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# **Concepts and Methods for Estimating Incomes in Village Studies in Semi-Arid Tropical India**

**R.P. Singh and M. Asokan**



**ICRISAT**

**International Crops Research Institute for the Semi-Arid Tropics  
ICRISAT Patancheru P.O.  
Andhra Pradesh 502 324, India**

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# CONCEPTS AND METHODS FOR ESTIMATING INCOMES IN VILLAGE STUDIES IN SEMI-ARID TROPICAL INDIA

R.P. Singh and M. Asokan<sup>†</sup>

The level of rural income is probably the single most important barometer of the impact of new technologies on agricultural development and on the rural welfare. At the same time fluctuations in and the composition of rural income and wealth largely condition the pace of technical change and agricultural development. This paper spells out the concepts and methods used to estimate income in the Semi-Arid Tropics (SAT) of India with information from the ICRISAT Village Level Studies (VLS). These estimates are the building blocks for income analysis in the VLS.

The paper is divided into three sections. The conceptual framework for income estimation is broadly outlined in the first part of the paper. Specific problems encountered in rural income estimation in SAT India are discussed in the second section. These include measurement problems arising from incomplete markets, complex institutional arrangements, and ambiguities in enterprise accounting, particularly for intercropping. The valuation of crop and livestock inputs and outputs is treated in the last section.

## INCOME CONCEPTS

The term income is often used interchangeably with revenues, receipts, sales, earnings, benefits, and profits. Each of these terms has a different connotation. Various definitions have been used for 'farm income' (Hayami 1978, Singh 1977, Singh 1979, Ban 1980, Dillon and Hardaker 1980). It has been interpreted as (1) the gross value of all goods produced on the farm whether sold for cash or not; (2) cash received from the sale of goods produced on the farm; (3) the net receipts from sales of produce after deducting the expenses for inputs such as seed, feed, and fertilizer; (4) the profit for an enterprise; and (5) the profit for the farm as a whole.

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<sup>†</sup>Economist and Research Technician, respectively, Economics Program, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh 502 324, India. The authors are thankful to J.G. Ryan, T.S. Walker, H.P. Binswanger, D. Jha, and N.S. Jodha for their valuable comments and suggestions.

## Household Income

Gross household income includes income from farm and non-farm activities such as crops, livestock, renting out assets, labor, trade, handicrafts, and others. But it does not include capital gains or losses such as changes in the value of assets due to appreciation and loss of assets due to natural factors.

Net household income consists of net income from farming, net income from business other than farming, wage and salary earnings, remuneration, rentals, interest earnings, gifts and subsidies. In other words, household income is the sum of returns to productive factors owned by the farmer and transfer income received by the farm household during the accounting period. In our case, the accounting period is the agricultural year from July 1 to June 30.

## Gross Farm Income

Gross farm income includes returns from crops, livestock, and rents from hiring out agricultural assets including land. It reflects the total productivity of all the resources used on the farm. It is the value of the total output of the farm over the agricultural year and includes outputs that are sold, consumed by the household, used for seed or livestock feed, paid in kind, or held in inventory at the end of the agricultural year.

Gross farm income has three main components: (i) crop income, (ii) livestock income, and (iii) rental income. The value of main and byproducts comprise crop income, while the value of livestock products produced on the farm and the difference between the sales and purchases of stock are included as livestock income. The rents received from hiring out draft animals, land, implements, and machines make up rental income (Appendix A).

## Total Farm Expenses

All inputs except family labor used in farm production are included in farm expenses. An alternative term for total farm expenses is total farm costs, which can be divided into fixed (indirect) and variable (direct) costs.

Fixed costs are those farm expenses that do not vary with the volume of production, such as capital maintenance and depreciation. Variable costs are specific to a particular crop or livestock enterprise and vary more or less in direct proportion to the area or production of the particular enterprise, such as seeds, fertilizer, fuel, etc.

### Net Farm Income

The difference between gross farm income and total farm expenses (excluding rent paid for leased-in-land) plus overhead costs such as depreciation and land revenue, is net farm income. If the rent paid for leased-in-land and interest paid out on loans are also deducted from net farm income the residual is net farm (equity) income. Net farm income measures the reward to the farm family for their labor and management and the return on all the capital invested in the farm, whether borrowed or owned. To measure the reward or returns to different resources, we deduct their values from net farm income. After subtracting the imputed costs of capital, land, and family labor used in producing farm income, the residual value records the returns to management. Deducting only the interest paid for borrowed capital from net farm income gives the net return to family-owned resources (land, labor, capital, and management) used in farm production.

