

Agriculture and its Integration with National Accounts Statistics: The Indian Case

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Abstract: This study examines the select domains of database on agriculture in India and its use in the national accounts statistics. Though, the share of agriculture in total value added has declined considerably to less than a quarter at the national level, several states are still agriculture-dependent. Besides, agriculture provides sources of livelihood to more than half of the total work force. Hence, the reliability of agricultural statistics and their integration to national accounts are of great significance from the productivity and sustainability point of view. The study examines the methods and sources used to collect statistics on acreage and yield of agricultural crops and also their limitations. It also discusses evolution of the national accounts statistics in India and treatment of the agriculture sector therein. The study concludes, highlighting some of the problems related to the treatment of the agriculture sector in the national accounts in its present form. In suggesting that the services sector value added has expanded much faster than that in the agriculture sector, many issues such as how well the agriculture sector data compare and can be integrated with the value added originating from the industrial sector or the services sector, need to be tackled very carefully.

Key words: Agriculture, database, national accounts, JEL Codes: C82, M41, Q10, India

INTRODUCTION

This study discusses select domains of agricultural statistics in India and its use for the purpose of valuation in the national accounts. A critical assessment of the entire National Accounts Statistics (NAS) is quite an ambitious task and this study only touches tip of the iceberg by focusing on the agriculture sector. In 2007-08, agriculture and allied sectors accounted for 16.4% of the country's Gross Domestic Product (GDP) with agriculture alone contributing about 14% of the GDP (Government of India, 2010) (The National Account Statistics (NAS) of India reserve the term Agriculture and Allied Activities to include agriculture proper, livestock and animal husbandry) and operation of irrigation systems while forestry and logging and fisheries are not a part of it whereas the economic survey uses the term agriculture and allied sectors to include all the above activities. Since this study is more concerned with NAS; the term agriculture and allied activities excludes forestry and logging and fishing. However, the term agriculture/agriculture sector includes the livestock and the irrigation systems.

The share of agriculture in GDP has declined considerably over the years with rapid increase in the value added from the services sector. The role of agriculture in boosting the overall growth appears to be diminishing over the years though agriculture continues to provide livelihood to more than half of the Indian population. Also, the sluggish growth of labour

productivity in agriculture has been quite worrisome. In the backdrop of these changes researchers take a critical look at the methodology used for collection of data in the agriculture sector and the data quality. Some of these issues have been of great concern since the early days of India's economic development. This study acknowledges those efforts.

Major domains of agricultural statistics include statistics related to production, land use, prices, fertilizers, employment, credit and trade of agriculture produces. Researchers focus only on the first two categories, viz., production and land use because these constitute the bulk of the data required for estimation of the national income. In this study, the domain production covers statistics related to area and yield of the crops and the production from crops, livestock and fisheries. Both for production and land use researchers discuss the data sources, their scope and limitations of information collected. Gauging the actual situation regarding the two is important since these estimates are widely used in forecasting the agriculture output thereby assisting the food policy. The supply side shocks notwithstanding, recent spikes in food prices is indicative of the problems that mismanagement of food can led to.

AGRICULTURAL STATISTICS IN INDIA: MAJOR DOMAINS

This study discusses the statistics on land use and production in agriculture, their limitations and the

sources of data. Unlike the cases with the population census and industrial statistics, no specific legal provisions or act exists in the country for canvassing and compilation of information on crop production and land use periodically.

Statistics on land use and production: Estimates on production are derived from the estimates on area and the yield. Researchers first dwell upon the methodology that is being followed to estimate land use and crop area and then turn to yield. For estimation of acreage for various crops and land utilization, the country based on the manner in which the land records used to be managed for the purpose of the land revenue system during the colonial India has been divided into two broad categories of states/UTs. In the first category are the so called Temporarily Settled (TS) states/UTs where land revenue was fixed for definite period and was revised at the end of the period. In such states, a village revenue agency maintains the land records: usually a reporter known in different states as Patwari, Lekhpal, Karnam, etc., who is believed to be well aware of agricultural and economic conditions, visits the villages under his jurisdiction and enumerates the pattern of land use and acreage of different crops. In the second category are the states/UTs known as the Permanently Settled (PS) where the tax rate was fixed in perpetuity. In such states, officers at police thanas/chowkidars manage the land records. These personnel are usually not trained for this purpose and are often in charge of 100-150 villages which make their task even more difficult. The village totals thus obtained are consolidated to obtain the figures for successive hierarchy of administrative units like tehsil, district and state.

