Sampling Methods for Crop Cutting Surveys – Part-II

Dr. A.C. Kulshreshtha
U.N. Statistical Institute for Asia and the Pacific (SIAP)

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Sampling Methods for CCS :- Estimation of crop yield through GCES

Methodology generally adopted for estimating average yield of crop and its sampling error is outlined

At stratum level, average yield of the crop is obtained as a simple arithmetic mean of plot yields (net) within it

Denote

X_{ijk} = Plot yield (net) in gms/plot of k^{th} plot in j^{th} village in i^{th} stratum

n_{ij} = Number of experiments analyzed in j^{th} village of i^{th} stratum

m_i = Number of villages in which experiments are analyzed in the i^{th} stratum

Estimation of crop yield through GCES (Contd.)

Notations (contd.)

n_i = Number of experiments analyzed in i^{th} stratum

S = Number of strata in a district

a_i = Area (net) of the crop in i^{th} stratum

d = Driage ratio

f = Conversion factor for converting green yield per plot into yield of dry marketable produce per hectare

Estimation of crop yield through GCES (Contd.)

- Stratum level average of the green yield for ith stratum is

$$\bar{X}_{i=} \frac{1}{n_i} \sum_{j=1}^{m_i} \sum_{k=1}^{n_{ij}} X_{ijk}$$

- District level average yield of dry marketable produce per hectare is

$$\bar{X} = d.f. \frac{\sum_{i=1}^{S} a_i \bar{X}_i}{\sum_{i=1}^{S} a_i}$$

Estimation of crop yield through GCES (Contd.)

Sampling variance of $\bar{X}$:

$$V(\bar{X}) = \frac{d^2 \cdot f^2}{(\sum_{i=1}^{S} a_i)^2}\left[W\sum_{i=1}^{S}\frac{a_i^2}{n_i} + (B-W)\sum_{i=1}^{S}\frac{a_i^2}{\lambda_i n_i^2}\sum_{j=1}^{m_i} n_{ij}^2\right]$$

Where

$$\lambda_i = \frac{n_i^2 - \sum_{j=1}^{m_i} n_{ij}^2}{n_i - (m_i - 1)}$$

B is M.S. between villages; W is M.S. within villages

$$B = \frac{1}{\sum_{i=1}^{S}(m_i - 1)}\sum_{i=1}^{S}\left[\sum_{j=1}^{m_i}\frac{1}{n_{ij}}\left(\sum_{k=1}^{n_{ij}} X_{ijk}\right)^2 - \frac{1}{n_i}\left(\sum_{j=1}^{m_i}\sum_{k=1}^{n_{ij}} X_{ijk}\right)^2\right],$$

$$W = \frac{1}{\sum_{i=1}^{S}(n_i - m_i)}\sum_{i=1}^{S}\left[\sum_{j=1}^{m_i}\sum_{k=1}^{n_{ij}} X_{ijk}^2 - \sum_{j=1}^{m_i}\frac{1}{n_{ij}}\left(\sum_{k=1}^{n_{ij}} X_{ijk}\right)^2\right]$$

Estimation of crop yield through GCES (Contd.)

- The percentage standard error is given by

$$\%S.E\left(\overline{X}\right)=\frac{\sqrt{V\left(\overline{X}\right)}}{\left(\overline{X}\right)}\times 100$$

NOTE

- In case the crop sown is pure, the net yield is the same as the actual yield obtained from the plot
- If the crop is sown in mixture, then the net yield is obtained by multiplying the actual yield by the eye estimate of the proportion of area occupied by the concerned crop as per the primary worker at time of crop cutting experiment

System of Crop Forecasting

- Advance estimates of crop area and production are released for principal food and non-food crops (food grains, oilseeds, sugarcane, fibers etc.) which covers 87% of agricultural output. Presently 4 forecasts are issued every year (July-June):
- First forecast – Middle of September
- Second forecast – January
- Third forecast – End of March
- Fourth forecast – June

[Kharif: June/July - October 2nd week: Paddy, Maize, Soybean

Rabi: Mid October- April: Wheat, Barley, Pulses]