### Net Returns to Capital and Management

The return to farm capital indexes the return to the capital investment made by the farmer. Farmers often use both borrowed and owned (or equity) capital; therefore, it is better to calculate separately the return to total farm capital and to farm equity capital. The net return to total farm capital and management can be calculated by deducting the value of family labor used on all crops and livestock and capital maintenance (including family labor used on leased-in-land and the (value of) owned bullock time used in crop production) from net farm income, while the net return to farm equity capital, which represents the return to the family-owned share of farm assets, can be calculated as net farm income minus rent paid for leased-in-land, minus the value of family labor and the interest paid on borrowed capital. Farm equity capital is total farm capital net of farm borrowings, and is also known as net worth.

In semi-arid tropical areas of India, underemployment and unemployment are very common. Farmers may have few alternative investment opportunities. Thus the return to family labor is also a relevant farm income measure. It can be estimated by deducting imputed interest (12 to 18% per annum) on total farm capital from net farm income. This value can be divided by the number of active family workers over 6 years of age and by total number of family members to give income per worker and per caput, respectively.

### PROBLEMS IN INCOME ESTIMATION IN SAT INDIA

Farmers in SAT India have access to various sources of income. Since farmers do not maintain a record of day-to-day transactions it is difficult to verify income and expense data. Many village transactions are not

monetarized. The valuation of many of these transactions is arbitrary, and one has to use his own judgement to derive opportunity cost measures. Except for inputs such as fertilizer and pesticides, most other inputs used in farming are either home produced or acquired on an exchange or barter basis. The rates of interest for some of the basic inputs such as seed vary from person to person, depending upon the farmer's personal relation with the lender and on the social and economic status of the borrower. Similarly, for cash loans rates of interest depend upon the use of the loan and the repayment period.

Analysis of the net income from individual enterprises is quite complex, particularly where intercropping is common (Jodha 1979). A number of crops are often grown in a single plot and the correct allocation of different costs among individual crop enterprises becomes very difficult because the area occupied by a single crop cannot be determined with precision. There are some possible measures which can be used to find out approximate area covered by the individual crops in row or mixed intercropping systems. One is the estimation of area on the basis of the number of rows and area covered by each crop. Another measure is based on a seed rate for comparable sole crop stands. But in this case it is sometimes difficult to determine sole crop seed rates, particularly for those crops that are seldom planted as sole crop. In the case of mixed intercropping, where some of the crops are grown in definite proportions in rows but some minor crops are mixed with those crops in the same row, the assignment of area to individual crops is tenuous at best. For mixed intercropping where the seeds are mixed before sowing, the total area divided by the number of crops grown may give a very rough idea of the area covered by individual crops (Norman 1979). In this situation the seed rate criterion of sole crop can also be used in estimating the area under each crop. Nevertheless, there is no definite method by which the actual area under each crop can be measured in intercropping because it varies from plot to plot depending upon the farmer's practice. In the case of row intercropping we have used information on row spacing to allocate crop areas. For mixed intercropping, we have divided the total area by the number of crops to arrive at an estimate of the area under each crop.

The SAT areas suffer from erratic and low rainfall and irrigation is not adequately developed. Generally, few farmers enjoy well irrigation where water is available throughout the season. The exact number of irrigations or the quantity of water given to the crop cannot be accurately estimated. Farmers spend a few hours continuously for a long period of time irrigating the fields from the limited water available in the well. Therefore, it is not always possible to keep an accurate account of the labor and the fuel used for irrigation of a particular plot or crop. We considered the cost of fuel and labor spent for irrigation on the whole farm and then divided by irrigated cropped area to estimate plot-specific costs of irrigation.

Farmers purchase fertilizer during the agricultural year. They also resell inputs at prices different from the purchase price. For these cases it becomes difficult to estimate accurate values for inputs and outputs as the period of sale and purchase is spread throughout the year. If data are collected on a recall basis, some of these seasonal transactions may not be recorded.

For livestock, information on actual production of milk and sale of milk products is difficult to obtain because part of the produce is either consumed on-farm or transformed into final products and sold. Milk production varies from season to season and even from day to day; thus, production data collected on a monthly basis may be imprecise. It is only possible to collect data on the average level of milk production during the period of an investigation. What is not sold is assumed to be consumed by the household.

Information on the sale of dung, hides, and skins, particularly for those farmers who maintain livestock to support their farming activities, is also difficult to obtain. Households may earn income from the within-year purchase and sale of livestock. This income cannot be estimated from the asset schedule which is collected once a year. In this case, the difference in the sale and purchase prices of animals as recorded in VLS-L (transaction schedule) is considered as an income to the household (Binswanger and Jodha 1978).

