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## **CALCULATION OF HOUSEHOLD INCOMES – A NOTE ON METHODOLOGY**

**FOUNDATION FOR AGRARIAN STUDIES**

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This manual is a collective effort led by Aparajita Bakshi with inputs from Arindam Das and Biplab Sarkar.

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# CALCULATION OF HOUSEHOLD INCOMES – A NOTE ON METHODOLOGY

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## **7. Summary**



This document describes the overall methodology of calculation of household incomes used in PARI at present. The methodology has been developed and modified over time, starting in 2007, as we gained experience and resolved problems that arose during the process of estimation. The current methodology has been applied to data from 20 villages in the PARI database.

## 1. Conceptual issues

Estimation of net incomes requires a detailed assessment of costs of production and a consistent valuation of output. In most cases, and for most important rural occupations, respondents cannot provide information directly on gross and net incomes. They can, however, provide information on specific items produced, on the use of inputs, and on the expenditure incurred in the process of production. Estimates of net income have to be derived from reported data on output, expenditure, input use and prices.

The FAS-PARI surveys are conducted soon after an agricultural year ends. Data on agricultural activities in these surveys are collected for the agricultural year preceding the survey. On other activities, data are collected for a year prior to the date of the survey. Accordingly, all incomes are calculated for one year. It may, however, be noted that in some cases, the production cycle for specific crops or non-agricultural activities is longer than a year. In such cases, expenditure incurred and output may vary from year to year within a production cycle. In these cases, suitable adjustments need to be made to get representative estimates of annual incomes.

A number of basic conceptual issues have to be dealt with in order to build a methodological framework for calculation of rural incomes.

### *1.1 Income as a derived variable*

A large number of rural households are self-employed, particularly in crop production but also in a variety of non-agricultural occupations. Most such households do not maintain any accounts. Accounting for these activities is very complex particularly because a substantial part of the produce is not marketed and a large part of the inputs used in the process of production are also not purchased from the market. For some of these products and inputs, in fact, either no markets or only very thin markets exist. As a result, because of complexities of valuation, even if, on a rare occasion, a household maintained some rudimentary accounts, such an account is likely to be partial and would not provide a summary estimate of the household's income.

To some extent, most rural households are unable to directly report their incomes. As a result, in the context of rural households, it is necessary that income be treated as a derived variable. That is, one cannot directly ask households to report their income over the specified reference period. Income has to be derived on the basis of a detailed accounting of output and costs in the economic activities pursued by the household. To this end, detailed data have to be collected on input use and production particularly for activities like crop production and animal husbandry.

### *1.2 Household as an economic unit*

A household has to be considered as the basic unit for estimation of incomes. It is common for members of households to work together in different occupations, most importantly, in agriculture, without any division of income from these occupations between members. Also, all income is typically pooled and consumed by the household as a whole and inter-se division, even when it is unequal between members, is not quantifiable.

In official statistics in India (for example, the Census of India and the NSSO surveys), a household is defined as persons normally residing together (under the same roof) and normally taking food from the same kitchen. In the FAS-PARI surveys, we stick to this definition of household for the sake of comparability with official statistics.

Using household defined thus as the unit for estimation of income poses some challenges.

First, there often are members of a family who are not a part of a household (because they do not live in the same house/eat from the same kitchen as rest of the family) but contribute substantially to the income of the household. In some cases, such contributions can be treated as remittances. However, this can be inaccurate in some other cases. Take the example of a member of a household who worked as a truck driver. This person did not normally live in the same house or normally eat from the same kitchen as he was mostly on the road. But the person was not part of any other household either and, in fact, contributed all income over and above what he consumed while working towards maintenance of this household. The question is whether such a person should be considered as part of this household and his entire earnings as income of this household or whether such a person should be considered not a part of this household, and his contribution be treated as remittances? In FAS-PARI surveys, we include the truck driver (who was mostly on the road) as a household member and his entire earning are included in income of the household.

Secondly, there are many cases where more than one household jointly undertakes an economic activity. One often encounters a situation where an extended family is not fully partitioned and, although members of this family normally eat from two or more different kitchens, their economic activities are carried out together. In such cases, division of income between such households becomes arbitrary.

In FAS-PARI surveys, we have decided to treat such households as joint households rather than attempting to divide their assets and income on some pre-determined (and often arbitrary) criteria. A joint household is defined as one whose members generally belong to the same family, live together in the same building or group of buildings, carry same production tasks together and jointly own a substantial part of their assets. In a joint household, the individual nuclear families do not eat from a common kitchen. We have decided to treat such households as joint households rather than attempting to divide their assets and income on some pre-determined (and often arbitrary) bases.

It may be noted that all data are collected during the survey for individual or single households. In the survey, investigators write detailed notes if the household shares assets with another household or if they cultivate their land jointly with another household. At the stage of data entry, these households are combined into a joint household, and data are entered for the two as a single economic unit. For such households, notes are written when some information pertains to a specific nuclear family within the joint household rather than the entire household.

### *1.3 The period of measurement*

Given that income is a flow variable, it has to be estimated for a uniformly specified period. In contrast, stock variables – like assets or debt – are valued at a specified instant (for example, at the time of the survey).

For the most important rural economic activities, there tends to be an annual production cycle. It would, therefore, be reasonable to estimate income for a period of one year. Since agriculture is the most

important economic activity in rural areas, it is useful to take a full agricultural year as the reference period for estimation of income from crop production.

The FAS-PARI surveys are conducted soon after an agricultural year ends. Data on agricultural activities in these surveys are collected for the agricultural year preceding the survey. On other activities, data are collected for a year prior to the date of the survey. Accordingly, all incomes are calculated for one year.