At the time of independence, land use statistics were available under five categories: a) forests; b) area not available for cultivation; c) other uncultivated land excluding current fallows; d) fallow lands; e) net area sown. Since 1950-51, following the recommendation of a Technical Committee of 1949, a more detailed 9-fold classification based on the above five categories was adopted:

- Forests: Forests
- Area not available for cultivation: Area under non-agricultural uses
- Barren and uncultivable land: Other uncultivated land excluding current fallows
- Fallow lands: Permanent pastures and other grazing lands
- Net area sown: Miscellaneous tree crops and groves not included in the net sown area
- Cultivable waste

- Fallow lands (other than current fallows)
- Current fallows
- Net area sown

Now, a 22-fold classification is being proposed (The revisions in classification schemes, although helpful in organizing the database better and in canvassing more information, may introduce tinter-temporal incomparability in the data owing to the definitional changes). The total geographical area of the country is 329 million ha of which 305 million ha is the reporting area for land use statistics in 2001-02 (Government of India, 2009) (Reported area is that for which data is available and may or may not match the geographical area) of the remaining 23 million ha, about 18 million ha is located in Jammu and Kashmir and in hill-tracts of the North-Eastern India. Of the reporting area, forests account for 23%, uncultivable and fellow lands (categories (b) and (c) above for 34% and the remaining (about 46%) is net area sown.

For estimation of acreage, the states/UTs are divided into three categories (Bansil, 2002; Ghosh *et al.*, 2008). In addition to the TS and PS states which account for 86 and 9% of the total reporting area, there exists a third category of states which have neither a cadastral map nor village officials to conduct surveys. They comprise mostly hilly and forest areas. Area statistics in these states is reported based on personal knowledge of the revenue officials as well as on past knowledge and experience.

Estimates for yield are based on the Crop Cutting Experiments (CCEs) initiated under the General Crop Estimation Surveys. Prior to independence, the estimates of yield were based on standard yield and crop conditioning factor in a region. Presently, the yield is estimated from crop cutting estimates which involve the following different steps:

- Random selection of a field
- Locating and marking an experimental plot within the fields
- Harvesting the crop within boundary of the plot
- Adjustments for driage. Normally, the field staff carrying out such work is well trained

Statistics on land use and production; limitations and efforts to overcome them: The statistics on acreage under different crops and the land use statistics are usually available with lag of 2 years due to delay involved in various stages of data collection: often the patwaris are overloaded with different duties. To reduce this time lag and enhance the utility of the statistics for users, the Ministry of Agriculture in late 1960s launched a scheme named, Timely Reporting System (TRS) whereby reliable

and timely estimates of acreage in principal crops in each season would be made available within 2 months of sowing of the crops. Patwaris would collect information on a priority basis in randomly selected 20% of the villages in selected states (at present 13 major states and two UTs).

In the PS states on the other hand where TRS is not possible due to lack of institutional structure at the village level, a scheme Establishment of an Agency for Reporting of Agricultural Statistics (EARAS) was implemented following the recommendations of a working group since 1975-76. The scheme envisages establishing an agency to carry out complete enumeration in randomly selected 20% of the villages to provide timely estimates of area and production under the principal crops.

To improve quality of statistics, Improvement of Crop Statistics (ICS) was initiated in 1975. The scheme is in operation in the 13 states where TRS is in operation and involves checks on area and yield based on the information collected independently from about 10,000 villages and 31,000 experiments. The discrepancies between the two sources—the enumeration by the patwaris (for area estimates) and CCEs (for yield estimates) under TRS and ICS are then assessed. During 1994-95 to 1998-99, the ICS indicated 30-40% error in area reporting by the patwaris which has been attributed to three types of errors:

- Crops grown but remain unreported
- Crops not grown but reported
- Incorrect reporting of area under the crops. Similar discrepancies were observed for yield estimates

Despite the above schemes, there remain problems with quality and scope of the data on land use, acreage and yield in India. Even the schemes discussed above have not been able to achieve their desired objectives of providing timely and quality data. Many states were reported delaying submission of the area estimates within the period stipulated under TRS and EARAS (Bansil, 2002). Sometimes, the coverage of the data too is incomplete. Although, ICS has pointed out deficiencies with the system of collecting crop statistics by the states, it has not been implemented properly due to such problems as non availability of equipments to conduct the CCEs.

The Indian Government, time to time has constituted several expert groups to look into the statistical problems related to agriculture sector. The government agencies also organize periodic seminars on these issues—every year a National Workshop on Improvement of Agricultural Statistics is being organized at the time of

releasing the Forth Advance Estimates in June/July. One of the seminars held several years back in 1972 came out with the following recommendations:

- The land use data used to be collected through patwari. Though, it was collected on a complete enumeration basis its reliability was questioned as the individual was assigned several tasks at one point of time. Hence, it was recommended to carry out periodic sample surveys to check the validity of statistics collected by the patwaris
- The progress of the TRS was slow. The information on irrigated and unirrigated areas had to be collected fast
- Along with the prices of major crops the seminar recommended that the Ministry of Agriculture must collect data on major inputs like water, fertilizer, electricity and fuel
- In the case of commodities subjected to the price control, published statistics reported only the controlled prices and not the open market prices. For the analysis of the trend, however it was felt that the open market prices were of greater importance which could be collected by NGOs in case the government agencies had difficulty in reporting them
- Input data were of poor quality. For example in the case of fertilizers there was a need to get reliable estimates of actual sales and stocks at the retail level and on allocation of fertilizers between crops
- Data on area coverage under irrigation, HYV seeds, etc. were based on certain norms which need to be made reliable through appropriate surveys
- The information on input-output was not adequate and there was a need for reliable data on cost of production
- The practice of using the land records to extract information on land holdings and land use pattern was erroneous and hence there was a need for better information on land holdings, incomes, savings, etc., of the agrarian structure
- Different sample surveys covered different aspects of agriculture. Hence, there was a need for maintaining coordination among them by creating an independent national organization for conducting agricultural surveys