First Advance Estimates

- Middle of September, South west monsoon about to be over and Kharif crops are at an advanced stage of maturity
- Coincides with holding National Conference of Agriculture for Rabi campaign
- Inputs from Space Application Centre (SAC), Crop Weather and Watch Group (CWWG), and other feedback such as relevant availability of water in major reservoirs, availability/supply of important inputs including credit to farmers etc. are considered while finalizing the estimates

Second Advance Estimates

- January – First forecast of Kharif improved on the basis of more precise information from States
- At this stage first advance estimates for Rabi crop are also prepared

Third Advance Estimates

- End of March/ Beginning of April
- National Conference on Agriculture for Kharif campaign
- States come up with assessment for both Kharif and Rabi crops
- Advance estimates of Kharif and Rabi are firmed up/validated with the information from SASAs, Remote Sensing, Market Intelligence Units (MIU) and Crop Weather Watch Group (CWWG)

Fourth Advance Estimates

- June
- National Workshop on Improvement of Agricultural Statistics
- Rabi crops are harvested by May
- SASAs are in a position to supply the estimates of both Kharif and Rabi seasons as well as likely assessment of Summer crops during the National Workshop

Final Estimates

- In addition to four forecasts, MOA provides final estimates in January
- System of preparing fully revised estimates for a crop year after 18 months which was in vogue till crop year 2003-04 has since being discontinued keeping in view the long time involved thus reducing the utility of such estimates
- It is desired that final estimates be made available in May with the fourth forecast, based on all information available and practice of revising these estimates in next December be discontinued
- National Crop Forecasting Centre (NCFC) has been setup by MOA with objective of examining existing mechanism of making forecasts and developing more objective technique. NCFC should also strengthen crop forecasting system of country, incorporating more objective techniques &models based on sound statistical techniques

Index numbers of crop statistics in agriculture

- Index numbers are important indicators to monitor performance over time and also the relative performance compared to other sectors at any given point of time
- DESAg generates index numbers of area, production and yield for each state covering 46 crops. Classifications of crops are done in two main groups and eight sub-groups
- First Group: Food Grain is classified into cereals (Rice, Wheat), coarse cereals (Jowar, Bajra, Maize, Ragi, Barley, Small Millets) and pulses (Gram, Tur and other pulses)
- Second Group consists: (i) Oilseeds, (ii) Fibers, (iii) Plantation crops, (iv) Condiments and spices, (v) Fruits and vegetables, (vi) Other crops

Index numbers of crop statistics in agriculture (Contd.)

- Sub-group oilseeds consists of Groundnut, Sesame, Rapeseed, Mustard, Linseed, caster seed, Safflower, Nigerseed, Soybean, Sunflower, Coconut and Cotton seed
- Fibres consist of cotton, jute, mesta and Sannhemp
- Plantation crops consists of tea, coffee and rubber
- Condiments and spices consists of pepper, ginger, garlic, chilies, turmeric, arecanut, coriander and cardamom
- Fruits and vegetables consists of potato, onion, banana, cashewnut, tapioca and sweet potato.
- Other crops consists of sugarcane, tobacco and guar seed

Index numbers of crop statistics in agriculture (Contd.)

- DESAg generates national and State level indices. Base year for present series of “Index of Area, Production and Yield in Agriculture” is the triennium ending 2007-08. Base year values of indices are based on average value of area and production of the triennium in order to smoothen the fluctuation of annual production
- Weighting factor of index is based on production over a triennium ending 2007-08 and national average price of the commodity during 2007-08
- Index number of area is obtained as percentage of current year area with respect to base year area of the crop. Index number of production is on similar lines. For index number of yields, index number of production is divided by index number of area

Methodology for Calculation of Index Numbers of Area, Production and Yield

Let, a_{ijk} : area under i^{th} crop in j^{th} year in k^{th} state

a_{i0k} : area under i^{th} crop in base year period in k^{th} state

P_{ijk} : production of i^{th} crop in j^{th} year in k^{th} state

P_{i0k} : production of i^{th} crop in base year period in k^{th} state

W_{ik} : weight of i^{th} crop in k^{th} state

B_{i0} : price per unit of i^{th} crop in base period

For the k and for the j, individual crop indices are calculated as below:

(a) Index number of area $= \frac{a_{ijk}}{a_{iok}} \times 100 = IA_{ijk}$

(b) Index number of Production $= \frac{P_{ijk}}{P_{iok}} \times 100 = IP_{ijk}$

(c) Index number of yield $= \frac{IP_{ijk}}{IA_{ijk}} \times 100$

Methodology for Calculation of Index Numbers of Area, Production and Yield (Contd.)