It may, however, be noted that estimation of income for a period of one year becomes problematic when the production cycle is longer than a year or when the returns from some investment made at a point of time are obtained for more than one year. This happens, for example, for perennial tree crops, ratoon crops, and for other crops whose crop-cycle is longer than a year. There are also corresponding parallels in non-agricultural activities. There could also be specific short duration crops that are sown at a time such that they are not harvested within the same agricultural year. In PARI surveys, each of these cases is handled separately.

When the crop production cycle (for example, for sugarcane) is longer than a year, we first estimate the gross value of output and cost of production for the whole production cycle (say 14 months). After that the gross value of output and cost of production are annualized for 12 months. The estimated income is the annualized net income. Similar problems arise in calculation of income from trees. This is discussed in section 3.3.

#### *1.4 Interconnectedness of different activities*

Another problem to be dealt with in calculation of household income is that different economic activities of households are inter-related. There are two common types of inter-linkages.

##### *1.4.1 Products of one activity used as input in another*

The first type of inter-linkage is where products from one economic activity are used as an input in another economic activity. For some of these commodities, only very thin markets exist and prices in such markets do not truly reflect the value that the households assign to such products.

The two most common cases of such inter-linkages are:

- Use of crop by-products as fodder for maintaining farm animals
- Use of dung obtained from animals as manure on land

It may be noted that these items enter as output in one economic activity and as cost in the other. In case of households which use all the straw as fodder in the same year, an exactly same amount is entered as value of straw in output of crop production and as value of home produced fodder in the cost accounts of animal husbandry. Similarly, for households that use all the dung as manure within the same year, an exactly equal amount is entered in the value of by-products of animal husbandry and in the value of home produced manure in the cost accounts of crop husbandry. For such households, these entries are cancelled out in the overall household income balance and therefore the prices used for these commodities do not affect the overall household income. The prices used, however, do influence income from individual economic activities. For households that do not use these commodities entirely within the same year, the values do not cancel out even across activities. This is common in villages where rabi crops like wheat are the major source of dry straw. In such villages, wheat straw produced from the rabi crop of the previous agricultural year is used as fodder during the next year.

##### *1.4.2 Common inputs and joint costs*

The second type of inter-linkage arises when a particular input is shared by multiple activities.

For example, a farm servant may be used for agricultural tasks as well as for tending cattle. In such a case, wages paid to the farm servant have to be divided between crop and animal husbandry.

Similarly, bullocks and tractors may be used for draught power for agricultural tasks as well as for transporting miscellaneous commodities including fodder.

In the context of farm business incomes, there are two types of joint costs. First, interest and depreciation costs of fixed capital are common to all crops and therefore have to be divided between individual crops. Secondly, almost all items of costs (other than seeds and costs of labour used for a few specific operations) are shared in case of inter-crops and mixed crops (Surjit, 2008).

#### *1.5 Valuation of own labour and capital*

It is important to flag the issue of valuation of family labour and capital (land and other) owned by the household. This issue has been discussed at length in both the documents of the Farm Management Studies as well as the CCPC Scheme. The two Review committees of the CCPC Scheme have also dealt with these issues at length. Detailed reviews of discussion of these issues in the context of the Farm Management Studies and the CCPC Scheme can be seen in Sen and Bhatia (2004) and Surjit (2008).

In the FAS-PARI estimates of income, we do not impute cost of family labour, rental value of owned land, or rental value of owned non-land capital. For estimating income from crop production, we calculate net income over Cost A2. Similarly, cost of family labour and rental value of own capital are not imputed in estimation of income from other sources either. (However, we do collect data on crop-wise use of family labour, extent of land owned and value of non-land capital.)

#### *1.6 Assets and incomes*

Cash flows from sale of assets or from borrowings should not be treated as income. Sale of a physical asset merely means its conversion into a financial asset. The financial asset itself should not be treated as income.

Income from assets arises mainly on account of changes in value of productive assets. Appreciation/depreciation of productive assets has to be accounted for in estimation of income. This is particularly important in the case of animal resources and trees (discussed in sections 4.1 and 3.3 respectively). Also, if households (for example, traders) earn profit in the process of purchase and sale of goods, such profits should be treated as incomes.

#### *1.7 Determination of norms*

Norms are required to identify and correct mis-reporting, systematic errors in data collection, and interpolation of missing values. FAS has standard procedures to clean data prior to any analysis. The following procedures are adopted.

First, data on village-specific standards are collected either towards the end of the village survey itself or soon after. If the village-specific norms could not be collected during the survey itself, the same should be conducted soon to avoid changes in prices and loss of memory. These standards relate to

- a. Conversion of locally used units of measurement (such as land units, volumetric units used in reporting production) to standard units (acres in case of land, metric units in case of weights)
- b. Data on prices of various inputs and outputs from local markets



- c. Data on average yields for different crop and livestock varieties in the village

Data for fixing these norms are collected as part of the village schedule that is filled in the village through meetings with panchayat and other officials and focus group discussions. Data on some aspects, such as prices of inputs and crops, are also collected from providers of these inputs (for example, traders and cooperative societies) and buyers of produce (for example, regulated markets and private traders). In addition, simple median values from the household data are also calculated.

Secondly, the distribution of the variables used in calculation of incomes, such as production, prices, input application rates, is examined. Extreme values and systematic departures from norms beyond a reasonable range are corrected. The method for correcting errors in specific variable is discussed in detail in Sections that deal with such variables.

Thirdly, missing values are replaced by standard values.

