of 'possession and operation of land' also eliminated nominal agricultural activities from the coverage of SAS of NSS 59th round. The exclusion of land possession criteria in NSS 70th round necessitated other objective criteria to decide whether a

1 *Sheila Bhalla (2008) "Definition and Statistical Issues Relating to Workers in Informal Employment", National Commission for Enterprises in the Unorganised Sector, New Delhi*

household is an agricultural household or not. Accordingly, it was proposed that a lower limit for value of average monthly agricultural produce may be determined for a household to be covered in the survey.

3.5 For the purpose of deciding a lower limit for value of average monthly agricultural produce, an exercise was taken up with the data of Schedule 1.0 (Household Consumer Expenditure Survey) of NSS 66th round.

3.6 During the exercise, home grown consumption of agricultural produce by households were studied in detail. The results of the study revealed that the percentage of households reporting items consumed out of home grown stock is significantly high for majority of the States which in turn implies that a large number of households will be qualified for selection using the present definition of agricultural household if no lower limit for value of agricultural output is considered. Inclusion of such households might result in wide variability in the estimates. Average Monthly Household Consumption Expenditure (MHCE) for home-grown consumption of those items was observed to be above Rs 250.00 for all the states except for Dadra & Nagar Haveli.

3.7 To eliminate households with insignificant agricultural activities being selected it was decided that households having value of monthly average agricultural produce less than or equal to Rs.250/-will not be considered for Situation Assessment Survey of Agricultural Households. Accordingly the lower limit for annual income from agricultural activities for a household to be treated as Agricultural Household for the purpose of the survey was fixed as Rs.3000 (i.e. Rs.250 x 12)

3.8 The purpose of having a minimum value for agricultural income for households to be considered as agricultural households in SAS 2013 (NSS 70th round) was to eliminate households engaged in insignificant agricultural activities that would have been under coverage due to the exclusion of 'land possession' condition. In 59th round, such income cut off was not necessary as 'possession of land' was an essential condition for a household to be treated as Farmer household. Moreover, farmers having insignificant farming activities like kitchen garden, etc. were excluded from the coverage of SAS of NSS 59th round.

The differences between SAS 2003 and SAS 2013 including those caused due to the incorporation of agricultural household in place of farmer and farmer household of NSS 59th round are summarised below[2]:

(a) Possession of land was an essential condition for defining a person as farmer (farmer household) in 59th round, but an agricultural household as defined in NSS 70th round may or may not possess land.

(b) In 59th round, farmers having insignificant farming activities, like kitchen garden, etc., were excluded from the survey coverage. In order to eliminate households pursuing agricultural activities of insignificant nature in 70th round, households with at least one member self-employed in agriculture either in principal status or subsidiary status and having total value of produce during last 365 days more than Rs. 3000/- were only considered for inclusion in the survey coverage.

(c) In 59th Round, data was collected for 'kharif' and 'rabi' seasons from each sample household, whereas in 70th Round data was collected for two halves of the agriculture year 2012-13 as July to December, 2012 and January to June, 2013 from each sample household.

(d) In 70th Round, actual expenditure (out of pocket expenditure) incurred by the agricultural households for running farm and non-farm business was collected.

**3.9 Survey and reference period of SAS 2013:**

2 Due to these differences, the estimates of SAS 2013 are not strictly comparable with estimates of SAS 2003

The NSS 70th round survey period was 1st January 2013 to 31st December 2013 and data was collected relating to the fixed reference period of the agricultural year July 2012 – June 2013. In order to reduce the recall error, the total information relating to each sample household was programmed to be collected in two visits. The first visit (January to July) broadly covered the first half of the agricultural year 2012 – 2013 and the second (August to December) the corresponding second half of the agricultural year. Further, the survey period of the round was divided into two sub-rounds. Sub-round one consisted of the first half of the survey period of each visit while sub-round two consisted of the remaining period.

**3.10 Coverage**: SAS 2013 of NSS 70th round covered only the rural areas of the country as it was done in case of NSS 59th round. The central sample consisted of 35200 households in 4529 villages, which were visited twice. A few households of visit 1 became "casualty" while surveying in visit 2 [3].

## 4. Key Findings of SAS 2013

4.1 The results of the Situation Assessment Survey, 2013 of NSS 70th round were brought out in three NSS reports as listed under:

NSS Report No.569: Some Characteristics of Agricultural Households in India

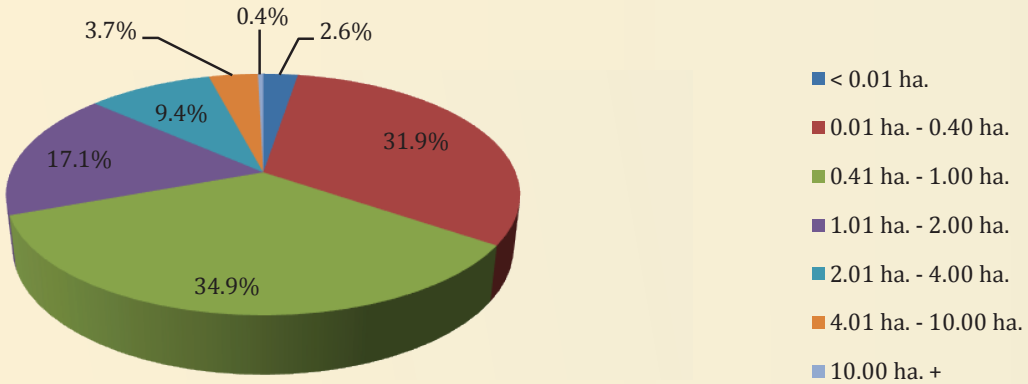
NSS Report No.573: Some Aspects of Farming in India

NSS Report No.576: Income, Expenditure, Productive Assets and Indebtedness of Agricultural Households in India

4.2 In addition to these detailed reports, a Key Indicators document containing the important estimates were brought out along with the unit level data within one year of completing the field work. Some of the important findings of SAS 2013 are summarised as under:

**4.3 Estimated number of Agricultural Households**: The SAS 2013 estimated the number of agricultural households in the country as 90.2 million. These agricultural households were about 57.8 percent[4] of the total estimated rural households of the country. About 69 percent of the agricultural households possessed land less than 1 hectare. Only 0.4 percent of the agricultural households possessed land 10 hectares or more.

**Figure 1: Percentage distribution of agricultural households by size class (ha.) of land possessed**



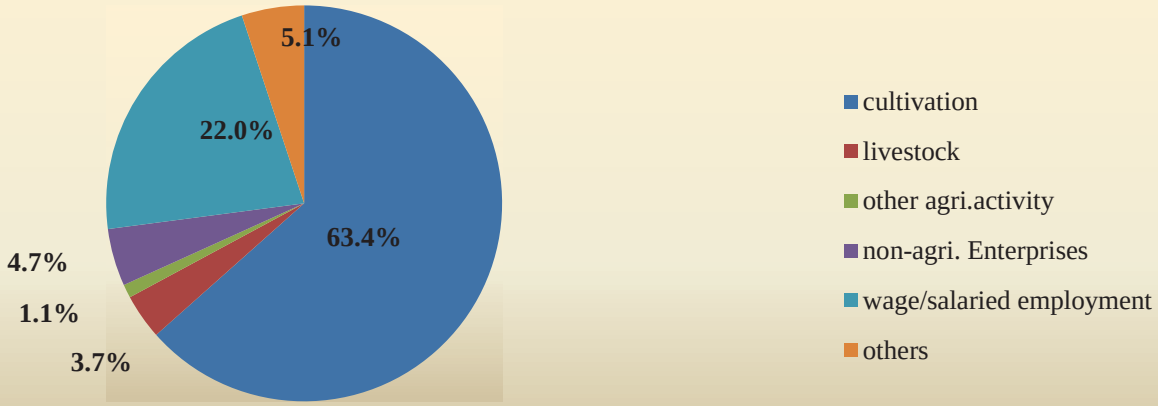

3 Out of the 35200 households surveyed during visit 1, 34907 could be surveyed during visit 2.

4 With respect to 156.1 million rural households as estimated by the Land and Livestock Holdings Survey of NSS 70th round

## 4.4 Principal Source of Income:

4.4.1 Among various sources from which the agricultural households received any income during 365 days prior to the date of survey, the source which yielded maximum income was taken as principal source of income. The survey revealed that about 63 percent of the agricultural households depended on cultivation for their principal income. It is noteworthy that 22 percent of the agricultural households had to depend on 'wage/ salaried employment' as the principal source of their income during the 365 days prior to the date of survey. 68.2 percent of the agricultural households depended on some kind of agricultural activities (cultivation, livestock activities or other agricultural activities) for their principal source of income during this period.

**Figure 2: Percentage distribution of agricultural households by principal source of income**




4.4.2 The survey results indicated that the principal source of income of agricultural households is largely determined by the extent of land possession. Among the agricultural households having less than 0.01 hectare land (which included landless agricultural households also) about 56 percent reported *wage/ salary employment* as their principal source of income and another 23 percent reported *livestock* as their principal source of income. Majority of the agricultural households which possessed more than 0.40 hectare land reported cultivation as their principal source of income. The group of agricultural households which possessed little land (0.01 to 0.04 hectare) earned their income both from *cultivation* (42 percent) and *wage/ salary employment* (35 percent). *Non-agricultural enterprises* were principal source of income for about 8 percent and 11 percent of the agricultural households, respectively, of bottom two size classes of land possessed. The details are given in the Statement below

**Statement 1: Per 1000 distribution of agricultural households by principal source of income during last 365 days for each size class of land possessed**

| size class of land possessed (ha) | per 1000 distribution of households by principal source of income | | | | | | | estd. no. of agri. households (00) |
|---|---|---|---|---|---|---|---|---|
| | cultivation | livestock | other agri-cultural activity | non-agricultural enterprises | wage/ salaried employment | others* | all | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| < 0.01 | 16 | 229 | 27 | 108 | 564 | 55 | 1000 | 23890 |
| 0.01 - 0.40 | 421 | 48 | 12 | 75 | 352 | 93 | 1000 | 287663 |
| 0.41 - 1.00 | 692 | 23 | 9 | 36 | 200 | 41 | 1000 | 314811 |
| 1.01 - 2.00 | 830 | 25 | 9 | 32 | 86 | 18 | 1000 | 154577 |
| 2.01 - 4.00 | 859 | 24 | 11 | 16 | 71 | 18 | 1000 | 84345 |
| 4.01 - 10.00 | 879 | 27 | 5 | 9 | 59 | 20 | 1000 | 33019 |
| 10.00 + | 894 | 55 | 15 | 18 | 17 | 1 | 1000 | 3706 |
| all sizes | **635** | **37** | **11** | **47** | **220** | **51** | **1000** | **902011** |

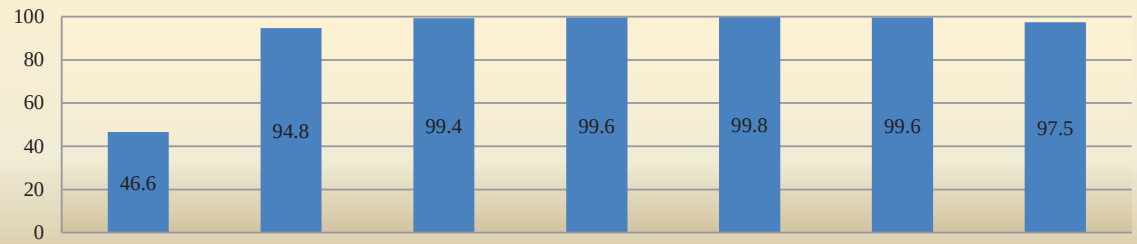
* Including pension, remittance etc.