- For any sub-group G of commodities, the indices for the year j and state k are calculated as :

$$\text{Index number of area} = \frac{\sum a_{ijk}}{\sum a_{iok}} \times 100$$

- State index is obtained by including all the items of the state in sub group G where the summation is taken over items in G

$$\text{Index number of production} = \frac{\sum P_{ijk} B_{io}}{\sum P_{iok} B_{io}} \times 100$$

$$\text{Index number of yield} = \frac{\text{Index number of production}}{\text{Index number of area}} \times 100$$

Improvement of Crop Statistics (ICS)

- ICS scheme initiated in 1973-74
- NSSO – responsible for planning and operation of ICS by employing full time field staff for supervision
- Improving the quality of statistics, Non-sampling errors
- Supervision and physical verification of Girdawari in 4 clusters of 5 survey numbers in each of the TRS sample village
- Errors of aggregation is also checked by scrutinizing abstract of the village
- Supervision by central and state staff

Sampling design of ICS for crop area statistics

- Sampling design for sample check on area enumeration is stratified multistage random sampling where talukas/ tehsils /CD blocks in a district form a stratum
- Villages within each stratum form the first stage units
- Survey numbers within each village form second or ultimate stage sampling units
- Sample villages are selected from the set of TRS/EARAS villages in a stratum for the current year by SRSWOR
- In all 4 clusters of 5 survey numbers each are selected using circular systematic sampling w.e.p. in selected villages

Sampling design of ICS for Crop Area Statistics (Contd.)

- For selection of clusters, all survey/sub-survey numbers are given serial numbers treating each sub- survey number as a sampling unit. This constitutes the sampling frame
- Two sets (one as observed by the Supervisors and other set as copied from corresponding entries of Khasra Register by Patwari) of area figures under different crops for the selected 20 survey numbers are obtained
- Totals of area under various crops recorded for 20 survey numbers are also obtained
- Two separate estimates of crop area viz. A-III and A-IV respectively based on Patwari's record and Superintendent's/ State Supervisor's observations are prepared

Sampling design of ICS for Yield Statistics

- ICS scheme acts as a watchdog on implementation of TRS, EARAS and GCES to improve quality of crop statistics
- About 30,000 CCEs are inspected at harvest time. Supervisors point out deviations from prescribed procedures during CCE by primary workers. Deviations may relate to selection of plots, harvesting, standard equipment's, weightment of grain etc. Supervisors correct any mistakes in filling schedules. Only these corrected versions of schedules are used for tabulation
- Sampling design adopted for selection of sample for inspection of CCEs is stratified multi-stage random sampling. Districts are treated as **stratum**, Villages as **fsu**; Survey / sub survey numbers within villages as **ssu** and a plot within a sub survey number as the ultimate sampling units

Sampling design of ICS for Yield Statistics (Contd.)

- Villages selected by SRSWOR from list already there for sample check for area enumeration and in which CCEs are planned
- If number of villages selected in the sample = desired sample size for check on CCEs then no selection is done
- If number villages < desired sample for sample check on CCE, additional number of villages are selected in second phase from remaining villages selected for GCES. Circular Systematic Sampling is adopted for selection of ultimate stage unit
- Sample checks on CCE are planned on two experiments for a crop in each selected village. State primary workers conduct CCE in presence of supervisor and correct errors. Corrected yield rate is filled in ICS schedule. Based on this information the estimates of yield rates for the district and state are worked out

Estimation of Area from A-III & AIV

- Two sets (i- Khasra Register, ii- supervisor) of area figures under different crops for selected 20 survey numbers from each of the selected village under ICS scheme are obtained. Thus two separate estimates A-III and A-IV based on Khasra & supervisor
- Estimated area under the crop in j^{th} village in i^{th} stratum in the district is

$$Y_{ij} = \frac{H_{ij}}{S_{ij}} \times a_{ij}$$

- Estimated area in the i^{th} stratum is $\hat{Y}_i = \frac{N_i}{n_i} \sum_{j=1}^{n_i} y_{ij}$

a_{ij} =Total area under crop in selected survey numbers in j^{th} village, i^{th} stratum

S_{ij} = Number of selected survey numbers in j^{th} village in i^{th} stratum

H_{ij} = Highest survey numbers in j^{th} sample village in ith stratum

n_i = Number of sample villages selected in i^{th} stratum

N_i = Total number of revenue villages in i^{th} stratum

Estimation of Area from A-III & AIV(Contd.)