## 2. Estimating Household Incomes in PARI

Incomes of households in the FAS-PARI villages are estimated separately for the following sources. The surveys used detailed modules on incomes from each of the sources. (The table or module numbers in the interview schedule corresponding to each source of income are mentioned in parenthesis). The sources of income estimated are the following:

Crop production (Table Numbers: 6A, 6B, 6C, 7.1, 7.2, 7.3, 7.4, 7.5, 9A, 9B, 10, 11, 12.1, 12.2, T1)

Animal resources (including rental income from animals) (Table: 18A, 18B, 18C, 18D, 9B)

Wage labour:

Agricultural labour (casual) (Table: 13)

Agricultural labour (long-term) (Table: 14)

Non-agricultural labour (casual) (Table: 15)

Non-agricultural labour (monthly/long-term) (Table: 15)

Salaried jobs (Table: 19B)

Government salaried jobs (Table: 19B)

Other salaried jobs (Table: 19B)

Business and trade (Table: 19A)

Money-lending (Table: 19B)

Income from savings in financial institutions and equity (Table: 19B)

Pensions and scholarships (Table: 19B)

Remittances and gifts (Table: 19B)

Rental income:

Rental income from agricultural land (Table: 5.1.2, 5.3.2)

Rental income from machinery (Table: 9A, 9B)

Rental income from other assets (Table: 19B: example, Rental income from shop or commercial place)

Artisanal work and work at traditional caste calling (Table: 19A)

Any other sources (19B)

In addition, special modules are inserted in specific villages where particular occupations were observed. Examples of such specific income generating activities are toddy tapping in Andhra Pradesh, and

sericulture in Karnataka.

In the following sections we describe in detail how income from each component is defined and measured.

### 3. Income from crop production

Crop incomes are calculated as gross value of output less paid out cost.

Net Income (from crop production) = GVO – Paid out cost

The net income is calculated separately for each crop. The total income from crop production is the sum of income from each crop.

The paid out cost broadly corresponds to Cost A2 of the Comprehensive Scheme of the Commission on Agricultural Costs and Prices (CAC). Cost A2 includes the following cost components (Sen and Bhatia, 2004)

Value of hired human labour  
Value of hired bullock labour  
Value of owned bullock labour  
Value of owned machinery  
Value of hired machinery  
Value of seed, home produced and purchased  
Value of insecticides and pesticides  
Value of manure, home produced and purchased  
Value of fertilisers  
Irrigation charges  
Taxes and Land revenue  
Miscellaneous expenses  
Rent paid for leased in land  
Interest on working capital  
Depreciation of implements and machinery

#### 3.1 Gross value of output

Gross value of output (or gross income) refers to value of total production. It includes total output consumed and sold. It includes value of main products as well as of by-products. Valuation of output is done separately for each crop. In the discussion that follows a distinction is made between the main product and the by-product. Main products refer to the main product for which the crop is grown. This would usually refer to grain or the fruit. By-product refers to the straw, plant bushes or other plant residue. In case of fodder crops, green fodder can be the main and only produce. If green fodder is used only for home consumption (for own animals), then the total cost of cultivation of green fodder is considered as total value of output.

##### 3.1.1 Valuation Main products

The total output of main product is valued at the reported price to obtain gross value of main product.

The total output reported is checked to remove errors and missing values. To correct for mis-reporting, the following measures are taken.

a) The yield per acre is derived for each crop.

- b) Box-plots of yield for each of these crops are derived. We identify the outliers.
- c) If specific reasons are observed for the extreme values then we retain them. Otherwise, we correct the extremely large values to  $Q3+1.5IQR$  and the extremely low values to  $Q1-1.5IQR$ . IQR refers to the inter-quartile range, Q3 and Q1 refer to third and first quartiles respectively.
- d) For missing observations, we impute the median value except for observations which have reported crop failure. Before arriving at this standard value we compare the median with the district average yield, CCPC data for the particular state, and data from village group discussions

For accuracy and eliminating probable mis-reporting in the data of crop prices, we analyse the distribution of reported prices. The reported sale price is compared with the trader price (obtained from the village schedule) and the minimum support price. It is normally expected that the difference between the median price and the trader price will be small (2-3 per cent). In such cases, the median price is used as the representative price. A large difference between these two prices will reflect either systematic errors in data reporting in the survey (in which case, trader prices should be used) or poor data collection from the trader. In case there are reasons to believe that trader prices are unreliable, the median price is used as the representative price. It is particularly important to ensure that traders have not reported MSP even when the actual price was lower than MSP or reported prices excluding handling charges/commissions.

In case the output is not sold, the median reported price is used to impute values. This standard price is usually the median price of the same crop reported in the data. In few villages we have also used the MSP to impute missing prices. This was done in Alabujanahalli village in Karnataka for ragi, since the number of households reporting sale was too small to compute the median price.

### *3.1.2 Valuation of By-products*

The outputs of by-products are most often reported in local units that are difficult to convert to standard units by weight. However, most villages have common local units. The quantity of by-products is subject to standard checks for systematic errors, and extreme values before deriving the value of by-products. For this, the distribution of the ratio of main product to by-product is obtained. A variation of 1.5 times above and below the median value is allowed. Households reporting extremely low or high production of by-product (in relation to the production of main product) are corrected to the floor ( $\text{Median} - 1.5 * \text{Median}$ ) and ceiling ( $\text{Median} + 1.5 * \text{Median}$ ) levels. Missing values are calculated using the median main product to by-product ratio and the reported amount of main product by the household.

Markets for by-products exist in most villages. The price of by-product is obtained from the reported sale price. For missing prices we use the median price.