The cost of maintenance of animals is also difficult to estimate. Data on the daily consumption of fodder and feed and on the labor time spent on the maintenance by own and hired resources are not available. In our income analysis, the difference in the stock of fodder between the beginning and ending inventory plus production, purchases and gifts, minus sales or gifts, has been assumed as consumed by the livestock. The average time spent for cattle maintenance and grazing has been separately estimated from the labor schedule (VLS-K). Because daily production data are nonavailable, cow dung production is estimated on an average annual basis.

The institutional arrangements in village markets are also complex and it is difficult to obtain accurate data on income from moneylending, trades, or handicrafts. In case of handicrafts, part of the resources are home produced; the remainder are purchased either from the market or from the village traders. Information on the informal credit market is particularly sensitive.

In the semi-arid tropics many farmers cultivate land on a leasehold basis. There are a myriad of complicated tenancy arrangements. The rent paid by the tenants as well as benefits received from the landlord have been adjusted to reflect the various tenancy contracts in the estimation of income.

In contrast, for comparing the land productivity of farms as an efficiency measure, benefits received by the landlord and rents paid by the tenants will not be adjusted in the analysis of crop income. The productivity of different types of tenancy arrangements will be analyzed separately to determine the ownership effect on the allocation of resources and productivity.

#### VALUATION OF INPUTS AND OUTPUTS

Farmers use inputs produced on their own farms and rely on the market for the rest. For purchased inputs the prices are known but own inputs should be evaluated on their opportunity costs, which are sometimes difficult to calculate. The procedures followed in estimating these costs are given below.

##### Seed

The value of seed, both home produced and purchased, has been estimated on the basis of the weighted annual average price taking into consideration varietal quality and the value of purchases by all VLS respondents in the village during the year of use. Since there were not many purchases at the time of sowing, it was felt that the actual price of seed at the time of sowing was not very accurate; therefore, the weighted annual average seed price was used for estimating the cost of both home-produced and purchased seeds.

##### Labor

The value of both hired and family labor was estimated on the basis of hourly wage rates available for males and females separately in the VLS-K labor schedule (Asokan, 1980). These were averages of the whole village. Similarly, the prevailing rental rates in the village were used to reflect the opportunity cost of bullock power.

##### Machinery

The actual rental charges for machines used on a hire basis have been calculated for each plot separately. For owned machinery, the average standard rate per hour in the village for electric motor and diesel pumpsets has been estimated considering the fuel and gasoline cost. To arrive at the total cost of owned machinery, the average standard rate has been multiplied by the number of hours used for each plot.

In SAT India, 5 and 3 horsepower electric motors and pumpsets are common. The charges estimated in the selected villages are as follows:

		Rs/hr
Aurepalle	5 HP (electric motor)	1.50
Dokur	5 HP "	1.50
Shirapur	5 HP "	1.50
Kalman	3 HP "	0.90
Kanzara	3 HP "	0.90
Kinkheda	3 HP "	0.90
	for 5 HP diesel pumpset	2.00

These estimates are based on the consumption of gasoline, oil, and electricity for running the motor/pump for an hour. Other costs have not been included. The labor charges for operating the pumpsets and motors are included in human labor use.

In addition to these charges, the government levies Rs. 2 per month per electric motor as a meter reading charge, plus a fixed charge of Rs. 120 per annum whether a farmer uses the electric motor or not. Thus Rs. 144 per annum has also been included as an overhead cost for those farmers who own an electric motor. For hiring in mechanical threshers 4% of the value of the main product is charged as the cost of threshing.

#### Fertilizers and Pesticides

In general there is no market for organic manure in the villages. The value of organic manure has been estimated from available information in the VLS-L transaction data file and from information given by the village investigators. For inorganic fertilizers and pesticides the per unit purchase price has been multiplied by the units used in that plot. The prices are village-specific and refer to annual averages.

#### Land Revenue and Taxes

Information regarding the revenue rate collected in the VLS-D plot schedule has been considered for estimating the value of rent for each plot. Other taxes have been viewed as other farm expenses and are assigned to the farm as a whole and not a particular plot. The practice of land being cultivated on a fixed lease or sharecrop basis varies from village to village and so do the charges. Rental values of leased-in and sharecropped land are based on information from the supplement to the plot schedule. In this schedule, details of different types on input and output sharing are available.

## Livestock Inputs

Data on livestock inputs have been compiled from the VLS-L transactions, VLS-K labor and VLS-N stock inventory schedules.

Fodder. The total quantity of fodder consumed by livestock has been estimated considering the stock of fodder at the start of the agricultural year plus fodder production, gifts, and purchases during the year, minus sales, gifts, and the inventory left at the end of the year. After making these adjustments, it is assumed that the residual amount was consumed by the livestock during the year.