## 4.5 Land Possession by Agricultural Households

4.5.1 Possession of land was not a necessary condition for a rural household to be an agricultural household for the purpose of the survey. However, information about the amount and type of land possessed by the agricultural household and operation of any such land for agricultural activities etc., were collected during the first visit of the survey. As per the results obtained from the survey, at all India level, only 0.1 percent of the agricultural households were reported to be landless and 6.7 percent of the agricultural households possessed only homestead land. 92.6 percent of the agricultural households possessed some other type of land in addition to the homestead land.

4.5.2 About 97 percent of the agricultural households in the country were estimated to have operated any land for agricultural activities during 365 days prior to the date of survey. More than half of the estimated agricultural households in the lowest size class of land possessed did not operate any land. Majority of the agricultural households in all size classes except the lowest size class of land possessed (which included landless agricultural households also) reported to have operated some land for agricultural activities during the 365 days prior to the date of survey

**Figure 3: Percentage of agricultural households operated land for agricultural activities**



| Statement 2:Per 1000 distribution of agricultural households by type of land possessed and number per 1000 of agricultural households operated any land for agricultural activities for each size class of land possessed | | | | | | |
|---|---|---|---|---|---|---|
| size class of land possessed (ha) | per 1000 distribution of agricultural households by type of land possessed | | | | | operated any land for agri. activities during last 365 days |
| | homestead only | homestead and other land | other land only | no land | all (incl. nr) | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| < 0.01 | 703 | 233 | 11 | 24 | 1000 | 466 |
| 0.01 - 0.40 | 100 | 895 | 5 | 0 | 1000 | 948 |
| 0.41 - 1.00 | 29 | 965 | 5 | 0 | 1000 | 994 |
| 1.01 - 2.00 | 20 | 976 | 1 | 0 | 1000 | 996 |
| 2.01 - 4.00 | 19 | 974 | 6 | 0 | 1000 | 998 |
| 4.01 - 10.00 | 20 | 972 | 9 | 0 | 1000 | 996 |
| 10.00 + | 2 | 941 | 57 | 0 | 1000 | 975 |
| all sizes | **67** | **926** | **5** | **1** | **1000** | **966** |

## 4.6 Demographic Characteristics of Agricultural Households

4.6.1 With an estimated number of 460.23 million persons belonging to the agricultural households, the average household size of agricultural households in the country was estimated as 5.1. The average sex ratio (number of females to 1000 males) of agricultural household was 948 during the period

4.6.2 The members of the agricultural households have been classified as *farmers* and *non-farmers* based on the activity status during two visits collected in the survey. Persons of age 7 years and above who were self employed in agriculture (i.e., worked as own account worker or employer or helper (unpaid family worker) in household enterprises under NIC 2008 div. 01 to 03 (i.e., agriculture, forestry and fishing) either in principal status or subsidiary status) were defined as farmers. Unlike in Employment Unemployment surveys of NSSO, the principal activity status in Situation Assessment Survey was determined with reference to a period of 6 months. Some demographic particulars were collected for the individual members of the agricultural households. The estimates of such parameters are presented separately for *farmer* and *non-farmer* members.

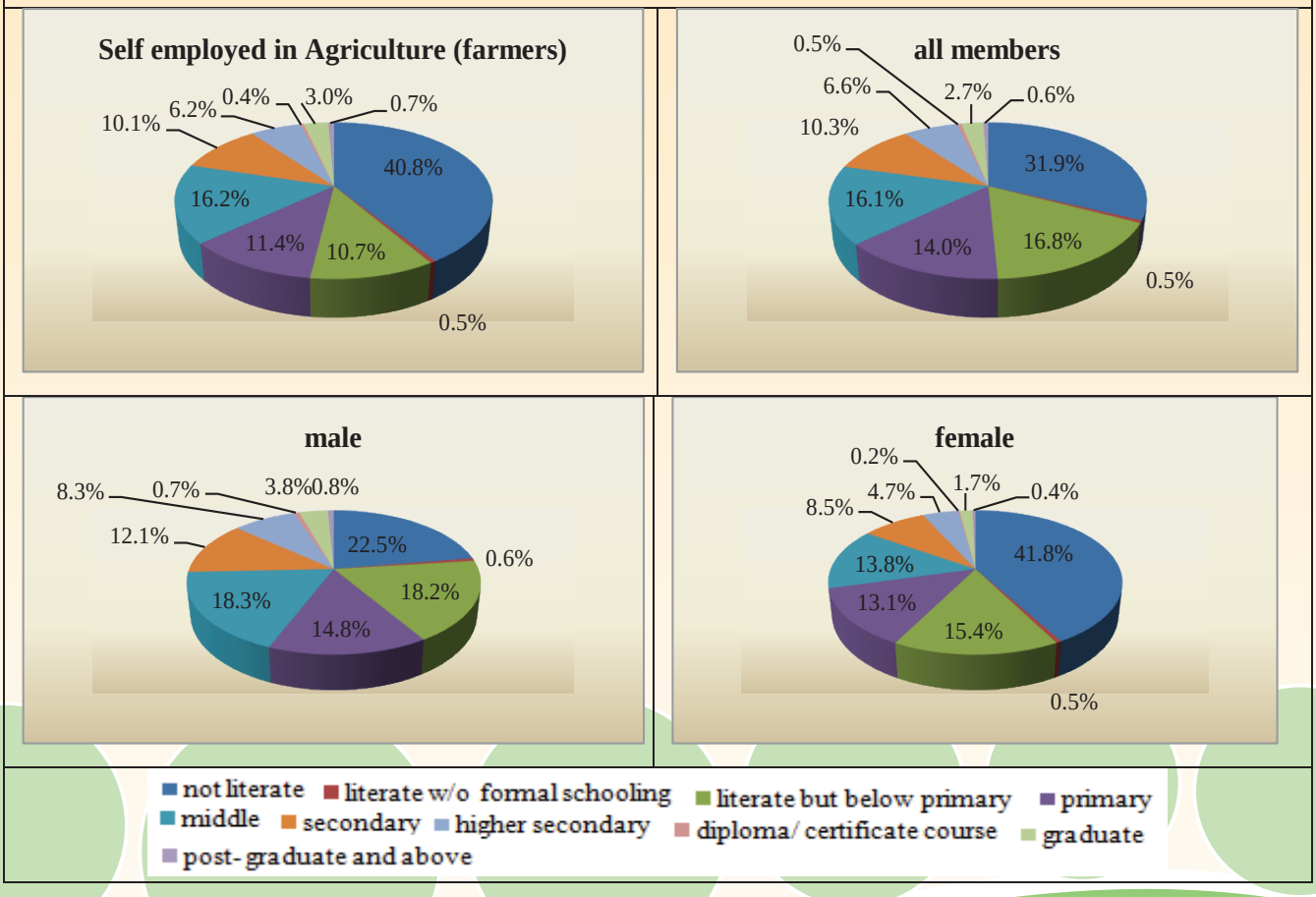
4.6.3 As per the results obtained from the survey, about 48 percent of the 400.9 million persons of age 7 years and above, belonging to the agricultural households were reported to be farmers (self employed in agriculture[1]) during the first half of the agricultural year July 2012- June 2013. The share of farmers among the male and female members (of age 7 years and above) of the agricultural households was about 58 percent and 38 percent respectively.

1 worked as own account worker or employer or helper (unpaid family worker)

| Statement 3: Estimated number of *farmers* among the member of agricultural households aged 7 years and above | | |
|---|---|---|
| sex | farmers | all members |
| | (in millions) | |
| (1) | (2) | (3) |
| male | 119.70 | 205.93 |
| female | 73.63 | 194.97 |
| persons | **193.33** | **400.90** |

4.6.4 As per the results of the survey, an estimated 68.1 percent of persons aged 7 years and above of agricultural households in the country were found to be literate at the time of the survey. The share of literates among the male members of the agricultural households was estimated as 77.5 percent whereas, the share of literates was 58.2 percent among female members. Among those who are self employed in agriculture, the literacy rate was about 59 percent (70.2 percent for males and 41.4 percent for females).

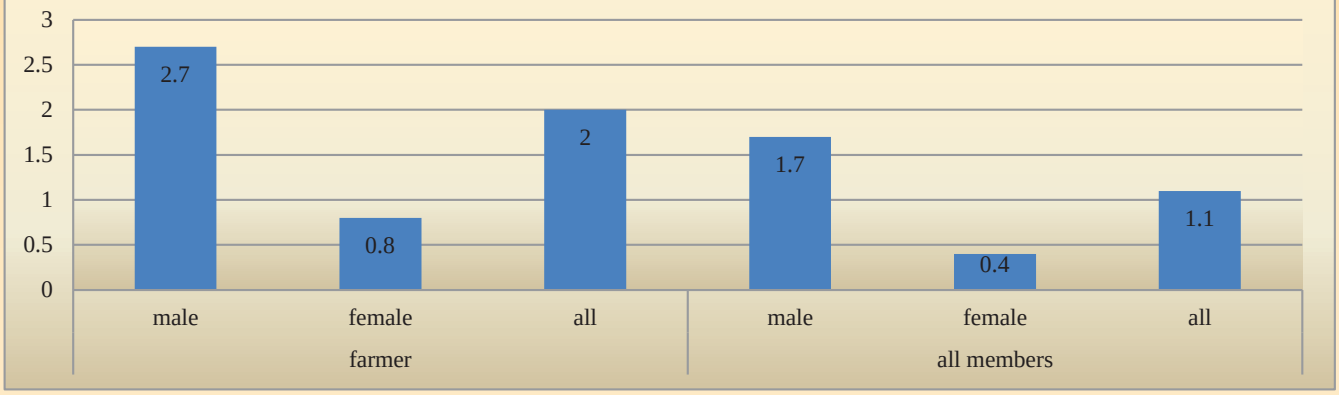
**Figure 4: Level of Education of members of agricultural households of age 7 years and above for farmers and all members**



### 4.6.5 Formal Training in Agriculture:

Information about household members of agricultural households who have attended some formal training in agriculture was collected during the visit 1 of the survey. The estimated share of persons who reported to have attended some kind of formal training in agriculture was very low at 1.1 percent at all India level. The share was slightly higher for farmer members (2 percent). The share of persons attended formal training in agriculture was higher for males than females.

**Figure 5: Percentage of persons attended formal training in agriculture**




### 4.6.6 Usual Principal Activity Status

4.6.6.1 The usual principal activity of the members aged 7 years or more of agricultural households were determined with reference to the fixed period of July 2012- December 2012 in visit 1 and with reference to January 2013- June 2013 in visit 2. The activity status on which a person spent relatively longer time (major time criterion) during the fixed period July to December 2012/ January to June 2013, was considered as the usual principal activity status of the person. Per 1000 distribution of persons aged 7 years and above of agricultural households by principal activity status for the period July 2012- December 2012 and January 2013 – June 2013 is given in *Statement 4*

**Statement 4: Per 1000 distribution of persons aged 7 years and above among agricultural households by Principal Status during two halves of the agricultural year**

| sex | per 1000 distribution of persons by principal activity status | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | self employed | | regular employment | | casual wage labour in | | | | others* | all |
| | | | | | public works | | other | | | |
| | agri-culture | non-agri culture | agri-culture | non-agri-culture | MG-NRE-GS | other | agri-culture | nonagri-culture | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| July 2012- December 2012 | | | | | | | | | | |
| male | 469 | 40 | 42 | 42 | 1 | 4 | 42 | 52 | 347 | 1000 |
| female | 290 | 9 | 8 | 8 | 2 | 1 | 23 | 6 | 660 | 1000 |
| person | **382** | **25** | **25** | **25** | 2 | **2** | **33** | **30** | **500** | **1000** |
| January 2013 – June 2013 | | | | | | | | | | |
| male | 428 | 41 | 2 | 44 | 3 | 5 | 54 | 71 | 353 | 1000 |
| female | 259 | 9 | 0 | 8 | 3 | 1 | 34 | 13 | 674 | 1000 |
| person | **345** | **25** | **1** | **26** | **3** | **3** | **44** | **43** | **509** | **1000** |

*unemployed or out of labour force

4.6.6.2 As per the usual activity status, 38.2 percent of the members of agricultural households in the country were self-employed (own account worker, employer or unpaid family worker) in agriculture during July 2012- December 2012. Among male members of the agricultural households an estimated 46.9 percent were self employed in agriculture during the same period, whereas, the corresponding share in the female members was 29 percent.