From the supply side, a study by Srinivasan and Vaidyanathan (1972) highlights a number of limitations relating to the land use data. The treatment of particular items for instance, area under mixed crops and source of irrigation is a major problem. Many states did not maintain up-to-date records. The intensity and quality of water

supply was not considered which could vary from region to region. Hence, the estimate of irrigated area and the area sown more than once might result in overestimation of agricultural output in the National Accounts Statistics. Therefore, precise estimation of how much of the decline in the share of agriculture in total GDP is real and how much is due to an improvement in the data quality remains uncertain.

Apart from the long time lag in collection, compilation and releasing the above statistics, a longstanding problem and is inevitably discussed by every committee/seminar that is organized on the agriculture statistics in India, there are other problems with the acreage, land use and yield estimates. There are large variations in the estimates of same statistic generated from the different sources and there is hardly a proper explanation for such discrepancies. This was major agenda for National Workshop on Improvement of Agricultural Statistics of 2007 and the workshop concluded that lack of proper coordination, validation and monitoring among the state agencies as responsible for this.

A committee comprising eminent agriculture professionals was constituted by the Government of India in February, 2009 under the chairmanship of A Vaidyanathan with aims to review the current methodology used in TRS, EARAS, ICS and General Crop Estimation Surveys; suggest ways and means to ensure timely availability of reliable estimates and to review the use of technology such as the remote sensing for acreage and yield estimation. The committee has recently submitted its report and has suggested a major revamp of the agricultural statistical system in the country.

Data sources: In general, the primary statistics on agriculture in India is collected by the states agencies known as State Agriculture Statistics Authorities (SASAs) which is then compiled by the Directorate of Economics and Statistics under the Department of Agriculture and Cooperation, Ministry of Agriculture (DES). The primary sources of information for DES are Land Use Statistics (LUS), Area and Outturn of Principal Crops and the Cost of Cultivation Studies (CCS). In fact, DES is single most important agency for data on agriculture and publishes Agriculture Statistics at a Glance (ASG) containing both cross-sectional and time series information annually.

Since, the final estimates of production from area and yield are available only after some time lag, advance estimates at four different points in a year are made available for 27 major crops to assist various policy related decisions (Agricultural crop year in India runs from July to June). There are two major crop seasons in India: the crops sown during the months of June to

September are known as kharif (kharif means Autumn in Arabic) crops and those during October to February as rabi (rabi means Spring in Arabic) crops. Besides the two, zaid crops comprising vegetables and inferior cereals are grown in some parts of the country. Zaid crops are sown usually after the rabi harvesting is done and are ready for reaping before the kharif sowing season:

- First advance estimate; released for kharif crops during September every year when kharif crops are at advance stage of maturity
- Second advance estimate; released in January when first assessment of rabi crops is made. The first advance estimates of kharif may get revised
- Third advance estimate; in March/April when earlier assessments of both rabi and kharif undergo revision
- Fourth advance estimate; in the month of June/July every year, third advance estimates are revised and since most of the rabi crops are harvested, SAS are in a position to supply both the kharif and rabi season estimates

After the fourth advance estimate, the DES releases final estimates in December/January of the following agricultural year. The final estimates for the previous year are also released along with these estimates. The estimates of value of output for the 45 principal crops are prepared using the production figures compiled by the DES and the prices relating to the peak marketing period prevailing in the primary market centres compiled by the state Directorates of Economics and Statistics. In the case of minor crops like cashewnut, indigo and papaya, the area and outturn figures are available in the publication Area and Outturn of Principal Crops in India but with a time lag of 1 year. Therefore, estimates for the current year for these crops are based on projections which are subsequently revised when the information is available. Apart from the DES, Central Statistical Organization (CSO) and National Sample Survey Organization (NSSO) under the Ministry of Statistics and Programme Implementation and Directorate General of Commercial Intelligence and Services under the Ministry of Commerce and Industry are important sources of information on statistics on agriculture in India. The CSO is responsible for managing National Accounts Statistics and also compiles data on crop production and livestock and fisheries. The NSSO specializes in designing of surveys, carrying out field work and processing and dissemination of the data. It has dedicated divisions for each of these activities. The Fields Operations Division of the NSSO also provides technical guidance to the States/UTs in Crops Estimation Surveys for the purpose of yield estimation.

EVOLUTION OF NAS IN INDIA AND EMBEDMENT OF THE AGRICULTURAL SECTOR

NAS in India: Indian statisticians were instrumental in development of the first UN System of National Accounts (SNA) in 1953 and also at the subsequent stages (Lequiller and Blades, 2006). This is probably one reason why India's national accounts have closely followed the recommendations of the successive versions of the SNA while concepts and methodology used for compilation is that of SNA, some procedures and approximations are constrained by the data collection system of the country. The Central Statistical Organization (CSO), once a while revises the base year in order to address the methodological changes and incorporate data from new surveys and censuses. This also helps in making the estimates suitable for international comparisons.