- Two sets (i- Khasra Register, ii- Supervisor's) of area figures under different crops for selected 20 survey numbers from each of the selected village under ICS scheme are obtained. Thus two separate estimates A-III and A-IV based on Khasra Register & Supervisor's
- Estimates of area thus obtained for each stratum in a district are added to get estimates of area at district level (Y_d) and the total of district level estimates gives state level estimate of area of crop
- In permanently settled states geographical area of village is not available, thus selection of plots is done by selection of households in village. Estimated area under crop in j^{th} village in i^{th} stratum by using inflation factor:

$$y_{ij} = \frac{(Total\ number\ of\ households\ in\ the\ village)}{Number\ of\ sample\ households} \times b_{ij}$$

where, b_{ij} = Total area under crop in selected households in j^{th} sample village of i^{th} stratum

Estimation of Area from A-III & AIV (Contd.)

- Estimate of variance at district level is calculated from

$$V(Y_d) = \frac{N(N-n)}{n(n-1)}\left[\sum_{i=1}^{K'}\sum_{j=1}^{n_i} Y_{ij}^2 - \frac{1}{n}\left\{\sum_{i=1}^{K'}\sum_{j=1}^{n_i} Y_{ij}\right\}^2\right]$$

where,

K' = the number of strata in a district in which the estimates of area under the reference crop is not zero.

$$N = \sum_{i=1}^{K'} N_i \quad \text{and} \quad n = \sum_{i=1}^{K'} n_i$$

Variance at state level is the sum of variance of district level estimate

Percentage standard error of the estimate of area at state level is

$$\% \text{ Standard Error} = \frac{S.E.\ of\ the\ Estimate}{Estimate} \times 100$$

Where, standard error is the square root of the state level variance which is the sum of variances of the district level estimates

Estimation of Area from A-I & II

- Patwari prepares crop abstracts for village from Khasra Register. ICS schedule gives area figures, as reported in Patwari crop abstract. Supervisor checks and records the corrected totals of area under crop in the ICS schedule
- Thus two sets of area figures under a crop in selected village. Based on these, two estimates A-I and A-II are prepared. Estimation is similar to A-III, A-IV except that the estimate now represents area under a crop as reported in ICS schedule

Pooling of estimates of Central and State samples at State level

Let $\hat{Y}_c$ = estimate of area at state level for Central sample

$\hat{Y}_s$ = estimate of area at state level for State sample

$\hat{V}_c$ = estimate of variance at state level for Central sample

$\hat{V}_s$ = estimate of variance at state level for State sample

Estimation of Area : Pooling of estimates (Contd.)

Calculate $e_c = \frac{1}{\hat{V}_c}$ and $e_s = \frac{1}{\hat{V}_s}$

Then pooled estimate of area is : $\hat{Y}_p = \frac{e_c \hat{Y}_c + e_s \hat{Y}_s}{e_c + e_s}$

Estimate of its variance is: $\hat{V}\left(\hat{Y}_p\right) = \frac{1}{e_c + e_s}$

Estimates of Yield Rates

- Sample checks are planned on two CCEs for a crop in each selected villages. CCEs conducted in presence of Supervisor and errors corrected. Corrected yield rates are filled in ICS schedule. Based on it, estimates of yield rates for district and state are worked out

Let, Y_{ijk} = plot yield in gms/plot in k^{th} experimental plot of jth sample village in i^{th} district

n_{ij} = number of CCEs conducted in j^{th} sample village of i^{th} district

n_i = number of CCEs selected in i^{th} district

a_i = total area under the crop in i^{th} district

m_i = no. of selected villages in which CCEs are conducted in i^{th} district

d = number of districts in the state

E = mean square of yield between villages

Estimates of Yield Rates (Contd.)