4.6.6.3 During the period January 2013- June 2013, 34.5 percent of the members of the agricultural households were estimated to be self-employed in agriculture. During this period, estimated share of self-employed in agriculture was 42.8 percent for male members and 25.9 percent for female members.

4.6.6.4 At all India level 50 percent of the members of the agricultural households were estimated to be either unemployed or out of labour force during the July to December 2012. The share was 50.9 percent during January to June 2013. Estimated share of unemployed/ out of labour force during July to December 2012 was 34.7 percent among male members and 66 percent for female members of agricultural households. During the period January to June 2013, the corresponding shares were 35.3 percent and 67.4 percent for male and female members, respectively.

## 4.7 Some estimates related to crop production during the two halves of the agricultural year July 2012- June 2013

4.7.1 As per the results obtained from the survey, an estimated 86.5 percent of the agricultural households were engaged in cultivation during July-December, 2012. The estimated share of cultivating agricultural households during the period January-June, 2013 was 71.1 percent.

4.7.2 During the period July-December, 2012, the estimated average gross cropped area per agricultural household was 0.937 hectare of which 50 percent was irrigated. The estimated average gross cropped area per agricultural household was 0.782 hectare during the period January-June, 2013

4.7.3 The estimated average value of total crop production (which includes value of harvested crop, pre-harvest sale and by-products ) per agricultural household was ₹ 40580/- during the period July-December, 2012. During the period January-June, 2013, the estimated average value of total crop production per agricultural household was ₹ 36696/-.

**4.7.4 Minimum Support Price**: The awareness about Minimum Support Price (MSP)[1] was very low among the cultivating agricultural households which reported sale of their crops during the reference period. Except for sugarcane, only less than half of the households which were aware about MSP, sold off their crops to procurement agencies. *Non-availability of procurement agency'*, '*no local purchaser'* and '*better market price over MSP'* were the reasons frequently reported by the agricultural households for not selling to the procurement agencies.

### 4.7.5 Crop Loss and Crop Insurance:

4.7.5.1 All over the world, agriculture is synonymous with risk and uncertainty. In India, where a large part of the agricultural produce comes from the monsoon fed crops, agriculture is highly dependent on the amount of monsoon rain. A bad or weak monsoon invariably results in heavy loss for the cultivators. Hence, having insurance for crops against various potential threats is of prime importance in crop production activities.

4.7.5.2 The data collected in the survey indicated that a very small percentage of agricultural households engaged in crop production activities were insuring their crops. In respect of wheat and paddy, the two most harvested cereals in the country, less than 5 percent of the cultivating agricultural households insured their crops. The share of households opted for crop insurance in

1 MSP for the purpose of this survey included various crop specific procurement prices declared by Government viz. Minimum Support Price (MSP), Statutory Minimum Price (SMP), Fair and remunerative price etc

the case of cotton, groundnut and soyabean was slightly higher compared to the other selected crops harvested during the two halves of the agricultural year July 2012- June 2013.

4.7.5.3 Not aware about the crop insurance was the most prominent reason quoted by the cultivating agricultural households for not insuring their crops during the two halves of the agricultural year July 2012- June 2013.The *lack of awareness about the availability of the facility* for the harvested crop was second highest reported reason for not insuring the crops.

Among the agricultural households which experienced crop loss during the two halves of the agricultural year July 2012- June 2013, reason for the crop loss and the *average total loss* (₹) were ascertained with respect to each major crop reported by the household. *Inadequate rainfall/ drought* was most reported reason for crop loss for all the selected crops except *coconut* and *urad* during the first half of the agricultural year. In respect of *coconut* and *urad*, the highest reported single reason for crop loss during this period was '*disease/insect/animal'.*

4.7.5.4 Among the agricultural households which had additionally insured their crops and experienced crop loss, a small percentage only received their claim at the time of the survey. In the cases where claim was received, the instance of delayed payment was more. More than 75 percent of the agricultural households that had additionally insured their crops did not receive their insurance claim against the crop loss they experienced in respect of the crops harvested during the period July 2012- December 2012.

### 4.7.6 Access to Technical Advice in the field of Agriculture:

4.7.6.1 Agricultural households' access to technical advices in the field of agriculture is a very important aspect that may positively influence their situation by changing their preferences and farming practices by way of adopting better quality seeds, timely preventive measures against crop loss due to controllable causes resulting in better yield, marketing of their crops and insuring their crops.

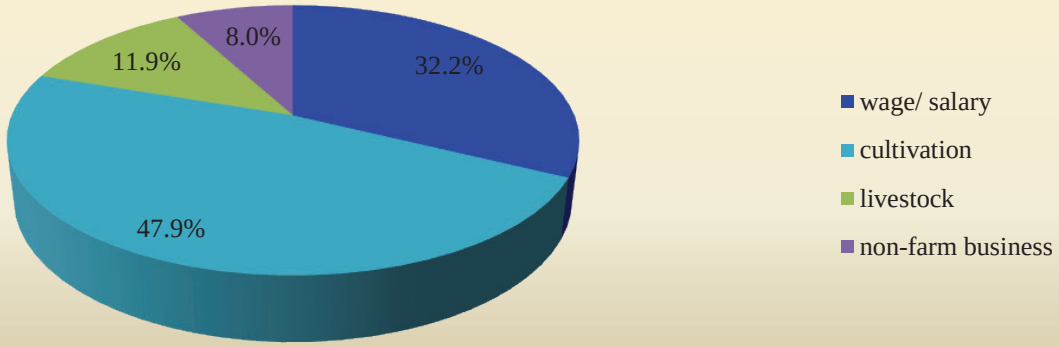
4.7.6.2 About 41 percent of the agricultural households engaged in crop production during the period July – June, 2012 accessed technical advice on agriculture from some of the listed sources (*any agent*). *'Progressive farmer'* and *'radio/TV/ newspaper/internet'* were the two most accessed sources for technical advice by the agricultural households during this period. 20 percent of the agricultural households reported accessing technical advice from each of these sources. The frequency of access of technical advices from these sources was mainly need based and seasonal except for *'radio/TV/newspaper/internet'* which was accessed by more number of households on a daily basis.

4.7.6.3 During the period January- June, 2013 an estimated 35 percent of the cultivating agricultural households accessed technical advice from at least one of the listed sources (*any agent*). '*Progressive farmer'* and *'radio/TV/newspaper/internet'* were the two most preferred sources for technical advice by the agricultural households during this period also. The frequency of contact was either need based or seasonal as observed in the first half of the agricultural year.

### 4.7.7 Average monthly income per agricultural household:

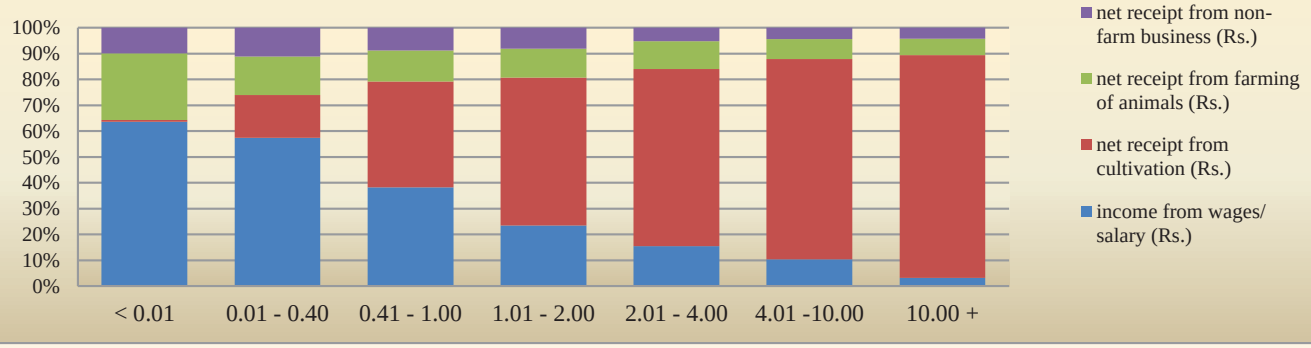
4.7.7.1 Average monthly income of the agricultural households included net receipts from cultivation, farming of animals, non-farm business and income from wages/ salaries. At all-India level, average monthly income per agricultural household during the agricultural year July 2012- June 2013 was estimated as Rs.6426/-. During the reference period, net receipt from farm business (cultivation and farming of animals) accounted for 60 percent of the average monthly income per agricultural household in the country. Nearly 32 percent of the average monthly income was contributed by income from wages/ salary.

**Figure 6: Distribution of average monthly income per agricultural households by sources**




4.7.7.2 Agricultural households in the lower size classes of land possessed were mostly dependent on wage/ salary employment than farm business (cultivation and farming of animals) for their income during the agricultural year July, 2012-June, 2013. For the households belonging to the lowest size class, farming of animals fetched more income than cultivation during this reference period. Percentage share of income from cultivation/ farm business in the average monthly income increased with increase in land possession. Major part of the average monthly income of the agricultural households belonging to the highest land class was from cultivation. Share of income from non-farm business in the average monthly income decreased with increase in land size

**Figure 7: Percentage Distribution of Average monthly income per agricultural households during July 2012- June 2013 by sources for each size class of land possessed (ha.)**

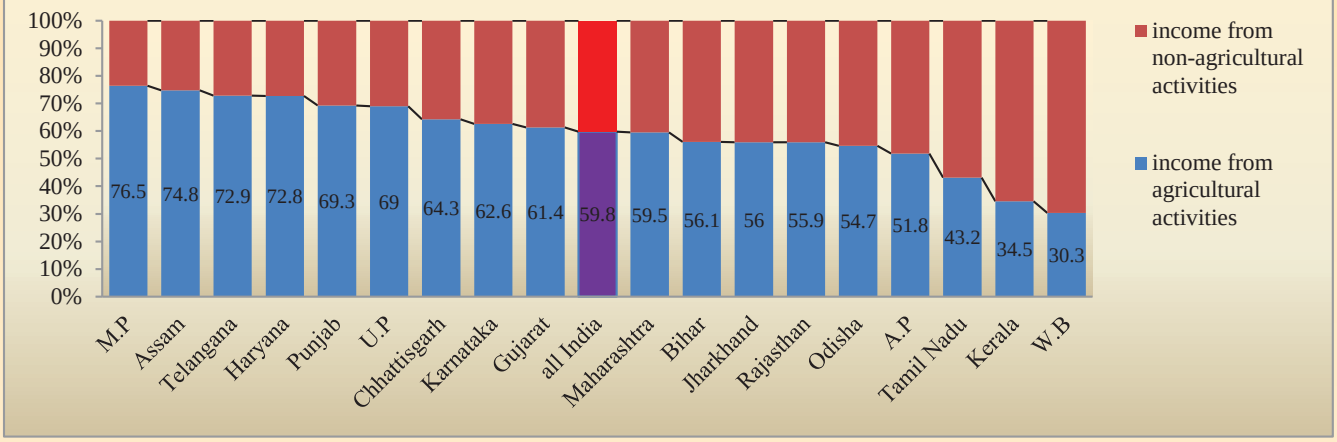



4.7.7.3 Among the major States, the highest average monthly income was reported by agricultural households of Punjab followed by Haryana and Kerala. The lowest average monthly income was reported by Bihar followed by West Bengal and Jharkhand.