First systematic attempt towards generating official estimates of national income and other macro aggregates was setting up of the Expert Committee by the Government of India in 1949 under the Chairmanship of PC Mahalanobis with DR Gadgil and VKRV Rao as members. The committee recommended preparation of the national income estimates on an annual basis. The details comprising the methodology and estimates were first published by the government in 1951. Later, the research of estimation was transferred to the CSO where a separate National Income Division was set up. Prior to independence (year 1947) too, many academicians and researchers tried to work out the national income estimates.

First official estimates were prepared with base year 1948-49 using the methodology recommended by the committee and continued till 1956. Over time availability of more information led to review of the methodology used and after a seminar and a series of follow up studies, the base year was revised to 1960-61. The coverage of NAS was extended to include estimates on capital formation and savings. The base years were subsequently revised from 1960-61 to 1970-71 and from 1970-71 to 1980-81. While in the former case, scope, coverage and methodology remained same; the methodology used for estimation of fixed capital in the 1970-71 series was revised in 1980-81 series. Also, the state of Sikkim was included. The 1980-81 series continued to provide estimates till 1999. Thus prior to 1999, the base year for computation of NAS was revised three times, once in each decade such that every time it was synchronized with the year of decennial population census which is conducted in the years ending with 1. This was because the workforce estimates were obtained from the population census.

In 1999, the CSO revised the 1980-81 series with series having 1993-94 as base year. For the first time, population census was not used to obtain information on the workforce for the purpose of the national accounts since it was believed that the NSSO data captures the workforce participation rate better (The estimates of working population were believed to be under-enumerated in the population censuses) and thus it was decided to use the same from the NSSO 50th round; employment and unemployment survey, conducted in 1993-94 accordingly the base year too became 1993-94. Apart from this, the 1993-94 series also, probably for the first time, used the database on horticultural statistics (released by the National Horticulture Board of the Ministry of Agriculture). Coverage of agriculture was extended to include production in the fore/backyard, floriculture and deep sea fishing. Several other changes, especially related to services sector output were made to comply with the recommendation of the 1993 SNA. The 1993-94 series continued to provide estimates till 2006 when the CSO revised the base year to 1999-2000. The practice of using the workforce estimates from the Employment and Unemployment Survey of NSSO (conducted in the same year) instead of those from the Population Census continued in the current series (1999-2000 series) (A report by EPW Research Foundation (EPWRF, 2002) mentions that the CSO decided to revise the base year once in every 5 years so as to capture better the rapidly changing structural features of the economy. The changes in coverage and methodology of NAS with regards to the agriculture sector, incorporated in the current series are discussed in study.

NAS and agriculture in India: In the national accounts statistics, the agriculture sector includes agriculture proper, livestock and livestock products and operation of irrigation system. The agriculture proper includes growing various crops including plantation crops, agricultural and horticultural services and ancillary activities like gur making, transportation of produce to the primary markets and activities yielding rental income from farm buildings and machinery, etc. The livestock covers breeding and rearing of animals and poultry, production of milk, slaughtering, preparation and dressing of meat, production of raw hides and skins, eggs, dung, raw wool, honey, silk worm cocoons and increment in livestock. Operation of irrigation system comprises supply of water through various Government channels to the agriculturists. Often, agriculture and livestock activities go together and it may not always be feasible to segregate the various inputs into those used in agricultural and livestock production.

Until revision of the base year to 1993-94 when several recommendation of the 1993 SNA were incorporated, the GDP from the agricultural sector was underestimated on the following counts (Asthana, 1998; EPWRF, 2002); omission of produces in floriculture, mushrooms and high value crops, underestimation of production of fruits and vegetables, spices and livestock products-in some cases, value of the reported production was even lower than that of their exports; the area sown under third and fourth crops (for instance in zaid season) in some states; under estimation of area under different crops (revealed in the ICS) and price data supplied by the states.

In the year 2006 when the base year was changed to 1999-2000, the coverage of the GDP estimates was extended to include production of the following (under agriculture and allied activities): salt through seawater evaporation; betel leaves (for states of Assam and West Bengal); toddy; goat milk (in 16 states/UTs), buffalo milk (in 5 states/UTs) and camel milk having economic value and not presently covered in the production data; duck eggs (in 15 states/UTs) and meat production from unregistered slaughtering in the states where the same is presently not covered in the production estimates (Government of India, 2007). Another important change made in procedures of compilation in the new series was to utilize the production data provided by the National Horticulture Board for all horticultural crops (with the exception of those covered under principal crops) and the price data provided by the State Directorates of Economics and Statistics for all crops.