F = mean square of yield within village and

f = conversion factor for converting green yield per plot in to yield of dry marketable produce per hectare

Average yield under the crop in ith district is: $\bar{Y}_i = \frac{1}{n_i} \sum_{j=1}^{m_i} \sum_{k=1}^{n_{ij}} Y_{ijk}$

Estimated average yield rate at state level is:

(Average yield thus obtained is converted to dry grain yield in terms of Kg./ha.)

$$\bar{Y} = \frac{f}{\sum_{i=1}^{d} a_i} \sum_{i=1}^{d} a_i \times \bar{Y}_i$$

Estimated variance of estimated yield rate at state level is:

$$\hat{V}\left(\hat{\bar{Y}}\right) = \frac{1}{\left(\sum_{i=1}^{d} a_i\right)^2} \left[F \sum_{i=1}^{d} \frac{a_i^2}{n_i} + (E - F) \sum_{i=1}^{d} \frac{a_i^2}{\lambda_i n_i^2} \sum_{j=1}^{m_i} n_{ij}^2 \right]$$

Estimates of Yield Rates (Contd.)

Where, $\lambda_i = \frac{1}{n_i(m_i - 1)}[n_i^2 - \sum_{j=1}^{m_i} n_{ij}^2]$

$$E = \frac{1}{\sum_{i=1}^{d}(m_i - 1)} \sum_{i=1}^{d} \left[\sum_{j=1}^{m_i} \frac{1}{n_{ij}} \left(\sum_{k=1}^{n_{ij}} Y_{ijk} \right)^2 - \frac{1}{n_i} \left(\sum_{j=1}^{m_i} \sum_{k=1}^{n_{ij}} Y_{ijk} \right)^2 \right]$$

$$F = \frac{1}{\sum_{i=1}^{d}(n_i - m_i)} \sum_{i=1}^{d} \left[\sum_{j=1}^{m_i} \sum_{k=1}^{n_{ij}} Y_{ijk}^2 - \sum_{j=1}^{m_i} \frac{1}{n_{ij}} \left(\sum_{k=1}^{n_{ij}} Y_{ijk} \right)^2 \right]$$

Percentage standard error is: $\%SE(\bar{Y}) = \frac{\sqrt{V(\bar{y})}}{\bar{y}} \times 100$

Application of Remote sensing and GIS technology

- Developments in computer technology and remote sensing satellite data processing has rendered vast coverage online information
- Commercial Geographical Information System (GIS) packages facilitated a range of applications of satellite Earth Observation (EO) data
- SYMAP- Synagraphic mapping system.
- GIS is used to solve spatial/ non-spatial data problems . Using a GIS:
  - Users can integrate geographical features displayed on computer map and retrieve associated attribute information for further analysis
  - Maps can be constructed by querying or analysing attribute data
  - New information can be generated by performing spatial operations
  - Different attribute data can be associated via shared location code

Application of Remote sensing and GIS technology (Contd.)

- Indian studies on applications of remote sensing technologies initiated after launch of IRS-IA satellite. Crop Acreage and Production Estimation (CAPE) was a projects for estimation of crop area under wheat, rice, cotton, ground nut, sugarcane, potato, sorghum& mustered
- Methodological studies at IASRI: Singh et.al. (1992) used satellite data for stratification of crop area for GCES to obtain more precise estimator of crop yield. Singh et. al. (1999) developed small area estimator of crop yield using satellite spectral data and yield data obtained from GCES. Singh et. al.(2002) used satellite data and farmers eye estimate of yield for crop yield forecasting model
- Joint project of IASRI, Space Application Center,NE Space Application Center & DES Meghalya to explore possibility of estimation of area and production of field crops by integration of remote sensing technology, GIS and field studies.

Application of Remote sensing and GIS technology (Contd.)

- Joint project of IASRI, Space Application Center,NE Space Application Center & DES Meghalya to explore possibility of estimation of area and
- To utilize capabilities of remote sensing and improve crop production, forecasting methodologies, a National Crop Forecasting Centre (NCFC) established in Ministry of Agriculture in 1998. Recently a project, Forecasting Agricultural output using Space, Agro-metrology and Land-based observations (FASAL) launched under NCFC to meet requirements of timely nation wide and multi- crop reliable forecast
- Outcome of all these studies encouraging and indicate that remote sensing and GIS have a great potential to improve quality of area and production statistics of the country

Small Area Estimation (Contd.)