4.7.7.4 The share of agricultural activities (cultivation and livestock activity) in the total average monthly income per agricultural household out of the four sources was 60 percent in the rural India as a whole but was, reportedly, as low as 30.3 percent for West Bengal, 34.5 percent for Kerala and 43.2 percent for Tamil

Nadu. The share of agricultural activities in the total monthly income per agricultural household was highest for Madhya Pradesh (76.5 percent) followed by Assam (74.8 percent) and Telangana (72.9 percent). During the agricultural year July 2012 - June 2013, agricultural activities accounted for more than half of the average monthly income per agricultural household in all the major States except West Bengal, Kerala and Tamil Nadu.

**Figure 8: Percentage distribution of average monthly income per agricultural household by source of income during July 2012-June 2013**



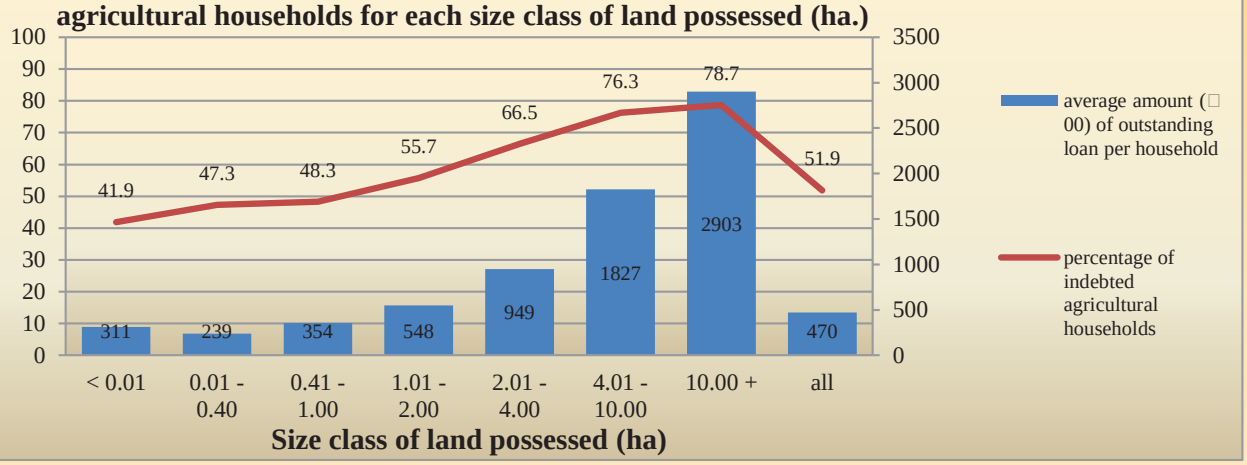

4.7.7.5 The share of wage/salary in the average monthly income per agricultural household was highest for West Bengal (53.4 percent) followed by Kerala (44.2 percent) and Tamil Nadu (41.6 percent) whereas, at all India level, income from wage/ salary accounted for 32.2 percent of the average monthly income per agricultural household.

## 4.7.8 Indebtedness of Agricultural Households

4.7.8.1 Information on the amount of outstanding loan as on date of survey (i.e. the day on which data was collected from the household) was collected from each of the surveyed agricultural households during the first visit. Along with the outstanding amount, information on source and nature of the loan was also collected. In this survey, loans included all kind of outstanding loans irrespective of the purpose for which loans were taken. The survey revealed that about 52 percent of the agricultural households in the rural India were estimated to be indebted at the time of the survey. The average amount of outstanding loan per agricultural household was estimated approximately as ₹47000.

4.7.8.2 At all India level, the percentage of indebted agricultural households increased with size class of land possessed with 41.9 percent in the lowest size class of land possessed and 78.7 percent among agricultural households possessing 10.00 + ha. land. The average amount of outstanding loan also increased with the size class of land possessed except for the lowest size class (<0.01 ha.) where the average outstanding loan amount was slightly higher than that of the next lowest size class of land possessed.

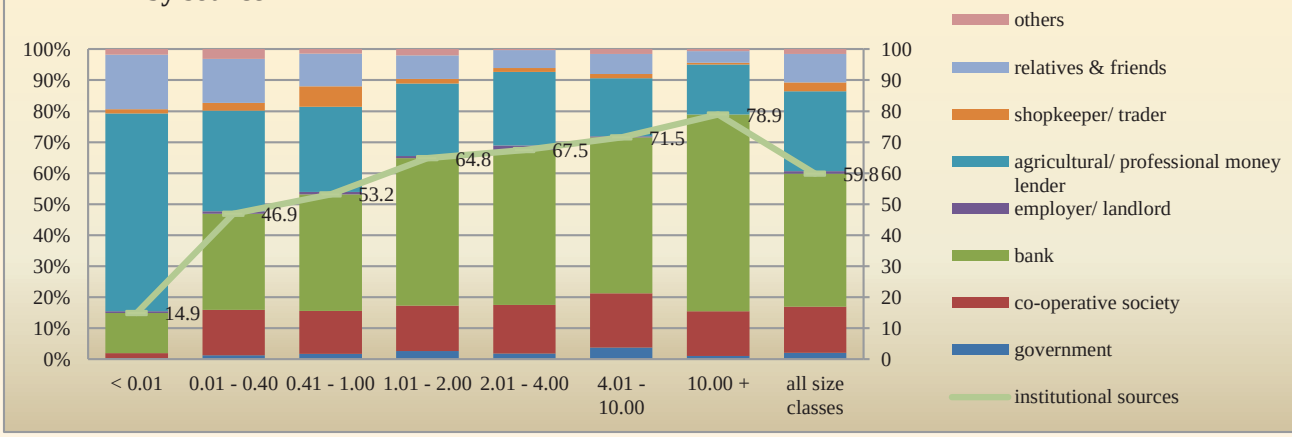
**Figure 9: Average amount of outstanding loan (₹ 00) and percentage of indebted agricultural households for each size class of land possessed (ha.)**




4.7.8.3 The average amount of outstanding loan per agricultural household increased from approximately Rs.31100/- in the lowest size class of land possessed to Rs.290300/- (approx.) in the highest size class of land possessed (>10.00 ha.) as given in the above chart.

**4.7.8.4 Source of loans:** At all India level, about 60 percent of the outstanding loans were taken from institutional sources[1] which included Government (2.1 percent), Co-operative society (14.8 percent) and banks (42.9 percent). Among the non-institutional sources, 'agricultural/professional money lenders (25.8 percent) had the major share in terms of outstanding loans.

**Figure 10: Percentage distribution of outstanding loans per agricultural household by source**




4.7.8.5 The share of institutional loans increased with increase in the size of land possessed. For the agricultural households belonging to the lowest size class of land possessed (i.e. possessing less than 0.01 hectares of land), only about 15 percent of the outstanding loans were from institutional sources (government, co-operative society, bank), whereas the share was about 79 percent for the households belonging to the highest size class of land possessed (i.e. possessing 10.00 + hectares of land).

1 In case of formal employment, loan from employer can be treated as institutional. Since information was not collected in such details, the entire source 'employer/ landlord' is treated as 'non-institutional' for the purpose of this report.

## 4.8 Estimates related to Agricultural Sector/ Farmers from Other NSS Surveys

4.8.1 In addition to the Situation Assessment Surveys (SAS), the other surveys conducted by NSSO also bring out estimates related to agricultural sector or of households engaged in agriculture/ cultivation. The *quinquennial* Employment Unemployment Surveys, *decennial* survey on Debt and Investment etc. provide important estimates on this sector.

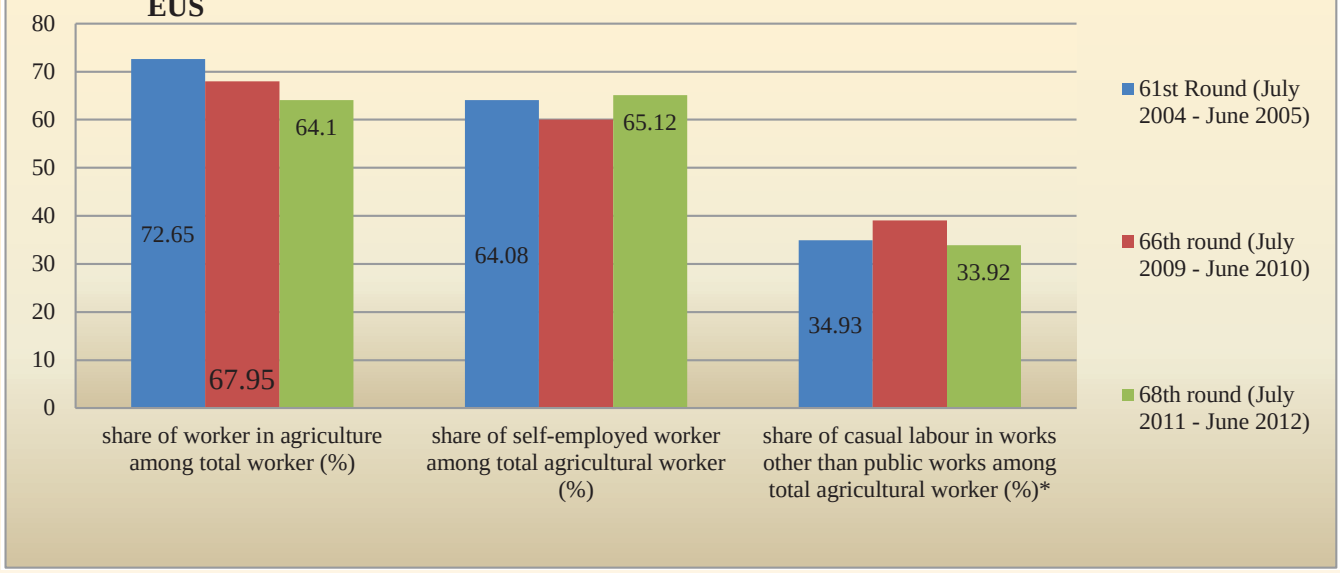
### 4.8.2 Estimates based on Employment Unemployment Surveys

4.8.2.1 Workers in Agricultural Sector: The Employment and Unemployment Surveys define workers as Persons who, during the reference period, were engaged in any economic activity or who, despite their attachment to economic activity, temporarily abstained from work for reasons of illness, injury or other physical disability, bad weather, festivals, social or religious functions or other contingencies.

4.8.2.2 The workers in the usual status (ps+ss) are obtained by considering the usual principal status (ps) and the subsidiary status (ss) together. The workers in the usual status (ps+ss) include (a) the persons who worked for a relatively long part of the 365 days preceding the date of survey and (b) the persons from among the remaining population who had worked at least for 30 days during the reference period of 365 days preceding the date of survey.

4.8.2.3 As per the 68th round of Employment & Unemployment Survey (July 2011- June 2012), 64.1 percent of the rural workers in the usual status (ps+ss) were in agricultural sector[1]. The last three rounds of Employment and Unemployment Survey indicated a steady decline in the share of workers in agricultural sector from 72.65 percent

**Figure 11: Etsimates of share of Workers (ps+ ss) in Agricultural Sector based on EUS**




### 4.8.3 Estimates from All India Debt and Investment Survey (AIDIS)

4.8.3.1 The latest round of All India Debt and Investment Survey (AIDIS) was conducted in NSS 70th round (January 2013- December 2013). For the purpose of analysis, rural households were initially classified into two types, namely, cultivator and non-cultivator households.