By-products are most frequently used as fodder for own animals. Value of straw used as fodder for own animals is included in the gross value of agricultural production.

If the straw is used only for maintenance of own cattle, the same value has to be included in the cost of maintenance of cattle. In such a case, the net contribution of this to total household income should be zero. This, however, may not be true in all cases. In particular, following situations may arise.

1. The household has used straw stored from the previous year for maintenance of livestock. In such a case, value of homegrown straw in estimation of cost of maintenance of animal resources may be more than the value of homegrown straw in crop husbandry.
2. The household has kept straw stored produced this year for maintenance of livestock next year. In such

a case, value of homegrown straw in estimation of cost of maintenance of animal resources may be less than the value of homegrown straw in crop husbandry.

### *3.2 Estimation of components of cost of cultivation*

#### *3.2.1 Cost of seeds*

Cost of seeds is the product of quantity of seeds used (purchased and home produced) and price of seeds. There can be large variations in the actual amount of seeds cultivators sow while preparing the nursery. These could also differ widely from recommended seed rate for the crop in the region. These variations in seed rate could be because field conditions require higher or lower seed application rate or because, given the farming practices, the germination percentage is low. In view of this, the seed application rates are allowed to vary over a considerably large range. The seed rates are corrected for upward bias only.

We prepare a box-plot for seed use per acre for each crop. The observations below  $Q1 - 1.5$  times the inter-quartile range (IQR) are retained as it is whereas the observations above  $Q3 + 1.5$  IQR are standardized to the ceiling value provided no specific reason for such a high seed rate is provided ( $Q1$  and  $Q3$  are the first and third quartiles respectively). The ceiling value is  $Q3 + 1.5$  IQR.<sup>1</sup>

Seeds are valued at reported prices. In the survey questionnaire, respondents are asked to report prices of home produced and purchased seeds separately. Missing values are replaced by median price. Error corrections are done for seed prices, and extremely low and high reported values are replaced by floor and ceiling values. Extremely high and low observations are identified using box-plots. If specific reasons are reported for the extreme values then we retain the values. Otherwise, we standardize the extremely large values to  $Q3 + 1.5$  IQR and the extremely low values to  $Q1 - 1.5$  IQR.

If a household has had excessive production of seedlings (paddy or other crops) and has sold it, these should be deducted from the amount of seed used, and treated as a separate item of income from crop production. Such information is reported in Tables 6B and 6C of the interview schedule at the time of data collection.

#### *3.2.2 Cost of manure*

Households use home produced or purchased manure. In both cases, there can be large variations in reported prices of manure because of variations in quality of manure, the units in which it is purchased (baskets, carts or tractors) and the transportation costs. In view of this, reported prices are used to value manure. Only the obviously low and high values are to be corrected using  $Q1 - 1.5$  IQR and  $Q3 + 1.5$  IQR values respectively. For missing observations, we use the median price.

If all the dung produced by animals owned by the household is used as home-produced manure, exactly the same amount has to be included in the cost of agricultural production and in the income from animal resources. In sum, this should not affect overall household income.

If, however, all the dung is not used by the household as manure (it may be stocked for use in the next year, it may be sold, or it may be used for some other purpose such as fuel), the entry in gross income from animal resources will be higher than the entry in cost of home produced manure.

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<sup>1</sup> Inter quartile range refers to the difference between the third and first quartiles.  $IQR = Q3 - Q1$ .

Often households use manure stocked from previous years, that is, the home produced manure is stored for a few years and then applied. In such cases, we annualize the cost of manure, depending on the frequency of manure application. For example, if the household applies manure once in three years, the cost of manure used is the total reported cost divided by three.

### *3.2.3 Cost of fertilizers*

Information on the quantity and price of each type of fertilizer used by the household for each crop is collected in the PARI survey (Table: 7.2). Total expenditure on fertilizers incurred by the household for each crop is calculated using this information.

It is expected that there will be large variations in application of different fertilisers across crops and households. We calculate per acre value of fertiliser applied and examine its distribution for each crop. Box plots are used as a guide to identify outliers and the permissible range of variation. Data on these outliers are examined carefully. For example, in some cases, investigators may have recorded that the respondent was over-reporting costs. Fertiliser use data for individual fertilisers are corrected in case of extreme outliers/observations where investigators have clearly recorded over-reporting.

Fertiliser prices generally vary within a very close band (within 10 per cent of median) for most households. In a few cases, respondents seem to get confused about prices of different fertilisers. For example, DAP price is reported for urea or the other way around. In such cases, the variation between reported prices and market prices is huge (like, 100 per cent). Such cases are few and easily identifiable. For these observations, reported fertiliser prices are replaced with median values.

### *3.2.4 Cost of plant protection chemicals*

This includes total cost of plant protection chemicals incurred by the household. Cost of operation and maintenance of machinery used for spraying plant protection chemicals is included here. Maintenance cost should be divided according to the days and hours the machine is used in different crops.

There are large variations in the types and amount of pesticides used depending upon field conditions, nature of pest and disease infestation, level of awareness among cultivators and financial conditions of the cultivators. In view of this, as far as possible, reported pesticide costs are used directly for income calculation. On this variable, only minimal corrections are done.

For cleaning, where it is absolutely necessary, crop-wise box plots of per acre pesticide use are constructed, and extreme outliers are identified (beyond  $Q3 \pm 3 IQR$ ). Then the specific schedules are checked for explanations of why pesticide use was so high. Only in cases where no clear explanation is given, data should be changed to the median to bring the pesticide use within the permissible range ( $Q3 \pm 3IQR$ ).