- Need for crop production estimates for small areas (CD blocks, panchayats) has assumed urgency especially after the introduction of Crop insurance requiring expansion of CCEs which appears impossible
- Technique of “Small Area Estimation” (SAE) appears a promising solution. For it use of auxiliary information through farmers’ appraisal survey for obtaining crop yield estimate at Block/ Gram Panchayat level for the purpose of estimation of yield rates should be good
- Another approach for estimation at small area level could be to make use of remote sensing digital data along with yields data from GCES. IASRI has taken up some studies for development of crop yield estimation at block level using remote sensing satellite data along with CCE yield data.

International Status of Crop Statistics- Canada

- **Statistics Canada -** Main agency. Agricultural statistics generated through National Farm Survey and Agricultural Census

National Farm Survey:

- Survey provides annual data based on sample of farming operations
- Collected information covers farms, operating arrangements, land use, tenure and size, livestock and poultry, field crops, operating expenses, farm capital, and farm income and cash receipts
- Sample survey with a cross-sectional design on (i) Agricultural land use (ii) Agriculture (iii) Crops and (iv) Livestock
- Survey targets all farming operations in provinces with sales of farm products of $250 or more ($2,500 in Newfoundland) in the twelve months preceding the survey (Excludes institutional farms and farms on Indian reserves and settlements)

Canada: National Farm Survey (Contd.)

- Sample selection and data collection varies over regions
- Canadian Wheat Board area (Prairie Provinces, British Columbia) uses two list frames and one area frame
- List frames contain: (i) large census farms vis-à-vis crop, livestock and expenses criteria; (2) census farms > twenty acres, and not in list
- Area frame contains all agricultural enumeration areas. Quebec and Ontario uses one list frame, made up of census farms, and one area frame, made up of agricultural enumeration areas
- Only list frame of census farms is used in Maritime Provinces and British Columbia. In Newfoundland there is complete enumeration of census farms

Canada: National Farm Survey (Contd.)

- Frames are **stratified** within sub provincial areas on the basis of crop, livestock and expense characteristics
- Samples are drawn from frames using **Circular Systematic Sampling**
- Data collection through: telephone; mail-out with interviewer pick-up; personal interview; mail-out with telephone interview
- Responding to this survey is mandatory. Data are collected directly from survey respondents
- Imputations are deterministic using nearest-neighbor "hot-deck" method. Raising factor adjustment to account for total non-response

Canada: Census of Agriculture (Contd.)

- Statistics Canada- Census of Agriculture Quinquennially
- Data provide comprehensive picture of major products of agriculture industry, also on new crops, livestock, technology
- Data used for estimates and Sample Frame for agricultural surveys
- Major areas covered: (i) Agricultural products (ii) Agriculture (iii) Farm finance (iv) Farmers and (v)Farms
- Reference period: previous calendar year (value of agricultural products sold) and census day (no. of livestock on the operation)
- Error detection methods involve numerous edits to identify and resolve problems

International Status of Crop Statistics- USA

- National Agricultural Statistics Service (NASS), US Dept. of Agric.(USDA)- Conducts surveys, nodal organization for collecting all agricultural statistics including crop area, production, crop forecasting

Census of Agriculture:

- Provide county (3200+) level data, uniform definitions/ methodology
- Data on all products, expenses, income, operator characteristics
- Census of agriculture conducted in all 50 states, all farms and ranches selling $1,000 or more of agricultural products including horticulture
- Unit non-response and under-coverage adjustments made by re-weighting techniques applied to data from reporting farms

International Status- USA- June Area Survey

- **June Area survey:** Largest **annual** NASS survey, provides direct estimates of acreage. Utilizes area-sampling frame
- Area frame: all land stratified by land use in all states except Alaska and Hawaii
- PSU based on land area, provide complete coverage of all operators performing agriculture activity on that land
- Sample of over 11,000 segments (smaller units of PSU of 1sq. mile) selected from each land use stratum for data collection
- All farm operators of selected segments interviewed. About 85,000 agricultural and non-agricultural land use tracts identified within sampled segments
- Over 35,000 detailed personal interviews are conducted with farmers operating farms inside the segment boundaries. Every 5 years, over 2,000 extra segments are sampled to supplement census coverage measures

USA- June Area Survey (Contd.)