(i) *Cultivator households*: All rural households operating at least 0.002 hectare of land

1 Activities in Agricultural Sector includes (i) Crop and animal production, hunting and related service activities (ii) Forestry and logging and (iii) Fishing and aquaculture

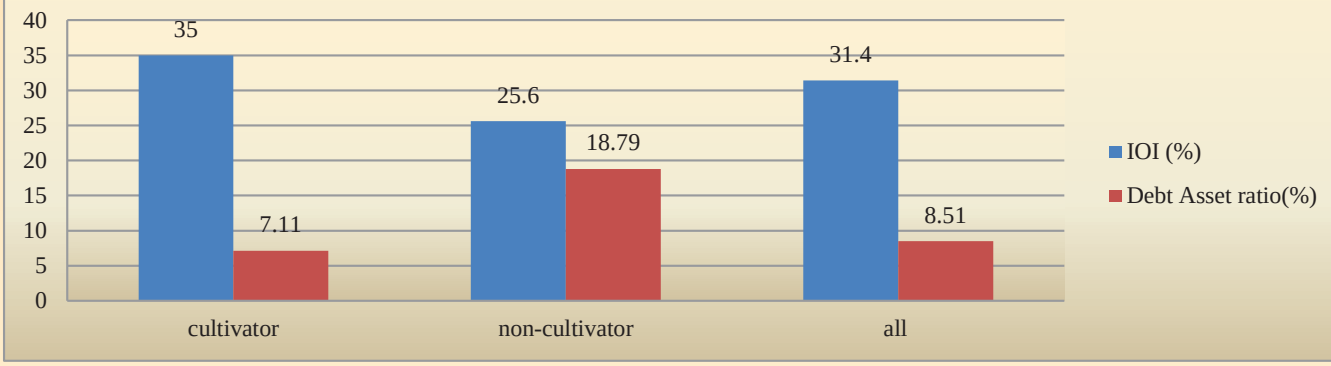
during the 365 days preceding the date of survey were treated as 'cultivator households'.

(ii) *Non-cultivator households:* All rural households operating no land or land less than 0.002 hectare were considered to be non-cultivator households.

4.8.3.2 All Important estimates based on the information collected in AIDIS have been presented separately for the cultivator households in the rural sector.

**4.8.3.3 The Incidence of Indebtedness** (IOI) which is the percentage of indebted household was reported to be 35 percent for the cultivator households, higher in comparison to the 25.6 percent IOI for non-cultivator households.

**Figure 12: Incidence of Indebtedness (IOI) and Debt-Asset Ratio (%) per indebted household for different occupational catogories in Rural India**




**4.8.3.4 Debt - Asset Ratio (DAR)** is the average amount of debt (AOD) outstanding on a given date for a group of households expressed as a percentage of the average amount of assets (AVA) owned by them on that given date. DAR is a measure of burden of debt on a group of households on a given date *vis-à-vis* the available asset with them.

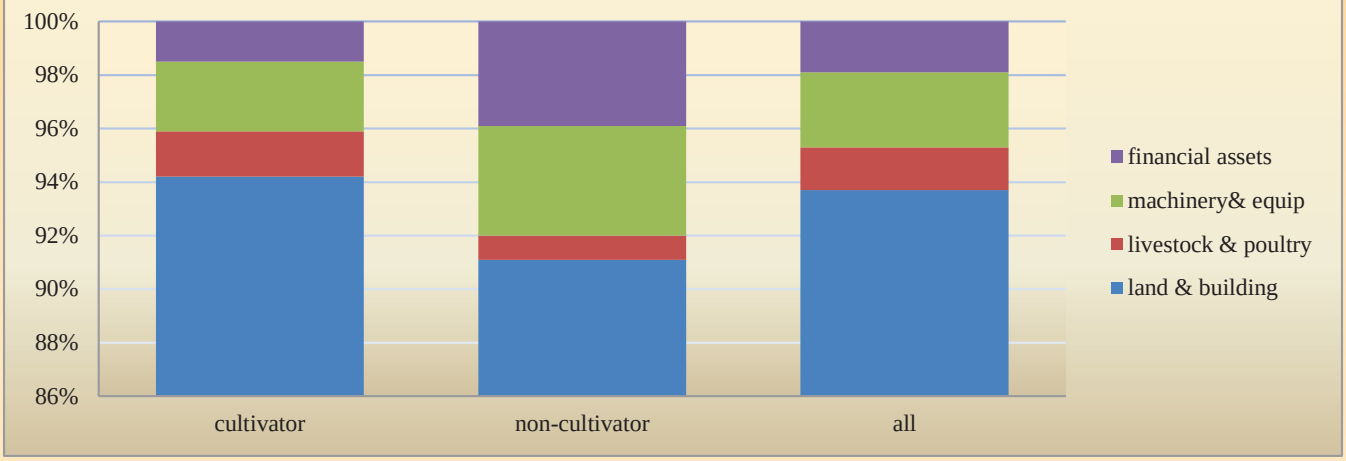
**Statement 5: Incidence of Indebtedness (IOI), Average Value of Asset (AVA), Average amount of Debt (AOD) and Debt-Asset ratio (%) per indebted household for different occupational categories**

| occupational categories | IOI (%) | AVA per indebted hhs (Rs.) | AOD per indebted hhs (Rs.) | Debt Asset ratio for indebted household (%) |
|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) |
| | | Rural | | |
| cultivator | 35.0 | 1552914 | 110438 | 7.11 |
| non-cultivator | 25.6 | 468078 | 87938 | 18.79 |
| all | **31.4** | **1216361** | **103457** | **8.51** |

4.8.3.5 As per the results of the AIDIS of NSS 70th round, the Debt - Asset Ratio as on 30.06.2012 for the cultivator households (7.11 percent) is much less than the non-cultivator households (18.79 percent).

**4.8.3.6 Percentage Distribution of total value of Assets by type of asset:** Land and building together represents the major component of assets (jointly holding 94 percent share in the total value of assets) in rural India. This share was slightly higher for cultivator households (94.2 percent) compared to non-cultivator households (91.1). The share of financial assets, which is a measure of liquid asset, for cultivator households (1.5 percent) was less than half for that of non-cultivator households (3.9 percent)

**Figure 13: Percentage distribution of total value of asset by type of assets in rural India**

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# Glimpses of Statistics Day 2015

# Celebration of Statistics Day 2015 in the Field Offices of NSSO (FOD)

The National Sample Survey Office (NSSO) under Ministry of Statistics and Programme Implementation (MOSPI), Government of India, observed **Statistics Day-2015 on 29th June 2015** all over the country. This year the theme was "**Social Development: health, education, poverty, employment, social backwardness, housing and environment**". This is 9th in a row since 2007 when the Govt. of India Celebrated 29th June as Statistics Day, coinciding with birth anniversary of Prof. Late P.C. Mahalanobis.

The objective of the observance and celebration of Statistics Day is to create awareness among people specially among young generation about the role of statistics in socio-economic planning and policy formulation. The FOD also celebrated this occasion throughout the country in its various field offices and in RO Kolkata, it was arranged by SDRD. Zone wise brief summary report on Celebration of Statistics Day 2015 is presented below:

## EAST ZONE

**1. RO, Muzaffarpur:** Celebrated the day in a very devout manner and around 50 persons including officials from SROs Motihari, Purnea & Darbhanga as well as academics and members of the Press attended the function. After floral tribute a documentary film on the Professor and official statistics was shown. Thereafter, a seminar was organised on the theme. Renowned academicians from Economics, Mathematics and Sociology department of BRA Bihar University namely Prof. D. K. Das, Prof. Bhola Ishwar, Prof. S Sengupta, Prof. T P Singh & Shri Ganesh Mehta besides Dr. Bivas Chaudhuri, Director, FOD delivered lectures in the seminar. The guest speakers were presented with memento by Shri A K Mishra, SSO & HO.

**2. RO, Burdwan:** Celebrated the Statistics Day; where 73 members including some guests and students from Bardhman University, Raj College besides the staff members of Regional Office of NSSO (FOD), Burdwan participated. The programme was organized in two parts. The first part comprised inauguration, slide show on the basis of NSSO data covering the period of 10 years relating to the theme Social Development: Health, Education, Poverty, Employment, Social Backwardness, Housing and Environment and paying homage to Prof. Mahalanobis whereas in the second part, a panel discussion was held on the theme of Statistics Day of this year 2015. Prof. Jayydeb Sarkhel was the Chief Guest and also chairman of the panel discussion. J.P. Bhattacharjee, DDG concluded the celebration with his observations and thanked all the participants. The Statistics Day was also Celebrated with due sincerity by the staff members of all the three SROs at Chinsurah, Bankura and Midnapore.

**3. RO, Ranchi:** Celebrated the day along with all officials/ officers of the five SROs. Sh. M. Mallick, DDG delivered an illuminating speech on the life and role of Prof. P.C. Mahalanobis and his achievements and contribution in the field of large scale sample surveys. Dr. Ramesh Sharan, HOD, Deptt. of Economics, Ranchi University and Prof. S. Chakraborthy, Department of Mathematics, Birla Institute of Technology, Mesra, Ranchi were invited to attend the function as guests on the occassion.

**4. RO, Sambalpur:** The 9th National Statistics Day was celebrated by the Regional Office, Sambalpur. The programme was inaugurated by Prof. S.S. Rath, Dept. of Economics, Sambalpur University. Dr. S.K. Sahu, Lecturer, Dept. of Statistics, Sambalpur University, Dr. U.C. Pati, Lecturer in Economics, GM College, Sambalpur & Dr. Abhiram Das, Lecturer, Odisha University of Agriculture and Technology, Chiplima and all

officers and staff of RO, NSSO (FOD), Sambalpur and SRO Bhawanipatna, students from Sambalpur University & G.M. College, Sambalpur participated in the celebration. There were 70 participants in all. Dr. U.C. Pati presented a brief account of Social Development in India and the role it has played in changing the economic condition and standard of living at micro level.

**5. RO, Malda:** Celebrated the Statistics Day at Malda and its SROs Behrampore and Siliguri. The programme started by garlanding the photograph of Prof. Mahalanobis, followed by remembering his work and contribution to the field of Statistics and economic planning and in the development of modern statistical system in India by various officials. Thereafter, discussion on "Social Development: Health, Education, Poverty, Employment, Social Backwardness, Housing and Environment" was held. Banners in this regard were also displayed at the appropriate places in the office campus.

**6. RO, Bhubaneswar:** The Ninth Statistics Day was celebrated by Regional Office of Bhubaneswar. The function was inaugurated by Dr. J. Sarangi, Retd. Head of the Department, P.G. Department of Statistics, Utkal University. Shri Manoj Kumar Sahu, Head of Office, RO, Bhubaneswar, welcomed the delegates and participants and in his welcome address, he explained the objective of the celebration, contributions of Prof. P.C. Mahalanobis to statistics & the Indian Official Statistics system with special reference to NSSO and surveys conducted by FOD. The inaugural session was also attended by Shri Dasarathi Sahoo, former DDG. Prof. J. Sarangi, in his inaugural speech paid rich tribute to the founder father of Indian Statistical System. One technical lecture was delivered by Shri D. Sahoo, DDG, NSSO(FOD), RO, Bhubaneswar. As a part of the celebration there was an essay competition on "Social Development: health, education, poverty, employment, social backwardness, housing and environment".At the end of the session, vote of thanks to the guests and delegates was delivered by Sh. M.K.Sahu, SSO, NSSO(FOD), RO, Bhubaneswar.

## WEST ZONE

**7. ZO/RO, Nagpur:** Celebrated the Statistics Day function at Odeon Hall, Geological Survey of India office with gaiety. The programme was presided by Smt. S.A Bhoyar, DDG, ZO Nagpur. She briefed the importance of the Statistics day and the theme "Social Development: Health, Education, Poverty, Employment, Social Backwardness, Housing and Environment". She briefly explained as to how Social Development Statistics is important in economic development of India. Chief Guest Prof. Sh. Vikas Jambhulkar, Tukdoji Maharaj University spoke about contribution of Statistics in Service Sector & Economic Development of India. Quiz and essay contests were organized. The event was attended by all the staff of Zonal and Regional Offices.

**8. RO, Baroda:** Organized the celebrations in the Office premises of NSSO Bhawan of RO Baroda. Apart from the staff, the students of the M.S. University actively participated in the celebration. Dr. K. Muralidharan, Prof. and HOD, Dept. of Statistics, M. S. University was the chief guest and Shri Rohit Prajapati, Environmentalist was the Guest of Honor. Welcome address was delivered by DDG, NSSO, Baroda. Guest of Honor highlighted the use of Statistics in our daily life and emphasized that without statistics no decision can be taken in the present era. The chief guest also highlighted the responsibility of informer in giving detail and reliable information. A quiz competition was arranged and the winners were given a small token of award for actively participating in the competition. The event was covered in the local print as well as electronic media.