Agriculture in present system of NAS: As mentioned before, agriculture and allied activities in the NAS include agriculture proper, livestock and livestock products and operation of irrigation systems. Before researchers discuss each of the three separately, it is important to note that the production approach is used to estimate contribution of the agriculture proper and livestock and livestock products to GDP in terms of the Gross Value Added (GVA) whereas the same for operation of irrigation systems by government sources is estimated using the income approach. The GVA is difference between the value of products by-products and ancillary activities at the prices received by the producers and the value of inputs to the process of production (raw materials and services) at purchasers prices. Table 1-3 show various input/output item groups, their coverage and the methodology.

Agriculture proper; valuing the output: For the purpose of valuation in NAS, agricultural crops are divided into 11 groups; first 10 are crop groups and the 11th group comprise of by-products of the crops covered under the ten crop groups like gur production and bagasse (these activities are performed in farms) and crop remnants like straw, stalks and sticks (The DES classifies 42 agricultural crops into two groups: major and minor crops. The former group comprises 25 crops and the latter, 17. It is these 42 crops that are divided into 10 crop groups in the NAS). Table 1 shows the crop groups, the sources of the data and the methodology used for valuation of output in the national accounts.

Table 1: Agriculture proper in the NAS; valuation of output

Groups	Coverage/definition	Notes on methodology for valuation for the purpose of the national accounts
Cereals	Paddy, wheat, jowar, bajra, barley, maize, ragi and small millets and other cereals	Acreage and yield based on sources discussed in date sources
Pulses	Gram, Moong, tur, moth, horse gram, masoor, urad, other pulses and peas	Date sources
Oil seeds	Linseed, groundnut, rapeseed and mustard, sesamum, castor seed, coconut, safflower, niger seed, soyabean	Date sources
Sugar	Sugarcane, gur, palmyra sugar, other sugar	Date sources; Agriculture proper: valuing the output (Gur and other sugars)
Fibers	Kapas, jute, sunhemp, mesta, other fibres	Date sources
Drugs and narcotics	Tobacco, tea, coffee, opium, betel leaves, isabgol, saffron, coca, other drugs and narcotics	Agriculture proper: valuing the output
Dyes and tanning	Indigo, other dyes and tanning material	Production and prices: State DES of Tamil nadu and Rajasthan; Area: LUS
Condiments and spices	Cardamom, dry chilies, black pepper, dry ginger, turmeric, garlic, fennal, cumin, ajwain, methi, tamarind, nutmeg, cloves, cinnamon, coriander, arecanut, and other condiments and spices	Date sources
Fruits and vegetables	Banana, mango, grapes, cashewnut, papaya, apple, mosambi, lemon, orange, lichi, pineapple, sapota, guava, potato, sweat potato, tapioca, brinjal, cabbage, cauliflower, okra, tomato, green peas, other vegetables, onion, chery, almonds, walnut, pear other temperate fruits, subtropical fruits, other citrus fruits, jack fruit, drumstick, floriculture, backyard farming	'Indian Horticulture Database' of National Horticulture Board, NSSO for backyard farming (Agriculture in present system of NAS)
Miscellaneous crops	Rubber, fodder, mulberry, guar seed, grass, miscellaneous food and non-food crops	Output estimates based on average yield per hectare on the area from LUS
By-products	Straw, Stalks and sticks of cereals and pulses cane trash, bagasse and poppy seed and husk	CCS (date sources), Agriculture proper: valuing the output

Data releasing agency is DES and original sources are LUS, Area and Outturn of Principal Crops and the CCS; Prices used for evaluation are based on states DES (Directorate of Economics and Statistics) of the state governments; Compilation based on Chapter 9, Government of India (2007)

Table 2: Livestock and livestock products in the NAS; valuation of output

Groups	Coverage/definition	Data releasing agency	Original source/survey	Notes on methodology for valuation for the purpose of the national accounts
Milk	Milk consumed or sold in fluid form, ghee, butter and lassi	DAHDF	ISS	Milk production estimates from DAHDF; If unavailable for a state then based on yield rates prevailing in neighboring states
Meat	Meat, meat products and by-products comprising hides, skins and other products	CSO	Slaughter houses in states	Meat: total production of meat, estimated by the states from registered and unregistered slaughterhouses; meat products and by-products: estimates based on the no of slaughtered and fallen animals and the corresponding yield rates
Eggs	Eggs	DAHDF	ISS, IASRI and SAHD surveys	Poultry meat: number of adult fowls, chickens and ducklings slaughtered
Wool and hair	Wool from sheep and hair from camels, goats and pigs	CSO	CSO studies, ISS	Average yield rates (quantity in grams or kgs/animal/year) from camels and pigs
Dung	Dung-fuel and manure	DAHDF	ISS	Production: population and evacuation rates; Utilization rates: Manure and fuel
Silkworm cocoons and honey	Silk worm by types and honey	CSB, KVIC	CSB, KVIC	Production: outturn estimates of silk worm cocoons by types and honey
Increment in livestock	Change in the population for each category of livestock	DAHDF	Livestock census	Projections on the basis of growth rates observed between the last two Livestock censuses

Acronyms; DAHDF: Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture; KVIC: Khadi and Village Industrial Commission; SAHD: State Animal Husbandry Departments, ISS: Integrated Sample Surveys, CSB: Central Silk Board; Prices used for evaluation are based on States Directorate of Economics and Statistics of the state governments; Compilation based on Chapter 9, Government of India (2007)