### *3.2.5 Cost of irrigation.*

Cost of irrigation includes tax payments for water, cost of water purchased from public agencies or private water sellers, and cost of fuel for running own irrigation equipment.

Cost of maintenance of irrigation equipment is also included in cost of irrigation. These may include crop-specific costs (for example, fuel consumption) or annual costs (for example, annual electricity charges or annual maintenance). Annual costs are divided across irrigated crops in the ratio of gross value of output of such crops.

Maintenance costs that are long-term costs (major maintenance expenses incurred once in a few years) are

annualised depending on the frequency with which such expenses have to be incurred.

### *3.2.6 Cost of hired labour*

Hired workers in some cases may bring with them implements, bullocks, ploughs and other means of production. Wages paid to such workers may be higher and may include, implicitly, the rental value of these means of production. We will not separate such implicit rental value of means of production and entire wage payments will be accounted for as payment towards hired human labour.

#### *Casual labour*

Cost of hired casual workers includes total wages paid to all daily and piece-rated workers hired for various agricultural operations.

In some villages, a part or total wage payment is done in kind. Kind wages for agricultural casual labour are valued on the basis of type of kind wages. Three types of kind payments are found in the PARI database: a) cooked food b) alcohol and c) share or fixed quantity of agricultural produce.

A standard valuation for cooked food component of wage is done for each village, depending on the quality and quantity of food received. Information is collected in the second round surveys to arrive at such standard rates.

Alcohol is valued at market prices during the survey year. This information is also collected in the second round.

Wages disbursed as agricultural produce are valued at standard commodity prices derived from village data (same prices that are used to value GVO).

#### *Long-term workers*

Long-term workers can be hired for specific tasks or may be multi-purpose workers. Multi-purpose workers may work in multiple activities like crop husbandry, animal husbandry, domestic work, as well as non-agricultural economic activities at the employer's household. Of these, working in crop and animal husbandry is most common. Specialised workers, on the other hand, may be hired for driving tractor, for tending cattle, for specialised agricultural tasks (such as irrigation workers or gardeners in grape fields), or for specific non-agricultural tasks (collection of rent, working in businesses) on a long-term basis.

The cost of hiring long-term workers is divided across different economic activities and across different crops when incomes are calculated. We divide payments to long-term workers across various economic activities that they participated in proportion to the gross income from these activities. The share that is allocated to crop husbandry will then be further divided across crops in proportion to the days of deployment of long-term workers in different crops as reported in the table on labour use (Table: 11) of the household schedule. If crop-wise labour deployment of long-term workers is not available, then the contribution of long term workers to different crops is based on share of each crop in total GVO.

The practice of payment of part of the wages in kind is commonly observed in PARI villages. Kind payments are mostly in terms of food, clothing and agricultural produce. Village specific standardized rates are used to value kind payments to long-term workers. Information regarding such payments are collected in the second round surveys (see, also, sub-section on kind payments for casual workers).

### *Animal labour*

This includes cost of maintenance of owned animal labour and rental payments for rented animals (excluding cases where the animals are brought by a hired worker). As mentioned earlier, in case the rental payment is implicitly included in the wages of human labour, the same will not be accounted for as animal labour.

Maintenance cost of owned draught animals includes share in common costs like home grown and purchased fodder, veterinary charges, maintenance of buildings, labour costs, and depreciation. In some cases, purchased processed feed (branded cattle feed, oilcake, oilseeds, and other such additives) is used only for milch cattle. If so, it should be accounted only in cost of maintenance of milch cattle.

In most villages, draught animals are used primarily in agriculture for tasks like land preparation and threshing as well as for transporting agricultural inputs and produce. Draught animals are also used for transporting fodder and other materials required for animal husbandry. Draught animals may also be used, in some villages more than in others, for transporting consumption goods or for human transport.

In villages where draught animals are primarily used in agriculture, the entire maintenance cost of bullocks is recorded as cost of animal labour in crop production.

In cases (villages or individual households for which we may have information) where agricultural tasks like land preparation are done entirely by machines but households keep one or two draught animals primarily for transporting fodder, the entire maintenance cost of bullocks will be recorded as a cost in animal husbandry.

We also incorporate income from appreciation of value of animals, and correspondingly, depreciation of animals as a cost of animal husbandry. Valuation of depreciation of adult bovines would be relevant to cost of maintenance of owned draught animals. All issues relating to cost of maintenance of animals are discussed in detail in Section 4.

### *Cost of machine labour*

Machines include all mechanical devices that transmit force, and in the process, alter its magnitude and/or direction. All attachments that are used exclusively with specific machines (for example different types of ploughs used with tractors) are counted as farm machinery. Simple farm implements, however, are not included in farm machinery. Cost of operation and maintenance of irrigation machinery and machinery for spraying plant protection chemicals are not included here.

Cost of machine labour will include operation and maintenance cost of owned machinery and rental payments for hired machinery. In case of costs of operation and maintenance that are common to multiple crops, these costs will be divided across these crops in the ratio of area under these crops. In case of inter-crops the costs are divided in the ratio of GVO of each crop. If machinery is rented out then cost of maintenance is divided as between crop production and rental income.

### *3.2.7 Rent*

The details of all rental payments on land, in cash and kind, are recorded in the questionnaire (Table: 5.1.1, 5.3.1). Rents can be paid for a single season, or for a whole year. In case only one crop is cultivated on leased land, the total rent is accounted as cost for the specific crop. In case multiple crops are grown on leased land, at the time of analysis of data, rent paid is divided across different crops cultivated on leased

land in ratio of gross value of output of those crops.