**9. RO, Ahmedabad:** Celebrated along with DP Centre Ahmedabad. The celebration was organized in Regional Office, Ahmedabad. Shri Preet Singh,

DDG RO Ahmedabad chaired the function. Shri Nand Lal, DDG, DPC delivered the speech on purpose of celebrating the Statistics Day. Shri S.K. Bhanawat talked briefly about the biography of Late Prof. P.C. Mahalanobis. The eminent speakers and academicians who spoke on this occassion included Dr. Sukhdev Mishra, Scientist(Statistics), National Institute for Occupational Health; Smt. Devyani A. Chatterjee, Assistant Professor, S. M. Patel Institute of Commerce, among others. Dr. S.D. Mishra spoke on 'Health'. About 55 officers/ staff attended the function. At the end of the session, vote of thanks to the guests and delegates was proposed by Sh. Rajendra Sharma, SSO, NSSO (FOD), RO, Ahmedabad.

**10. RO, Aurangabad:** The Statistics Day function was organized in co-operation with Directorate of Economics & Statistics, Govt. of Maharashtra and Department of Statistics, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad in RO building premises. About 125-130 persons attended this function. The programme commenced with inaugural and introductory speech of Shri Anil D. Patil, Director, FOD, Aurangabad. In his speech, he threw light on the various points like life and contributions of Prof. P.C. Mahalanobis, organizational set up of the NSSO and different Surveys with emphasis on S.E. and A.S.I. Surveys, being conducted by the NSSO (FOD), importance of data being collected through surveys etc. Dr. S.L. Sananse, H.O.D, Department of Statistics, Dr. B.A.M University, Aurangabad was invited as Chief Guest for the function. Special Guest of the Programme, Dr**.** V.H. Bajaj, Professor and Head, Department of Statistics, Dr. B.A.M University, Aurangabad, and Shri U.V. Phole, Joint Director, DES, Aurangabad laid emphasis on the theme "Social Development: Health, Education, Poverty, Employment, Social Backwardness, Housing and Environment" & importance of this day. He also threw light on the vast usage of statistical data being collected by the NSSO as a Nodal Agency of the Government of India.

**11. RO, Mumbai:** Celebrated in the presence of Sh. M.L. Rakshit, DDG, and other officers/staff. As part of the celebrations, Lectures, Debate & Quiz sessions were arranged on the day. There was very good participation from the Officers and staff in the Competition. Dr. Dattajirao Patil, Director, Bharatiya Vidyapeeth Institute of Management Studies & Research was the chief guest of the function. Ms. Rita Abhi, Chief Statistician, CIDCO and other statistical officers from Central and State Government offices attended the function.

**12. RO, Raipur:** Celebrated jointly with Directorate of Economics & Statistics, Government of Chhattisgarh. Prof. Dinesh Marothia, Member, State Planning Commission was chief guest. Sh. Amitabh Panda, Commissioner, DES, chaired the function and delivered the welcome note. A state level essay competition on the topic "Role of statistics in social development" was organised and 6 cash prize and certificates were given. Approximately 150 persons were present. Vote of thanks was given by Sh. E. V. Gangadhar Rao, DDG, NSSO, RO, Raipur.

**13. RO, Pune:** The programme was inaugurated by the renowned statistician Dr. Avinash Dharmadhikari, General Manager, TATA Motors, Pune, Dr. Dilip Sheth, Principal, S.P. College, Pune was also present in the inaugural session. The chief guest Dr. Dharmadhikari, in his address, gave a detailed presentation on the achievements of Prof. P.C. Mahalanobis since his childhood in establishing a statistical system in the country. The chief guest stressed the need for 'statistical thinking' and finding out solutions to problems. Dr. Dilip Sheth, Principal of S.P. College explained the need of statistics in real life. He also explained the connection between Mathematics and Statistics. Dr. V Parameswaran, DDG, RO Pune, said that late Prof. P.C. Mahanalobis was a great visionary of the 20$^{th}$ Century and founding father of NSSO. He briefly indicated about the utility of NSSO data and explained about the theme of Statistics Day.

## NORTH ZONE

**14. ZO/RO, Jaipur:** Celebrated in the presence of Sh. S.L. Menaria, DDG, NSSO (FOD), ZO Jaipur and other officers/staff. Sh. Akhil Arora, Secretary, Planning, Govt. of Rajasthan, Jaipur chaired the function. Shri O.P. Bairwa, Director, DES welcomed the participants and delivered a talk on the importance of Statistics Day. Shri S.L. Menaria, gave brief introduction of the life of Late Prof. P.C. Mahalanobis and his contribution in the field of statistics. Total seven presentations were made during technical session by the representatives of different departments. All the presentations were sharply focused on the theme subject and its various aspects.

**15. RO, Srinagar:** Celebrated the day in the auditorium of Central University of Kashmir, Srinagar. The importance of the Statistics day was highlighted in the media in advance. In this connection a press release from the Director, NSSO (FOD), RO Srinagar regarding importance of the day in a local Newspaper and call for papers through Press information Bureau were arranged. To grace the function Professors and students from the Department of Economics and Statistics from the Central University of Kashmir along with other diginitaries were invited to deliver speeches.

**16. RO, Jammu:** Celebrated Statistics Day at Conference Hall of FCI, Rail Head Jammu with the theme "Social Development: health, education, poverty, employment, social backwardness, housing and environment". Apart from administration and field staff, R.O Jammu and SRO Udhampur, NSSO (FOD); Miss Veena Thapar, JD and Mrs Rajni Charak, Regional Joint Director from Directorate of Economics & Statistics, Govt. of J&K also participated in the celebration. Speaking on the occassion, Mr. Rakesh Kumar Kamra, DDG, RO Jammu presented a brief life sketch of Late Prof. P.C. Mahalanobis and his contribution in the field of Statistics. He also spoke about the importance of "Social Development: health, education, poverty, employment, social backwardness, housing and environment" in the economic development of our country and role of NSSO in collection of data related to Social Development. He stressed on the need of a strong data base and a regular system of collection of data pertaining to Social Development. He appealed to the masses in general to extend their whole hearted cooperation to the field staff of NSSO (FOD) given responsibility for collection of data. The Officers of DES, J&K made the audience aware about working of the statistical system and monitoring of various data collecting agencies. The other speakers from NSSO (FOD) also spoke on the theme.

**17. RO, Shimla:** Celebrated in the presence of Deputy Director General H.P. Region, Sh. Ram Krishna and other officers/staff. DDG, RO Shimla made the inaugural speech and addressed the officers present. Sh. Brish Bhan, Assistant Director, NSSO (FOD), Shimla drew the attention of all the participants on the theme of Statistics Day 2015 which was "Social Development: health, education, poverty, employment, social backwardness, housing and environment".

**18. RO, Jalandhar:** Celebrated Statistics Day in collaboration with DAV PG College Management Committee, Jalandhar. The function was inaugurated jointly by Dr. B.B. Sharma, Principal, DAV College and Dr. B.B. Singh, DDG, RO Jalandhar. Five speakers were invited to deliberate on the theme of Statistics Day. DDG, RO Jalandhar delivered a lecture on 'Estimation of Poverty'. 138 persons including Professors and students from DAV and other colleges, NSSO officials from RO and SRO attended the function.

**19. RO, Chandigarh:** Celebrated in the presence of Sh. Harbinder Singh, Deputy Director General and other officers/staff. Dr. M. Mathishekaran, Director General, Labour Bureau was the Chief Guest and he delivered a lecture on Social Development & Employment with emphasis on functions & activities of Labour Bureau. Prof. Kanchan Jain

Chairperson, Prof. Sangeeta Arora and Prof. Kalpana Mahajan, Department of Statistics, Punjab University, Chandigarh delivered detailed lectures on the theme of Statistics Day 2015 : "Social Development: health, education, poverty, employment, social backwardness, housing & environment" and Recent Trends in Environmental Statistics respectively.

The celebration was concluded by Shri R. K. Arora, SSO & HO, NSSO(FOD), Chandigarh.

**20. RO, Ajmer:** Celebrated Statistics Day under the chairmanship of Sh. S.S. Jadawat, DD, Ajmer. Sh. Pradeep Kumar, Sh. Balram Kasana, JSOs & Ms. Anshul Soni Intern, gave Power Point Presentation on the different dimensions of Social Development: health, education, poverty, employment, social backwardness, housing & environment. Also, a quiz competition was organized and prizes were distributed to the winners.

**21. RO, Mohali:** Celebrated Statistics Day under the chairmanship of Sh. Kailash G. Sharma, Director, NSSO FOD, Mohali. The officers/staff of the Regional Office attended the celebrations. Four speakers delivered their speeches on the theme i.e. "Social Development: health, education, poverty, employment, social backwardness, housing & environment".

## SOUTH ZONE

**22. ZO/RO, Bangalore:** Celebrated along with DP Centre Bangalore. The function was graced by Sri K.P. Unnikrishnan, Dy. Director General, South Zone, NSSO (FOD), Bangalore. In his inaugural speech he spoke about the contributions of Shri P.C. Mahalanobis. Sh. T. Baskaran, DDG, DPC, Bangalore explained the importance of statistics in the context of collection, analysis & utility of the statistics in details. Smt. Sandhya Krishnamurthy, DDG, DPC, Bangalore, Dr. Rajeswari Kasturi, Director, NSSO, RO, Bangalore, Sh. Ahmed Ayub, DDG, DPD, Hqrs. Kolkata were also present on the occassion. Dr. Jyotsna Jha, Director, Centre for Budget and Policy Studies, Bangalore made a presentation on importance of Health, Education and Employment for social development of our country. Quiz programme and Crossword puzzle were conducted for students & officials and prizes were also distributed to all the winners.

**23. RO, Hyderabad:** Celebrated in the presence of Sri P.V.R. Prasad, DDG and other officers/ staff. Prof. C. Ravi, Centre for Economics and Social Studies, Hyderabad delivered his lecture on "Social Development Statistics". The celebration was attended by 83 officials of NSSO (FOD), AP (N) region, Hyderabad, SRO-Warangal, Karimnagar and Nizamabad. 129 Students from various colleges participated in the Essay Competition. Students of various colleges participated in the Elocution and the same was conducted by Sri P.V.R. Prasad, DDG, NSSO (FOD), RO Hyderabad.

**24. RO, Hubli:** Celebrated Statistics Day at Hubli in which Vice-Chancellor of Karnataka University, Dr. Pramod B. Ghai presided over the inaugural session of the Statistics Day function. Dr. M.N. Joshi, Registrar, Karnataka University, Dharwad was also present as the Chief Guest on the said occassion. Prof. G.K. Kadekodi, Former Director, Institute of Social and Economic Change (ISEC) and Professor, Centre for Multi Disciplinary Development (CMDR), Dharwad delivered lectures on the theme for the Statistics Day 2015. Prof. M.V. Muddapur, retired professor, Department of Studies in Statistics, Karnataka University, Dharwad also spoke on this occassion on the theme for the Statistics Day 2015.

**25. RO, Panaji:** Celebrated to create awareness among the staff towards important contributions of Prof. P.C. Mahalanobis especially related to large-scale sample surveys on Social Development. The function was inaugurated by lightening the lamp and offering garlands to the photograph of Prof. P.C. Mahalanobis. Shri Mohan Bamane, Assistant Director, in his welcome address, briefed about

Late Prof. P.C. Mahalanobis. Smt. Usha Pralhad Pol, Director told about the usage of data collected by the FOD on Social Development Surveys by policy makers. Miss Sulochana Pednekar, Research Assistant at Goa University delivered lecture on Social Development covering the issues related to health, education, poverty, employment, social backwardness, housing and environment. Function concluded with vote of thanks by Shri N.K. Fadnis, SSO.