Table 3: Agriculture proper and livestock in national accounts: valuing the inputs

Inputs	Coverage/definition	Data releasing agency	Original source	Notes on methodology
Seed	Seeds used as input	DES, SADS	CCS	Value of seeds used as inputs is price times area times seed rates; price same as that used for output
Organic manure	Dung, other than that used for making dung cakes for fuel	DAHDF	ISS	It is assumed that output of dung, other than that used for making dung cakes for fuel of the animal husbandry is used as input in the agriculture sector
Chemical fertilizer	Material wise consumption of chemical fertilizers	FAI	Producers	Consumption of chemical fertilizers is obtained from material wise distribution of chemical fertilizers to states by the Central Fertilizer Pool and other manufacturers. Fertilizers are evaluated at retail prices prevailing in the markets
Pesticides and Insecticides	Pesticides and Insecticides used as input	DPPQ	CCFI	Consumption of pesticides and insecticides times their cost at the national level
Irrigation charges	Charges payable to the govt in lieu of the water supplied to the farmers from govt owned and other means of irrigation	State DESs	Irrigation departments	State wise information on the; sale of water (for irrigation), irrigation cess; local cess; betterment levy and other items. If this information is unavailable, estimates from budget documents are used which may include other receipts that are not a part of irrigation charges
Electricity	Electricity consumed for agricultural purposes	CEA		Electricity consumed for agricultural purposes times the corresponding price per unit
Market charges	Charges paid by the farmers to carry their produce to the markets	DES	Ad-hoc surveys	Separate charges for agriculture and livestock production. Percentage of market margins and market costs to the total value of output is 2.358 (1997-98)
Diesel oil	Consumption of diesel	IOC, ILC and CCS		Estimated based on number of tractors and diesel engines in use (obtained from ILC) and per unit consumption of diesel (data from CCS) and the prices of diesel from IOC
Repairs, maintenance and operation costs	Current repairs, maintenance of fixed assets and operation cost	AIDIS	AIDIS	Data on expenditure on these items is collected
Feed of livestock	Two categories: Roughages (trash, grass, fodder, straw, etc.) and concentrates (oil cakes, crushed pulses, grains, medicines, salts, etc.)	DES, NSSO		For roughages, entire production of fodder, cane trash and grass and 95% of production of stalks and straws in the agriculture sector are considered to be consumed by entire livestock population. An adjustment is made for the consumption of these items by animals which are mainly used for transportation purposes
FISIM	Financial services indirectly measured	Banks and other financial institutions in the organized and unorganized sector		These are the output of financial intermediation for which no explicit information is available on the output; such output is imputed indirectly. Income approach is used

SADS: State Agricultural Departments, FAI: Fertilizer Association of India, DPPQ: Directorate of Plant Protection and Quarantine, Ministry of Agriculture, CCFI: Crop Care Foundation of India (formerly Pesticides Association of India), IOC: Indian Oil Corporation Limited, ILC: Indian Livestock Census, AIDIS: All India Debt and Investment Survey; Compilation based on Chapters 9 and 18, Government of India (2007)

In the case of sugarcane, outturn excluding the quantity converted into gur by the cane growers is taken and gur is evaluated separately. Thus, total sugarcane production is divided into two parts: sugarcane utilized as such and the sugarcane converted into gur. While the former is evaluated at sugarcane prices, the latter at gur prices. Estimates of gur production are not directly available and are built up using the information on different uses of sugarcane. On average, the amount of gur produced is 9-10% of that of the sugarcane used for gur making. Bagasse is obtained as a by-product during conversion of sugarcane into gur and in the present series (1999-00 base year); its production is taken to be 35% of gur production. Besides its use in the production of the gur and crystal sugar, sugarcane is also used for production of khandsari, bura, etc., in India. The consumption of sugarcane for producing khandsari, bura, etc., is obtained from the data for registered and unregistered establishments (The quantity of sugarcane left over after allowing for its uses in the above activities is assumed to be converted into gur).

Unlike gur, processing of tea is an activity outside the scope of agriculture. Hence, the output of raw tea leaves alone needs to be accounted for in the agriculture sector and this is taken to be equal to the input of raw tea leaves in the tea processing industry. This information is available from the Annual Survey of Industries (ASI) in absence of which the production of tea leaves is estimated to be 4.44 times of the processed tea by the Tea Board on the basis of Techno-Economic Surveys. Information on area and outturn of opium is obtained from Central Bureau of Narcotics and that for the other plantation crops is obtained from respective commodity boards.

Toddy crop is used to prepare a beverage consumed mainly in Southern parts of the country. Its value is estimated by multiplying the value of toddy consumption, obtained from the quinquennial survey on consumption conducted by the NSSO in 1999-2000 by the corresponding population separately for rural and urban areas of the states.