### *3.2.8 Marketing expenses*

Marketing expenses mainly include cost of transportation to the market but may also include other expenses related to marketing of the produce (such as taxes paid in regulated markets).

This is a departure from the CACP method. CACP (and the two review committees) have argued that CACP should estimate the cost of production on the farm and therefore cost of transportation to the market is not included.

While we are interested in a CACP-consistent estimate of cost of cultivation, our estimation of household incomes should account for expenses the household has incurred in transporting the produce to the market.

For several reasons, it is better to handle these costs separately rather than include them either in "Other costs" or net them from value of output. For one, that way we can include and exclude them as per our need. Also, having it as a separate column will help us be more consistent in handling these costs across the households.

### *3.2.9 Crop insurance*

Any premium reportedly paid towards crop insurance is accounted for in this item.

### *3.2.10 Taxes*

Land revenue and any crop-specific taxes other than irrigation cess that the household may have paid are included here. In case of taxes that are not crop-specific, the amount is divided across crops in proportion to the gross value of output of each crop.

### *3.2.11 Other crop-specific costs*

Any other crop-specific costs not accounted so far are included here.

### *3.2.12 Interest on working capital*

CACP calculates interest payment on all working capital at 12.5 per cent per annum interest rate for half the duration of the crop. Working capital includes total expense incurred on seeds, manure, fertilisers, plant protection, and hired labour. The logic for using half of crop duration for calculation of interest is as follows. CACP calculates crop-wise profitability valued at the end of the crop season. Since expenses are incurred at different points of time in the crop season, interest cost should be calculated from the time a particular expense is incurred until the end of the crop season. As details are not available on when each item of expenditure is incurred, CACP assumes that, on average, interest could be calculated for half the duration of the crop. While such an assumption, obviously, introduces an element of inaccuracy and arbitrariness, it has the advantage of simplicity.

Strictly speaking, interest costs (and, by the same logic, interest incomes) have to be handled differently depending on whether the objective is to calculate crop-wise profitability (as done by CACP) or to calculate annual household income. In case of calculation of household income, estimates pertain to the whole year and valuation of income is not done at any specific point of time within the year. That is, we are not saying income as valued at the end of the agricultural year (unlike, crop profitability, which is valued at the end of a crop season). If we were valuing income at a particular reference point of time (say, end of agricultural year) we would have to impute an interest cost on all working capital (in agricultural and non-agricultural



activities) and impute an interest income from all cash flows (agricultural and non-agricultural) from the time in the year when costs/cash flows take place until the reference point (end of the agricultural season). This is frightfully complicated. It can be important in some specific contexts but may not have great value for the village as a whole.

In view of comparability with the CACP methodology, we follow the methodology used by CACP for calculation of interest costs. Accordingly, the interest is calculated on all crop-specific expenses for half the duration of crop at the rate of 12.5 per cent per annum. It should be noted that interest cost is calculated on entire working capital irrespective of how much of it was actually borrowed.

### 3.2.13 Depreciation

Depreciation of farm assets is calculated to derive the present value of those assets in subsequent years. Following formula is being used to calculate depreciation.

Annual depreciation = (Present value of the asset - salvage value)/Remaining life

Working formula:

Annual depreciation = (Present value - salvage rate \* present value) / (Total life - age)  
 = {OP(1-r<sup>l</sup>)(1-s)} / (L-l)

Where OP= original price, r= rate of discount, l= age, s= salvage value (percentage of present value) , L= Total life

Item wise rate of depreciation, used for calculating annual depreciation

Item name	Total life in years	Rate of depreciation	Salvage rate
Bullock cart	5	20%	20%
Cage wheel	20	5%	10%
Combine harvester	20	5%	10%
Disc plough	10	10%	10%
Furrow maker	5	20%	20%
Generator	10	10%	10%
Leveller	5	20%	20%
Other equipment	5	20%	20%
Plough	5	20%	20%
Power tiller	10	10%	10%
Pump (diesel and electric)	10	10%	10%
Rotavator	10	10%	10%
Seed drill	10	10%	10%
Sowing machine	10	10%	10%

Sprayer (back mounted)	5	20%	20%
Sprayer (used with tractor)	10	10%	10%
Sprinklers and pipes	10	10%	10%
Straw reaper	10	10%	10%
Thresher (manual)	5	20%	20%
Thresher (with motor)	10	10%	10%
Tractor/Tractor accessories/Tractor trolley	20	5%	10%
Other tractor accessories(used for cultivation)	10	10%	10%
Tubewell and accessories	20	5%	10%

### 3.2.14 Maintenance of other equipment

Maintenance cost of all implements not included in machinery is recorded here. Maintenance costs are apportioned across crops in proportion to GVO.

### 3.2.15 Other annual costs

These include other annual costs not included in any of the components above and that are incurred by the household periodically. Some examples of such costs may be costs of land improvement, soil testing etc. Costs such as electricity charges for irrigation, maintenance of irrigation and other machinery are also reported as annual costs in Table number-10 in the FAS PARI schedule. However, at the time of income calculation, the costs are apportioned to specific crops. Certain crop-specific costs, like crop insurance for potato, or sticks used for tomato cultivation, that are not reported in Table 7.1.1 onwards, are shown in Table: 10.

Annual expenses related to irrigation (electricity charges, maintenance of irrigation equipment) should be apportioned across crops under the head of irrigation itself. As described in Section 3.6, expenditure on irrigation is divided across irrigated crops proportionately to gross value of output.

Annual expenses related to machine labour (maintenance of machinery) are apportioned across crops under the head of machine labour itself (see Section 3.2.7). In case of machines that are also rented out, due care should be taken to first apportion the share across multiple activities (crop production and renting, for example). In case of substantial one-time maintenance expenses, due care should be taken to annualise expenses.