- Survey designed to account for all agricultural activities/ land uses within segment boundaries
- Data collected on crop acreage, genetically modified crop acreage, grain stocks, inventories of cattle, hog, sheep, poultry, land values, cash rents, farm numbers, and value of sales
- Data collected by personal interview during first 2weeks of June. Respondents examine aerial photograph to identify each field and crop planted. Acreage data refer to current crop year, while livestock and stocks data refer to June
- Operators not sampled from list frame comprise non-overlap (NOL) domain. NOL domain identified from this survey used to calculate an incompleteness measure for multiple frame estimates

USA- Acreage and Production Survey

- Survey provides data to estimate acreage, production of selected crops and inventory of major livestock species at county level for state and federal programs.
- Survey conducted in 42 states. All counties represented in sample. Commodities covered are specific to each state
- NASS, USDA Risk Management Agency (RMA), SDA Farm Service Agency (FSA) jointly define a federal county estimates program
- Farmers enquired: planted acres, area harvested for grain and silage, quantity harvested. For fruit: No. of trees or vines, quantity harvested. For livestock: total inventory; No. of beef cows, dairy cows, calves
- Survey conducted annually at end of harvest season

USA- Acreage and Production Survey(Contd.)

- Some states conduct 2 surveys, late summer for early harvested crops (small grains) and in late fall for row crops, hay, and livestock. Most states conduct only one late fall survey
- Target population: all farms & ranches in each state
- All counties and rare commodities adequate representation
- County estimates for small grains released in mid-February
- Row crop estimates published in March -June.
- Livestock county estimates released in May - August.
- State program county estimates published by each state schedules
- RMA uses county estimate data to determine when crop loss insurance payments are to make to farmers
- FSA uses estimates in county prices, disaster assistance programs

USA- Agricultural Yield Survey

- Purpose: to provide farmer reported survey data of expected crop yields used to forecast and estimate crop production levels
- Sample farm operators selected from March Crops/Stocks survey (small grains), and June Crops/Stocks survey (late season crops and tobacco). Farmers reporting acreage ≥ one commodity included in data collection to forecast crop yields
- Monthly survey: May - November.
- Small grains data: May – August; Row crop data: August – November; Hay yield data: August -October with hays stocks collected in May. Tobacco data: May -November
- Mail out-mails back data collection. Tele- interview, if request

USA- Agricultural Yield Survey(Contd.)

- Crop Production report is published by12 of each month. Acreage, yield, production forecasts prepared for crops in season
- NASS estimates of supply: official, independent, unbiased baseline. Credible estimates, Producers minimize swings in farm gate prices
- Crop production estimates valuable for producers and industry alike to plan marketing and movement of commodity throughout the year

Crop Progress and Condition Survey:

- Provides frequent and timely updates of farmer activities: planting, harvesting, progress of crops through various phenological stages of development, crop condition ratings throughout growing season

Crop/Stock Survey: Farm operations selected from Multiple Frame

Objective Yield Survey: Based on Crop cutting surveys before harvest

International Status -Peoples Republic of China (PRC)

- Did not inherit strong statistical system. SSB established in 1952
- Great Leap Forward (1958-1960)
- Cultural Revolution (1966-1976). Statistical Institutions re-established in 1972. Agriculture reporting system based on census data
- Each of PRC's more than 5 million agricultural production teams (small collective farms) enter about 500 different categories of data in 13 quarterly and annual statistical reporting tables each year
- Three categories: (i) Basic Information- construction of communal property, arable land, commune and team prices, scientific information (ii) Agricultural Production- crops, livestock, forestry (iii) Miscellaneous - mechanization, fertilizer, distribution of commodities produced, income

Peoples Republic of China (PRC)- Censuses

- Two types of agricultural censuses are conducted:
  - (i) Annual (fixed time) census, completed by end of February
  - (ii) Seasonal census, done in each growing season
- SSB provides leadership and reporting format for collection of census data, (called “all around”, or "overall" surveys)
- Forms adjusted for local conditions, filled out under combined leadership of local Government agencies to meet requirements
- Census data provided by basic production teams and summarized upward through governmental levels to the State level

PRC - Censuses (Contd.)