The production of crops in fore/backyard of houses was taken into account for the first time in the national accounts in the 1993-94 series. The information was obtained from the Survey on Livestock and Operational Land Holdings carried out by the NSSO in 1991-92. In addition, information on agricultural production in homestead only and outside homestead raising field crops' was included for broad size class of operational holdings. Appropriate adjustments were made to account for the residential building which was part of the item in the survey giving information on operational holdings.

The value of output on account of the production of crops in fore/backyard was estimated using these area estimates and the value per hectare of fruits and vegetable crops. Note however that the survey was conducted only in rural areas.

Livestock and livestock products; valuing the output: The livestock and related products are classified into seven broad groups for the purpose of valuation of output into the national accounts. Table 2 shows the groups, their coverage, sources of information and the methodology used for the valuation of output.

Agriculture and livestock; valuing the inputs: Since, it is difficult to apportion the inputs used in agriculture proper and the livestock used for agricultural purposes, the two are valued together. The various items considered as items of intermediate consumption are grouped into 11 categories. Researchers show them in Table 3.

Irrigation systems: Unlike the case with most items under agriculture proper and livestock which by and large are unorganized, it is easier to estimate the contribution of irrigation systems (by the governments) in the national accounts and this is done using the income approach. The income approach involves summing the factor incomes accruing from production of an activity. Estimates for the irrigation systems are prepared based on the data available in budget documents and the annual reports of non-departmental commercial undertakings.

NAS and the agricultural sector; some issues: This study discusses some of the problems related to database and the methodology, used to estimate contribution of the agriculture and allied activities to the national accounts. Such problems may lead to under/over-estimation of the contribution of sub-components of the agriculture sector to the national income.

Data gaps: Several new entrepreneurial activities in the agriculture sector like mushroom cultivation, etc., have been taken up in the economy in recent years (Kulshreshtha *et al.*, 1997) and their production estimates are not available.

The CSO acknowledges that reliable estimates of many activities including such banned activities as hunting, trapping and game propagation are not available and the available data yields insignificant estimates of such activities (Government of India, 2007). Since most of the agriculture production in India takes place in unorganized sector, many such units (including slaughter houses for the livestock) are not registered. The reliable

information on meat production is only available since 1998-99 that too mostly from the organized sector. Hence, it is likely that the existing methods and database underestimate the true contribution of agricultural sector in the GDP.

In respect of minor crops such as mango, citrus fruits and grapes, the estimates of area under these crops are available from the DES but estimates of yield are not available. For these crops, the estimates of production are built up from the yield rates available from various reports of the Directorate of Marketing and Inspection and State Agricultural Departments (Kulshreshtha *et al.*, 1997). In case of many fruits like kiwi, no information is available on production. Similarly, the coverage of herbs and floriculture is only partial. A central scheme, scheme for crop estimation surveys on fruits and vegetables and minor crops is being implemented by some states.

Data quality: Many censuses and surveys are not conducted on annual basis and thus require interpolation to bridge the data gaps. For instance, annual data on livestock population is estimated using inter-censal growth rates. Such, growth rates may not take into the conditions, such as drought, floods, etc., prevailing in either of the census years. In many areas, it is not possible to conduct the rigorous surveys due to such problems as difficult terrain and unfavorable political and social conditions. In such states, mostly ad-hoc methods are used. For instance, acreage estimation in Assam is based on ad-hoc methods.

In some cases, the data being utilized is too dated. For instance, the Government of India (2001) mentions the benchmark estimates of production of fodder related to the year 1955-56 and the area figures available from the DESMOA (*viz.*, the Directorate of Economics and Statistics, Ministry of Agriculture) are the two sources for estimating the output of fodder. In the case of grass, the area figures are estimated from the Land Use Statistics (LUS) and the source for yield estimate is the NSS Report No. 65, table with notes on animal husbandry year 1951-52. Needless to say that a lot of changes have happened in the 60 years since these surveys were conducted and in light of which the methodology should have been updated.

Even the quality of the production data on the important crops is under attack. As late as in 2010-11, the difference between the first and the final advance estimates in 2010-11 was substantial, >50% in the case of maize for instance (Mehra and Dhoot, 2012).

Information on prices: Another issue relates to prices do researches have the appropriate prices of the inputs and the outputs? The subsidies are provided at various stages

and while making a rigorous analysis of prices or of cost of calculation or agricultural performance we often do not have the requisite information to arrive at the subsidy-adjusted prices. Even for an analysis of the prices actually paid by the poor households are hardly captured. As they purchase commodities in smaller quantities they end up paying higher prices than the market prices that are gathered in surveys on wholesale prices or cost of living index (Rao and Komala, 1997). For the construction of cost of living index of the agricultural workers though the surveys cover the centres from where the agricultural workers purchase commodities the variations in prices paid in response to quantity purchased are not captured. Similarly for inter-sectoral resource flow the accuracy of prices at which the agricultural products are purchased by the rest of the economy and the appropriate quantities that are transacted across sectors are essential.