For other types of annual costs, the costs are apportioned according to gross value of output across crops.

### 3.3 Income from trees

In case of trees, we have faced two types of situations. In the first case, non-timber products from trees, such as leaves, fruits, or stems are used by households. Some examples are use of Khejri and Adu leaves as fodder and firewood in Sikar in Rajasthan, arecanut, mango and bamboo in West Bengal, coconut in Andhra Pradesh and Karnataka. In case of such products, incomes are calculated in the same way as crop incomes. The gross value of product is calculated based on the total annual production and market price. All paid out costs are also calculated. The net income is the gross value of output less the cost of production. So far we have calculated the income from perennial trees in Rewasi (khejri and Aadu trees), Alabujanahalli (eucalyptus and silver oak trees), Siresandra (eucalyptus and silver oak trees) and West Bengal (arecanut, mango, bamboo etc.). But, the methodology for calculating income from trees is case-

specific.

In case the trees are used for timber, as in the case of eucalyptus and silver oak trees in Karnataka, an appreciation value of timber (by weight) is used as imputed annual income from the tree. The rate of appreciation applied according to the age of the trees for eucalyptus is given below.

<b>Eucalyptus tree</b>		
<b>Age</b>	<b>Weight (kg)</b>	<b>Rate of Appreciation in value to be applied</b>
1 year	1.5-2	50%
2 years	5	50%
3 years	10	20%
4 years	15-20	20%
5 years	20-25	20%
6 years and above	40	10%

In case the household reported sale of timber, only the annualized appreciated value at the selling price is considered as income. The total income from sale is not used as there is a long gestation period for production of timber.

In Siresandra village five households owned silver oak trees. The age or value of trees was not reported nor were there any sales. In such cases of incomplete information, FAS makes the assumption that the tree weighs 20 kg on average and a flat 20 percent appreciation in value is applied. The valuation is done at market price for timber of the specific tree

#### **4. Income from Animal Resources**

Gross income from animal resources includes value of all animal products (milk, dung, eggs, poultry/ovines for meat, wool, and any other animal product) plus the capital gains from appreciation of value of young bovines and ovines.

##### *4.1 Gross value of output*

The gross income is calculated from information on total output and market prices. Gross income includes value of output sold and consumed.

For each village, mean quantity of animal products (milk, dung, eggs etc.) are calculated from the distribution of the reported data. Information on the maximum and minimum production of animal product from each type and variety of animal in the village is collected from the village. Very high and low reported values are replaced by these maximum and minimum values. Missing values are replaced by the median.

Corrections are also made to variations in prices of animal products. The distributions of reported prices for each type of animal product are examined. Extremely low values (those below  $Q1 - 1.5IQR$ ) are replaced by median prices. Extremely high values (those above  $Q3 + 1.5IQR$ ) are replaced by  $Q3 + 1.5IQR$ . Missing values are replaced with the median price obtained from the distribution.

In our estimates of gross value of output from animal resources, we need to incorporate capital gains on

account of appreciation of value of young bovines and ovines. A household may, for example, rear animals (bovine calves or ovines) and sell them when their values have appreciated. Correspondingly, we also need to account for depreciation in value of adult animals. Over the years, as animals age, their value depreciates and the households have to spend on buying new animals. Depreciation in value has to be accounted as part of the cost of maintenance of animals.

CACP estimates depreciation of animal resources using age of animals. For PARI villages, appreciation and depreciation in value of different types of calves and adult animals were calculated on the basis of their reported value. The appreciation and depreciation rates of different types of animals are given in the following table.

Name	Age Group	Appreciation	Depreciation
Goat	0-1 (Kid)	100%	No
Goat	Above 1 (Adult)	50%	No
Cattle	0-1 (Calf)	100%	No
Cattle	1-3 (Calf)	50%	No
Cattle	Above 3 (Adult)	0%	No
Duck/Hen/ Chicken/chicks	All	100%	No

#### 4.2 Cost of maintenance of animals

The following expenses are included in estimating cost of animal husbandry:

- Cost of fodder/feed,
- Veterinary charges,
- Cost of maintenance of buildings,
- Rent of land leased for animal husbandry,
- Insurance,
- Cost of labour hired for animal husbandry,

As mentioned in section 3.2.7, if draught animals are used by the households for crop cultivation then we separate the cost of maintenance of owned draught animal and this cost is included in animal labour cost for calculation of incomes from crop production. The total maintenance cost is apportioned across crops in proportion of extent of land under each crop.

If the animals are not used in cultivation, the maintenance costs are included in estimation of incomes from animal husbandry. If animals are used for both, the total costs are divided in the ratio of GVO from the two sources.

The major cost of animal production is on feed and fodder. We use some procedures to impute missing values for feed requirements and check the variability in reported data on cost of fodder.

For each village and each type of animal we collect information on the maximum and minimum fodder/feed requirements in group discussions or from key informants. Extremely low and high reported values are adjusted using these minimum and maximum values. Missing values are replaced by median value depending on age and animal breed.

Price of fodder and feed are corrected on the basis of the distribution of reported prices. Outliers are replaced by floor and ceiling values ( $Q1-1.5IQR$  and  $Q3+1.5IQR$ ). Missing values are replaced by median values.

Often crop main and by-products are used as fodder. Such homegrown fodder is valued at prices reported in the crop production table.

In most cases, labour used for animal husbandry is provided by family workers or multi-purpose long-term workers. Costs of multi-purpose long-term workers who participate in animal husbandry are divided across activities in proportion to gross value of output from these activities.