- Census required manpower that came from Government bureaucracy. Information used for planning at all levels
- Brigade is like farm as a reporting unit which keeps planting, yield records, as reported by teams, for each field in the brigade
- For a census during the growing season, the brigade has the following three subjective methods to "forecast" brigade yield
  - A group formed from statistical cadre and an informed peasant subjectively evaluates yield of the fields.
  - In some fields, grains counted on some plants. Historic records compared with current count and yields subjectively derived. This method reportedly works better than the first
  - A "typical" field selected and the group carefully evaluates yield

PRC - Censuses (Contd.)

- Fertilizer use, weather, historical relationships are considered in subjective development of these yield forecasts
- For spring crops, data reported to county by 10th June; for autumn crops, by 20th October
- Census system also report livestock numbers and economic data
- Commune reviews data from brigade reports, passes them to county
- County reviews data (usually from about 650 brigades), passes to next higher level of government.
- Manual summarization process repeated up to State level
- Census information is used for sampling plans in the PRC

PRC – Typical Area Investigations

- Also referred to as "spot" or "key area method" adopted at province, prefecture, county level
- Data reported twice each year: Summer- by April; Autumn- by Sept
- At county level: technicians from SSB, Agriculture Bureau, Food Group form a team to forecast yields
- "typical" brigades (pieces of land) where survey work done chosen
- team goes by truck, stops every five minutes to evaluate a field
- Visual examination, counts of stalks/ kernels, past harvest data used to make the yield estimate for each field
- Prefecture, province also provide technicians for county teams

PRC – Sample Surveys for Crop Forecast

- Sample surveys are being re- instituted. Surveys conducted during two main crop seasons
- Each crop has individual sample survey instead of multiple data items. Depending province, surveys done for paddy rice, wheat, corn, sorghum, millet, and/or sweet potatoes
- Sample surveys conducted using five stage sampling design, which utilize prior census data to develop the sampling frame
- Three-year average (TYA) of yield per mu (666.7 sq meters) for each county is computed using end season census data for the crop being surveyed. This past data is used for counties to draw first stage sample
- Provinces consist of about 80 counties

PRC – Sample Surveys for Crop Forecast (Contd.)

- Counties are arranged in ascending order by this average yield; then cumulative county area of the crop is computed
- Sampling interval determined (20% approx. of counties, min. 7) and systematic sample of cumulative area values selected
- TYA yield per mu is computed for these selected counties and compared to the province TYA yield per mu
- If sample value is not within ±2 % of province value, the sampling interval is reduced, thus larger sample drawn
- Second stage-sampling unit is commune (average 23 communes per county)

PRC – Sample Surveys for Crop Forecast (Contd.)

- TYA yield per mu from census data reported by communes in each selected county computed. Communes arranged in ascending order by TYA yield, then cumulative commune area of the crop is computed
- Sampling interval is set such that about 30% of communes in each county are selected using a systematic sample of cumulative area values. Again TYA yield for communes in the sample compared with county TYA yield. Process repeated with a larger sample size if ±2 % tolerance is not met
- Third stage-sampling unit is the production team which has the responsibility for agricultural activities. A production team consists of about I or 2% of commune's land
- Fourth stage - sampling unit is the field

PRC – Sample Surveys for Crop Forecast (Contd.)

- Fifth stage- sampling unit is plot in selected fields
- Systematic point sampling scheme is generally used to determine the centers of plots. In some areas instrument like protractor is used which measures a circular sample of about I .I sq meters. In wide row crops, a fixed length of row (3.3 -3.7 meters depending on crop and area) is used
- Data collection for sample plots: two types: (i) forecast (ii) harvest data. Survey teams in local areas do data collection
- Enumerators types: (i) full-time employees of SSB Sample Survey Team, (ii) part-time workers hired for the survey
- Same plots are used for both forecast and harvest estimate of production surveys

THANKS