Inter-temporal comparability: The difficulty, encountered in a typical time series analysis, relates to the comparability of data over time as the changes in methodology used for measuring value added take place. For example, the gross state domestic product figures at the state level taken from the CSO were available for two different bases: at 1980-81 prices for the period 1980-81 through 1997-98 and at 1993-94 prices for 1993-94 through 2003-04 (CSO, 2003). The problem with the two series is that they differ not only in terms of prices but also coverage or the sectoral composition. Apart from changes in the database and improvements in methodology including those based on the 1993 SNA, several new activities across sectors have been included in the series based on 1993-94 prices. Hence, construction of an extended series starting from 1980-81 till date is not without limitations. From the series made available by the CSO it is difficult to gauge if revisions could be carried out while converting the series based on the 1980-81 prices into 1993-94 prices. At the national level, it is however claimed that the series starting from 1950-51 to 1999-00 is based on the revised national income and production statistics linked back with 1999-2000 as the base year, thus reworking the previous estimates applying the splicing technique to each activity independently (Preface to the Fourth Edition in EPWRF, 2002).

Again for the recent years from 1999-2000 to 2006-07 the base of GDP has been changed to 1999-2000. However, the sectoral distributions of GDP from two different series (at 1993-94 prices and 1999-2000 prices) for the year 2000-01 are quite similar. Hence, percentage figures and growth rates based on these two series may be broadly comparable. On the whole one may conclude that national income estimates are possibly tending to

converge with the methodology suggested by UN SNA and therefore, the comparability problem is on the decline. Given the largely unorganized nature of the agriculture, indirect method of estimation is indispensable for many activities. As the availability of information improves with time and methodological advances are incorporated, it introduces a problem of inter-temporal incomparability. In fact, the share of direct estimates in aggregate GDP rose from 57.6% in the 1970-71 base series to 63.7% in the 1980-81 base series and further to 89.6% in 1993-94. In the latest series, the sectoral share of direct estimates varies between 100% (mining, registered manufacturing, electricity, gas and water supply, railways and public administration and defence sectors) to 26.6% (forestry sector) (Government of India, 2001).

Inter-sectoral comparability: There are differences in the methodology used for income estimation across sectors. Hence, the aggregation carried out to arrive at the total GDP figures may not be appropriate. Further, there are no uniform definitions in the tertiary sector. The measurement of value added and its interpretation in certain components of the tertiary sector like trade, hotels and restaurants and community, social and personal services cannot be done as that in agriculture or manufacturing. The third issue relates to the situation in which certain service related activities within manufacturing or agriculture are moving out to gain their own identity. These activities were counted earlier as part of the manufacturing or agriculture activities and because of super-specialisation now fall into the domain of the tertiary sector. This may mean a sudden rise in the share of the tertiary sector in total value added for the recent years while in the past they remained embedded in other sectors. All this introduces the problem of comparability of sectoral shares over time.

Regional accounts: Presently, the territorial unit for compilation of the data is the state. Large intra-state variations in income, poverty and other social outcomes as well as interdependence between agriculture and these indicators of development are well known. Such variations and the emphasis on the decentralized planning mean district and sub-district level estimates becomes important for decisions making. It would also help understanding the transactions taking place in the regional economy.

In this connection, the CSO working group established in 1957 recommended Farm Management Studies' for improving the inputs data. Later in 1971 and 1975 the Working Groups on Regional Level Statistics were constituted who recommended development of strong infrastructure for collecting statistics at the district

and lower level organizations. In 1972, committee recommended a System of Regional Accounts (SRA). But the committee could not submit a set of regional accounts due to conceptual and data problems in particular those related to the treatment of savings, change in stocks and external trade.

Other methodological challenges: To take policy initiatives for providing input subsidy and for augmenting the supply of certain crucial inputs, the estimation of production function and the elasticity of substitution between various pairs of inputs are essential. Unless the input prices and quantities are accurately collected, the estimates specifically those estimated using the translog production function obtained may not be reliable. The translog estimates are more sensitive to data inaccuracy than the simpler form like Cobb-Douglas. But, the latter does not allow estimation of elasticity of substitution between a pair of inputs.

There are various standard indicators of performance such as the total factor productivity estimate which are accepted internationally. Whether such indices can be estimated for Indian agriculture without taking recourse to serious assumptions is doubtful. Similarly, the measurement of capital formation in agriculture and marketable surplus of various agricultural commodities involve serious issues. The private investment made by the small farmers often goes unreported.

Value addition created at various stages is hardly accounted for. The raw produce is processed at various stages by the women members of the households who combine their household jobs with other activities necessary at the processing stage. The detailed information needed to arrive at the appropriate valuation of the commodities is not collected. Similarly from the labour point of view, researchers have no accurate estimate particularly of those who make part-time contribution while pursuing household activities. Unless the detailed time use surveys are conducted the information on labour input will remain vague. On the other side, the disguised unemployment is quite prevalent in the agriculture sector and thus there is a tendency to overestimate the workforce by including those who are actually not engaged productively in this sector.

CONCLUSION

With methodological advancements and wider applications of technological skill in collecting and maintaining information, the database for the agriculture sector can be expected to acquire greater comparability from an international point of view. In this context, the use

of remote sensing to tackle some of the above data gaps has been recommended earlier by the National Statistical Commission and now by the Vaidyanathan Committee.

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