Data on some of the items of costs are provided jointly for all animals. We enter these as joint costs.

## **5. Income from Wage Labour**

Income from wage labour is obtained from the wage rate and duration of employment in each kind of wage work done by each member of the household. Wage income can be in cash or kind or both. Travel and other expenses are not deducted from wage income. Income from wage labour is divided into four categories. Information is recorded separately for each member of the household.

### *5.1 Income from casual agricultural labour*

This includes total wage earnings of members of household from working as casual workers in agriculture. We record both the total days of employment and the total earnings of each worker in the household over the reference year.

### *5.2 Income from long-term agricultural labour*

This includes total wage earnings of members of household who worked in agriculture under long-term wage contracts. For long-term workers we record only the total earnings over the reference year.

### *5.3 Income from casual non-agricultural labour*

This includes total wage earnings of members of household from working as casual workers in non-agricultural occupations, including casual labour done for public wage employment programmes. We record for each worker, both the total days of employment and total earnings over the reference year.

### *5.4 Income from salaried non-agricultural labour*

This includes total wage earnings of members of household from working on salaried manual non-agricultural occupations. These include occupations in which substantial manual labour is involved although the worker may work with machines. Blue-collar/non-manual jobs (for example, clerks and teachers) are not included here. We record, for each worker, the description of work and total earnings over the reference year.

## **6. Income from other sources**

All sources of income other than crop husbandry, animal husbandry and manual wage labour are accounted for in this section. Information is recorded for each worker separately. In case, income did not accrue to any particular individual, record "Household" under name of worker.

### *6.1 Salaried employment*

This includes income from all non-agricultural salaried jobs. For each worker, we record the description of

work, whether it is a government or a private job, and total earnings over the reference year.

### *6.2 Business and trade*

This includes income from all non-farm business activities. For each activity, we record a brief description and total earnings over the reference year. Total earnings from business and trade are net of all costs incurred.

### *6.3 Moneylending*

Any incomes from moneylending, if reported, are included here.

### *6.4 Income from savings in formal financial institutions and investments in equity*

In general, data on financial savings and investments are not collected. However, in some cases, particularly those where such savings and investments are the primary source of household income, the information may have been recorded by the investigators. If the household has reported any income from savings in formal financial institutions and investments in equity, these are accounted in total household income.

### *6.5 Pensions, scholarships and insurance claims*

All incomes in the form of pensions, scholarships and any insurance claims during the reference year are recorded and included in household income.

### *6.6 Remittances*

All inflows of remittances over the reference year are recorded and included in household income. Outflows of remittances are not accounted.

### *6.7 Rental income*

*6.7.1 Rental income from agricultural land.* All cash rents and value of kind rents received from leasing out of agricultural land during the reference year are included as rental income.

*6.7.2 Rental income from animals.* If animals owned by the household were rented out during the reference year, the rental income should be recorded here.

*6.7.3 Rental income from machinery.* Households often rent out machinery used for agricultural production, such as tubewell with pump, tractor and tractor accessories, power tiller, combine harvester, thresher, bullock cart and power sprayer. Income from renting out machinery, including sale of groundwater from borewells and tubewells are reported in Tables 9A and 9B in the FAS household schedule.

In calculating net rental incomes from machinery, any cost incurred by households (such as diesel costs, cost of labour hired for operating machines, repair and maintenance costs) are deducted from gross rent received.

To check for errors and mis-reporting, rental incomes are cross-checked with reported per-unit rents for similar machinery in the village. Such data are available from households in the village who hire in machinery for agricultural production. Missing values (households who have reported renting out machinery but have not reported net rental earnings) are replaced by median rental incomes from similar machinery reported in the village.

*6.7.4 Other rental income.* Any other rental income, for example from leasing of houses and other buildings,

are recorded here.

### 6.8 Artisanal work and work at traditional caste calling

Income from artisanal and caste-related activities during the reference period is included in total household income.

Total Household Income is the sum total of all income sources described in sections 2 to 6.

## 7. Summary

1. Total Household Income = Income from crop production + Income from Animal Resources + Income from wage labour + Income from salaried employment + Income from business and trade + Income from money lending + Income from savings in formal financial institutions and investments in equity + Pensions, scholarships and insurance claims + Remittances + Rental income + Artisanal work and work at traditional caste calling + Income from any other source

2. Income from crop production = (Gross Value of output – Paid out cost) + (Income from tree crops)

2a. Gross value of output = Output of main product X Price of main product + Output of byproduct X Price of by product

2b. Paid out cost = Cost of (seed + manure + fertilizers + plant protection chemicals + irrigation + hired labour + animal labour (hired + own) + machine labour (hired + own)) + rent on agricultural land + marketing expenses + crop insurance + taxes + other crop specific expenses + interest on working capital + depreciation of owned machinery + maintenance of other equipments + other annual expenses

2c. Income from tree crops = Gross value of output – Paid out costs + Annual Appreciation Value of timber (only for trees that are used for sale of timber)

3. Income from animal resources = Gross value of output – Cost of maintenance of animals

3a. Gross value of output = Output of animal product X Price + Annualized appreciation/depreciation value of animal

3b. Cost of maintenance of animal = Cost of feed and fodder + Veterinary charges + cost of maintenance of buildings + rent on land leased in for animal husbandry + insurance + labour hired for animal husbandry

4. Income from wage labour = total wages from agricultural wage employment (casual and long term) + total wages from non-agricultural wage employment (casual and long term)

5. Rental income = rental income from (agricultural land + animal + machinery + other)

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