**26. RO, Kozhikode:**Celebrated the day in a hall at a hotel in Kozhikode City. The main participants of the function were the faculties and students from various colleges in and around Kozhikode town as well as the officers and staff of RO Kozhikode. The function started with welcome address by Shri. P. K. Santhosh, A.D. Dr. P. Anil Kumar, HOD, Dept. of Statistics, Farook College inaugurated the function and in his inaugural address he stressed the importance of statistics in day to day life as well as in planning and policy formulations. A competition on presentation on the topic "Statistics for Social Development" was arranged.

**27. RO, Trivandrum:**Celebrated the day at Trivandrum Hotel, Statue, Thiruvananthapuram. One day programme was well attended by students – faculty delegates from five colleges of the town. Around 59 participants attended the session. Sh. M. Madhusudhanan, Deputy Director General in his introductory speech highlighted the importance of Statistics in formulating policy matters for shaping of all round development of the country and the valuable contributions rendered by the legendary Indian Statistician, Prof. P. C. Mahalanobis, towards this field. Dr. P. Mohanchandran Nair, HOD, Dept. of Demography, Kariyavattom Campus, presented a paper on the subject of "Health of Women and Children in Kerala: Levels and Issues". This was followed by another paper presentation done by Dr.Satheesh, Assistant Professor, Dept. of Future Science, Kariyavattom Thiruvananthapuram. The subject matter was "Data Science:Present Status and Future Prospects". A Quiz competition was held by Dr. Shibu, Assistant Professor, University College, Thiruvananthapuram.

**28. RO, Chennai:** Shri N.K. Sharma, DDG, RO Chennai presided over the function and Dr. M.R. Srinivasan, Head of Department, Dept. of Statistics, University of Madras, Chennai was the Chief Guest. As part of the Celebrations an essay competition was conducted in the office premises on 22nd June 2015. Shri P. Dhayalan explained the importance of the Statistics Day. Dr. M.R. Srinivasan delivered a lecture on Trends and Challenges in Statistics: Big Data.

**29. RO, Port Blair:** Celebrated in the presence of Shri S. Edward, Senior Statistical Officer along with other staff attached to this RO. Sh. Gautam Gupta, Scientist D, National Informatics Centre was the guest on the occassion. Shri S. Edward in his address stated that the objective of celebrating 'Statistics Day' is to create public awareness among the people about the role of Statistics in Socio-Economic planning and Policy formulation and to encourage younger generation for drawing inspiration from (late) Prof. P.C. Mahalanobis. He stated that the theme for Statistics Day 2015 is "Social Development; health, education, poverty, employment, social backwardness, housing and environment". Shri Akshat Yagnic, JSO gave a brief life sketch of Prof. Mahalanobis and his contribution in the development of Statistical System in India. Sh. Gautam Gupta gave away prizes to the winners of quiz competition organized as part of Statistics Day celebration.

**30. RO, Vijayawada:** Celebrated the day in which about 170 participants including students from 11 colleges/universities, statistical officials from state and central government participated in this event. The function was inaugurated bySh. D. Satish, Director, NSSO (FOD), Vijayawada and presided by Prof. K. Chandan, Dept of Statistics, Nagarjuna University, Sri ASNM Rao, Assistant Director, NSSO and Dr. Sister Kula Rekha Mudartha,

Principal, Maris Stella College. On this occassion, Prof. Sri K. Chandan delivered lectures on "Social Development Statistics". A presentation was made on the carrier prospects in statistics and data sources available. Essay writing and quiz were conducted on the theme of Statistics Day.

**31. RO, Madurai:** Celebrated in the presence of Sh. P. MANICKAM, ISS, Director, NSSO (FOD) MADURAI. Shri T. GURUMURTHY, SSO, NSSO, FOD, SRO THANJAVUR welcomed the participants. Shri. JOSE KURIAN, Asst.Director & H.O, NSSO, FOD, MADURAI RO briefed the statistical system in India and the role of CSO and NSSO in a nut shell. Prof. G. CHIDAMBARAM, Former Member of State Planning Commission, Govt. of Tamil Nadu, spoke on the data availability on social Statistics and educated the student community on the need to understand the application of different Statistical information available through Official Statistics. Dr. RAMASAMY, Associate Professor and HEAD, Department of economics,AVC College also presented the pictures. Dr. S.R. ELANGOVAN Ph.D, Department of Statistics, ANNAMALAI UNIVERSITY highlighted the various sources of data on Social Statistics . Shri. T. ASOKAN, Deputy Director(retired) added information on recent development in the field of Official Statistical System in India. A quiz programme was organised and prizes were distributed. News was published in the local districts. The function ended with a vote of thanks by Shri. P. SUBRAMANIAN, Senior Statistical Officer, NSSO, SRO , Thanjavur.

**32. RO, Coimbatore:** Padmashree Dr. G. Bakthavathsalam, Chairman, KG Hospital, Coimbatore inaugurated the programme and delivered a key-note address. Dr. R. Radhakrishnan, Ex-HOD, Dept. of Statistics, PSG College of Arts and Science, and Dr. Chinna Durai, Professor, Tamil Nadu Agricultural University participated in the function and addressed the gathering. In all, around 287 participants took part in the event. Various events were organized during the occassion. An inter-collegiate quiz competition was conducted with the objective of promoting awareness of statistics among students. Trophies were given to the colleges placed in the first, second and third places. Individual prizes for the members of the winning teams were also given. Participation Certificates were given to all the students who participated in the quiz programme. Video clippings on Statistics and Statistical Personalities were played on the occassion.

**33. RO, Kadapa:** Celebrated the Statistics Day in the office premises. Sri Manohar R, Director NSSO (FOD) Kadapa gave his inaugural speech. Thereafter the Chief Guest Dr. C Subba Reddy, The Reader, SKR Women's Degree College, Kadapa deliberated on role of statistics in government sector. Sri C Nagaraju, Assistant Director, NSSO(FOD), Kadapa and Sri Sundar Ram, Head of SRO Anantapur participated in the celebration. A quiz programme was conducted in the office premise among the seven teams of different colleges from Kadapa, Vempalli and Pulivendula. An Elocution Competition on 'Swachh Bharat- Releasing the dream of Mahatma Gandhi' was also conducted among the students of seven colleges. The winners were given prizes. Participation certificates to all the participants of Quiz and Elocution Competition were given. Wide publicity was given in the Print and Electronic media.

## NORTH-EAST ZONE

**34. ZO/RO, Guwahati:** Celebrated in the presence of Sh. Asis Ray, DDG, NEZ Guwahati and other officers/staff in collaboration with the Directorate of Economic and Statistics, Govt. of Assam, Guwahati. Prof. Dilip Kr. Barua, Ex-principal, Cotton College, Guwahati, Prof. Dr. M.P. Bezbaruah, Deptt. Of Economics, Prof. Dr. Amit Chaudhary, HOD, Depptt. of Statistics, Gauhati University and Shri B. Phukan, Director, DES, Govt. of Assam attended the event as Chief Guests. Prof. Dilip Kr. Barua shared how statistics plays a very important role in policy formulation, statistical development and

economic planning. He also said about the theme of the year. The celebration of Statistics Day will definitely publicize the importance of statistics in our society and economy. It also enlightens the life of Prof. Mahalanobis who worked for the empowerment of statistics and its implication in our economy.

**35. RO, Gangtok:** Celebrated the day at the Conference Hall of NSSO (FOD) at Tadong, Gangtok. The programme started with offering garland and Khada (white scarf) on the portrait of Professor Mahalanobis and lamp-lighting by Regional Head, Shri Ajay Baksi, Director and other Staff members present on the occassion. On theoccassion, the Head of Office, Shri D.T. Bhutia gave the welcome address. In his brief address, Shri Bhutia highlighted the contributions made by Prof. Mahalanobis in the field of statistics in India. Shri T.T. Lepcha, Senior Statistical Officer, spoke on the 'Prevailing health and poverty condition in the Indian Society'. The programme ended with the vote of thanks by Shri P.D.Shilal, J.S.O.

**36. RO, Kohima:**Celebrated the day with prompt and gaiety. A speech on the theme "Social Development: health, education, poverty, employment, social backwardness, housing and environment" of the celebration was delivered by Sh. M.M. Singh, Director, NSSO (FOD), RO Kohima.

**37. RO, Shillong:** Celebrated in the presence of Dr. Vishnu Kant Srivastava, DDG, RO, Shillong along with other officers/staffs. The programme was inaugurated by the Chief Guest Padamshree Smt. Patricia Mukhim, Editor, The Shillong Times. In the keynote, Dr. Vishnu Kant Srivastava, stated how Prof. Mahalanobis made efforts in accomplishing Statistics as a subject of study by proving that Statistics is not only about numbers but a true science of observations. The programme was concluded with Sh. M. Kharmutee, SSO, NSSO (FOD) Shillong rendering vote of thanks to all the participants, media, Government of Meghalaya and invitees.

**38. RO, Dibrugarh:**Celebrated the day with prompt gaiety. This year the faculties and students of Statistics Department, D.H.S.K College, Dibrugarh also participated. Officers from other Central Govt. offices also participated in the celebration. Quiz programme was made on the theme of the celebration.

## CENTRAL ZONE

**39. RO, Agra:** The programme was celebrated under the Chairmanship of Sh. Virendra Singh, Assistant Director & inaugurated by Chief Guest Sh. V.P. Tripati, Deendayal Rural Development Institute Agra. Shri Diwakar Khare, Director, Institute of Social Sciences, Agra, Shri Rajeev Saxena, Senior Generalist and Ex-Chairman Taj Press Club, Agra, Smt Poornima Jain, Dean, Social Sciences department, Dayal Bagh Institute, Agra were the Guest lecturers present in the event. All the Guest lecturers enriched the audience with their views on the Theme of the Statistics Day 2015 i.e. "Social Development: Health, Education, Poverty, Employment, Social backwardness, housing and environment.''

**40. RO, Dehradun:** Statistics Day was celebrated at Seminar Hall, State level Energy Park, Patel Nagar, Dehradun in the presence of DDG and other officers/officials. Sh. Pankaj Naithani, Secretary, Govt. of Uttarakhand discussed the contribution and work of Shri P.C. Mahalanobis and graced the occassion as Chief Guest. 58 Officers and 5 Media Staff participated in the celebration.

**41. RO, Bareilly:** Celebrated in the presence of Shri Pramod Chandra, AD and other staff. Chief Guest Dr. A.V. Balyan, Head (Retd.), Department of Statistics, Bareilly College inaugurated the seminar. In his inaugural speech he emphasized the need of reliable information and the strong database for policy makers to make appropriate policies for the development of the country and also discussed the theme "Social Development: health, education, poverty, employment, social

backwardness, housing and environment" in detail. Other speakers from different fields delivered lecture on the topic.

**42. RO, Bhopal:** Celebrated Statistics Day in which DDG, Regional Office, Bhopal inaugurated the function by lightening the lamp. The DDG in his speech highlighted the importance of Statistics. As a part of the celebrations various events viz. Debate, Essay Writing Competition and Quiz Contest were organized. Statistics Day was Celebrated in all the SROs under RO Bhopal with same spirit.

**43. RO, Gwalior:** Celebrated the Statistics Day in the presence of Sh. Rajnish Mathur, Director, Gwalior and other officers/staffs. The speeches were delivered on the importance and aim of NSSO, the importance of Social Development and how it is measured in Planning and Large Scale Sample Surveys.

**44. RO, Jabalpur:** Celebrated the day in graceful manner. Chief Guest Sh. Deepak Khandekar, Divisional Commissioner, Jabalpur inaugurated the programme and addressed the gathering along with some retired officers of RO Jabalpur and shared their experiences as well as highlighted the importance of Statistics.

# Celebration of 9th Statistics Day by Directorate of Economics & Statistics, Maharashtra

The 9th Statistics Day was celebrated on 29th June, 2015 by Directorate of Economic and Statistics under the chairmanship of Smt. A.D. Deo, Director, Directorate of Economic and Statistics, GoM, Shri U.S. Lonare, Joint Secretary, Social Justice and Special Assistance Department, GoM was invited as the Chief Guest. Shri V. S. Kulkarni, Deputy Secretary, Planning Department, GoM and Smt. P.R. Chhapwale, Under Secretary, Planning Department, GoM was invited as Special Guest for the Programme. All the Officers and Staff of Directorate of Economics and Statistics attended the said function.

The function commenced with offerings of flowers to the photograph of Prof. P. C. Mahalanobis and lightening of *samai* by the dignitaries.

Shri P. H. Bhagoorkar, Chief Research Officer, Directorate of Economics and Statistics, spoke life sketch of Shri P. C. Mahalanobis, a great Statistician. He spoke about contribution made by him in the field of statistics. He spoke about statistical measure D- square Prof. Mahalanobis contributions to large scale sample surveys is among his most significant and lasting gifts to statistics. Prof. Mahalanobis also helped in setting up then Central Statistical Organization which is now Central Statistical office in India, an apex body for co-ordination of statistical activities in India. Prof. P. C. Mahalanobis also made contribution to India's 2nd and 3rd five year plan. The theme of this year's Statistics Day was 'Social Development'.

Shri P. M. Pohare, Deputy Director (Administration), Directorate of Economics and Statistics was invited to deliver his speech. He spoke about the collection of data for Social Development statistics which dates back in 1990 AD. He said human is basic element/unit is of society, so development of human basically divided into 3 sectors viz. Health , Economic and Education. He also spoke about maintenance of administrative records is necessary. He stressed on the point that if administrative records are properly maintained, there is no need to do survey.

Then the Chief Guest of the programme Shri V. S. Lonare delivered his speech. He spoke about the importance of collection of statistics related to social development. He also said that the social development statistics is very essential in planning. He spoke about the various schemes implemented by State Govt. related to Social Development.

Thereafter Smt. A.D. Deo, Director, Directorate of Economic and Statistics delivered her speech. In her speech she enlightened us about importance of social development and statistics in planning and decision making. She also spoke about the necessities to maintain administrative records accordingly.

The function ended with vote of thanks with recall of memories related to Shri P. C. Mahalanobis given by Shri C. B. Aurangabadkar, Joint Director (co-ordination), Directorate of Economic and Statistics, Mumbai.

# Celebration of 9th Statistics Day by Directorate of Economics & Statistics, Andhra Pradesh

At the instance of Ministry of Statistics and Programme Implementation (MOSPI), Govt.of India, the Directorate of Economics and Statistics, Government of Andhra Pradesh has celebrated "**9th Statistics Day Celebration**" on **29-06-2015** in recognition of the notable contributions made by **Late Prof. Prasanta Chandra Mahalanobis** in the fields of economic planning and statistical development with the theme "**Social Development"** in a splendid way.

Elocution/Essay Writing Competitions were conducted on the topics **Education is the Golden Threshold to Nation's Development and Social Development as an Integral part of Economic Development** respectively **on 23-06-2015.** The Statistical Fraternity of DES has participated actively and prizes were distributed to the winners.

Prof RadhaKrishna, Chairman, Centre for Economic and Social Studies (CESS), Hyderabad and Former Chairman to National Statistical Commission has graced the occasion as Chief Guest and Sri N.Y. Sastry, Director (Planning), A.P.Secretariat has also participated in the celebrations on 29-06-2015. All the officers paid Floral tribute to the Late Prof.P.C.Mahalanobis.

At the outset, Dr. D.Dakshinamurty, Director, DES welcomed the statistical fraternity and expressed deep gratitude and respect to the Late Prof.P.C.Mahalanobis for the contributions made by him in the field of Statistics. He emphasized the importance of Statisticians particularly at field level in collection of information and the need for cross checking for further analysis of data. At the present scenario, the role of DES has been elevated and the Statisticians have to play a vital role in collection of data for policy making.

Further, the Director, DES has stated that while focusing on the economic development, we should be equally conscious of the Social Sector development. Reducing IMR, MMR, anemia among women and malnutrition, improving literacy and achieving global standards in these parameters continue to be our goal. The Andhra Pradesh Government has started with a renewed attention to make Andhra Pradesh one of the three best States in the Country by 2022. The Director, DES emphasized the importance of Quality, Reliability and Creditability of Statistics. The Director also explained the present status of Andhra Pradesh in Health, Poverty, Education, etc.

Sri N.Y. Sastry, Director (Planning), Andhra Pradesh Secretariat has felt that Statistics is a part of overall development of State and the Government is looking towards DES and Statistical fraternity for quality date for Planning and to take policy decisions for implementation of various Schemes in the State.

Prof. Radhakrishna, Chairman, Centre for Economic and Social Studies (CESS), Hyderabad and former Chairman to National Statistical Commission in his message recollected his association with DES, Government of Andhra Pradesh and stated that the DES, Government of Andhra Pradesh is one among the best DESs in the Country. He

also emphasized Prof. late P.C.Mahalanobis contributions to Statistics especially in large scale sample surveys and recollected the achievements made by P.C.Mahalanobis in the field of Statistics. Further, he presented the status of various Countries in the GNI and how the happiness is linked with social development of human being i.e health, education, etc. through Gross Happiness Index (GHI),Social Progress Index (SPI), component of World Happiness Report (WHR), Green GDP etc.

All the Officers/Staff of DES actively participated in the Celebrations. The "9th Statistics Day Celebrations" were also celebrated in all districts of Andhra Pradesh in outstanding way.

The winners in Elocution & Essay Writing competitions were awarded with Prizes and Certificates by the Chief Guest/Director, DES.

Publications on 1**.Compendium of Environmental Statistics, Andhra Pradesh 2013/2014 2. Gender Statistics, Andhra Pradesh 2011/2012 3. Report on Household Consumer Expenditure & Employment and Unemployment in Andhra Pradesh and a Brochure on 9th Statistics day** were released on the eve of Statistics Day.

# Celebration of 9th Statistics Day by Directorate of Economics & Statistics, Telangana

The Directorate of Economics & Statistics has celebrated the 29th June, 2015 as 9th Statistics Day at State level with the theme "**Social Development**", covering health, education, poverty, employment, social backwardness, housing and environment, as decided by the MOSPI, GOI. Dr. V. Subramanyam, Director, DES has welcomed all the dignitaries and participants and shared importance of the day and also about the theme of the day.

Sri. S. Niranjan Reddy, Vice Chairman, State Planning Board, Government of Telangana who has been invited as Chief Guest, in his remarks has congratulated all the Statistical fraternity on the eve of 9th Statistics Day. He appreciated the statisticians working in the State for their contribution in providing information to the Government in decision making process with low manpower. He also envisaged that the Planning Department shall play pivotal role, in future also, and should become center of all the Departments in the State.

Sri B.P. Acharya, IAS, Principal Secretary to Government, Planning Dept has also extended wishes to all the participants and emphasized the importance of Statistics in Social development and requested to build up a robust data base on important parameters for the use of Government in implementation of various developmental programmes. Sri A. Murali, IAS, Chief Executive Officer, SERP, Sri A. Sudarshan Reddy, Director, Planning Department, Sri M. Venugopal, Editor, Veekshanam have also graced the occasion and shared their views. The Chief Planning Officers from all districts have also attended the celebrations.

On this auspicious occasion, the Vice Chairman, State Planning Board has presented meritorious certificates to the Statistical fraternity for their best performance in discharging their assigned duties. Later, the Officials of DES and Planning Dept. have made detailed power point presentations on Statistics for Local Area Planning, Compilation of Gross State Domestic Product, Planning and implementation of Village Insurance Scheme, General Crop Estimation Surveys etc.

At district level all the Chief Planning Offices celebrated the 9th Statistical Day duly involving the District Collectors/Joint Collectors and other important dignitaries in a befitting manner.

## Celebration of 9th Statistics Day by Directorate Economics & Statistics, Uttar Pradesh

On 29th June 2015, 9th Statistics Day was celebrated by Economics and Statistics Division of Uttar Pradesh at Arth evam Sankhya Bhawan, Lucknow under the encouraging patronage of Shri Girija Shankar Katiyar. Director of DES, UP. Since 2009, a theme of importance is decided and intimated by Government of India for deliberations on this day as well as for focused efforts throughout the year on the various aspects of the theme, like present status, availability of data, identification of data gaps and outlining of futuristic plans to fulfill the data gaps and needs. The theme for the Statistics Day was "**Social Statistics**".

The formal celebration was inaugurated by Sri Girija Shankar Katiyar, Director Economics & Statistics Division. On this occassion, a brief paper on Life and achievements of Late Prof. P.C. Mahalonobis was presented by Smt. Alka Dhaundiyal, Deputy Director of DES,UP. She pointed that Prof. P.C. Mahalonobis prepared the statisical index named "Mahalanobis Distance" and worked hard on "Large Scale Sample Surveys"

Pratima and Anuradha the interns students made a live presentation on the role of statistics. Versha Patel, Saurabh and Anuj highlighted the different aspects of Poverty by means of an effective presentation. Ankit also made a presentation on Social Development. The Interns made different presentation on different aspects of Social Developments.

Mr. Shrinath Yadav, Deputy Director, DES UP made a wide presentation on Monitoring Poverty in Uttar Pradesh –"A Report on the 8th Poverty & Social Monitoring Survey." Mrs Manupriya Shrivastav the Additional Statistics Officer DES UP made a very lively and effective presentation on Unemployment with main focus on Social Development Theory. She explained the theory by means of beautiful illustrations from social life.

In the end of the programme, Shri G.S. Katiyar ,Director ,DES recalling the contribution made by Prof. P.C. Mahalanobis to the field of Statistics, stressed upon the maintaining the quality of data and for this, he suggested that the officers of DES should accept the challenges and take initiatives to develop new statistical techniques to maintain the quality of data. He concluded the programme giving a vote of thanks to all the participants for their presence and active participation.

The efficacious anchoring of the celebration together with the blending of thoughtful inputs in between by Smt. Alka Dhaundiyal, Deputy Director made the function lively and interesting. Statistics Day was also celebrated with similar enthusiasm and fervour in the Divisional and District Offices of DES, UP.At Varanasi Division, the day was celebrated with presentations on Late Prof. Mahalanobis and Social Statistics. To conclude the programme, a resolution was made by the participants that they would work for the betterment of statistical methods to make them more lively and interesting. A programme was also celebrated by Lucknow and Gorakhpur Division on this occasion .

## Celebration of 9th Statistics Day by Indian Statistical Institute

The Indian Statistical Institute celebrated the 122nd birth anniversary of Prof. P. C. Mahalanobis, founder of the Institute, on 29th June, 2015. On that day, the Institute organised a Technical talk by Dr. V.K. Saraswat (Padma Bhusan Awardee), Member, Niti Aayog on the topic "Current Economic and Scientific Scenario of India" along with other Lecture/Programme.

# Photo Gallery
# Statistics Day 2015

# 9th Statistics Day celebrations in Jalandhar R.O.


# Celebrations of Statistics Day on 29th June, 2015 at Chandigarh

## Directorate of Economics & Statistics, Andhra Pradesh celebrating 9th Statistics Day


## Directorate of Economics & Statistics, Telangana celebrating 9th Statistics Day

# Statistics Day Celebration by
# The Directorate of Economics and Statistics, Assam
# on 29th June 2015

# 9th Statistics Day celebrations by Directorate of Economics and Statistics, Uttar Pradesh


# 9th Statistics Day celebrations in Indian Statistical Institute, Kolkata

# 9th Statistics Day Celebrations in Rudraprayag, Uttra Khand

# 9th Statistics Day Celebrations , Vigyan Bhawan New Delhi



**Dr. Pulak Ghosh and Dr. Hukum Chand receiving C.R. Rao Award**

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