Labor. Animals are taken care of mainly by family members, but in some cases hired laborers — either permanent servants or casual workers — are also used. Data on human labor spent for the maintenance of animals was obtained from the VLS-K labor schedule. In the case of family labor, the data regarding livestock maintenance are available for three years in all the villages (as activity codes in VLS-K). These data refer to the day before the interview; consequently, they had to be adjusted by multiplying the average daily time spent on animal husbandry by 365 days to obtain total labor hours allotted for the maintenance of livestock during the whole year. These annual totals were multiplied by the prevailing wage rates in the village to estimate the total value of male, female, and child labor for each household engaged in animal husbandry. In the VLS villages, cattle are frequently tended by family members who cannot perform hard work. While calculating labor costs for livestock maintenance 60, 50, and 40% of male, female and child wages were hence assumed.

## Crop Output

The values of main and byproducts have been estimated by taking the weighted average annual price available in the VLS-L transaction files. Because most of the farmers sell their produce at different times after harvest, prices vary a great deal. In order to reduce the price effect biased in favor of large producers, average annual prices weighted by the quantities sold have been used, rather than just the harvest price. The average prices cover total transactions of individual commodities for all farmers in the village.

## Livestock Output

The value of livestock output from milk, wool, and eggs, and the income from sale of small animals, poultry birds, sheep, and goats have been derived from the VLS-L transactions schedule. For cow dung production

the prevailing price in the village has been used. Dung production has been estimated by considering published sources such as the Fertilizer Association of India, (1975). Estimates of dung production are based on the average beginning and ending inventory of animals. It is possible that the number of livestock may change during the year so multiplying an average standard dung production by the average number of animals may not give a precise estimate.

#### Other Expenses

Other expenses, such as ropes and veterinary medicines, have been derived from the VLS-L transaction schedule.

#### Depreciation

For convenience, the straight line method of depreciation was used. This considers the salvage value and the productive life of the asset. The rates of depreciation for each item are given in Table 1. Depreciation on buildings is not estimated because we do not have separate data on the values of farm buildings.

Expenses for production capital maintenance have been obtained from the VLS-L transaction schedule. A detailed description of the income and expense items used for estimating total household income is given in Appendix B.

Table 1. Rates of depreciation for different assets

Asset items	Annual depreciation rates (%)
<u>Livestock</u>	
Cows, bullocks, buffaloes (over 3 years of age)	12
Horses, camels, donkeys	15
Goats, sheep, pigs	20
Poultry, birds, other small livestock	100
<u>Implements and Machinery</u>	
Plows (iron), modern seed drills, Persian wheels, modern harrows, sugarcane crushers, pumpsets, threshers, bullock carts, pipelines, other durable equipments	10
Plows (wooden), desi seed drills	25
Mhotes, sprayers	25
Blade harrows, levellers	50
Hand chaff cutters, sickles, spades other minor implements	100

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## Appendix A. Definitions used in the VLS income analysis

A. Gross household income = Gross farm income + Gross nonfarm income

1. Gross farm income                      Incomes from crops, livestock, and renting out family owned resources (except family labor).
  - a) Crop income                            The gross value of both main and byproducts of crops, including fodder grown on owned and leased-in land.
  - b) Livestock income                      Includes the value of milk and animal products, such as eggs, meat, mutton, wool, cow dung, etc. income from sale of animals and poultry birds.
  - c) Rental income                        Embraces income received from hiring out bullocks, draft animals, machines and implements, and leasing out land.
2. Nonfarm income                        It includes income from:
  - i) regular salaries and daily wages of family members
  - ii) contract business
  - iii) handicrafts, trades, artisan-ship, and others
  - iv) transfer incomes such as gifts, gambling, remittances, interest received from money lending, and house rents.

## B. Expenses

1. Farm expenses                        Crop cultivation + livestock maintenance + maintenance cost of production capital.
  - i) Direct costs (out-of-pocket expenses)
    - a) Crop expenses                        1) Value of seed (home produced + purchased)
    - 2) Value of fertilizers and organic manures
    - 3) Value of pesticides/insecticides
    - 4) Hired human labor

- 5) Hired bullock labor
  - 6) Fuel and lubricant charges for operating farm machinery (used for own farm)
  - 7) Payments for hiring implements and machinery
  - 8) Irrigation charges
  - 9) Miscellaneous expenses
- b) Livestock maintenance
- 1) Cost of fodder and feed (both home produced and purchased)
  - 2) Cost of concentrates (both home produced and purchased)
  - 3) Hired human labor for feeding, grazing, and other husbandry activities
  - 4) Charges for grazing land and others
  - 5) Other miscellaneous expenses such as veterinary charges, ropes, and others
- c) Maintenance cost of production capital
- 1) Repairs and machines (payments to carpenters, blacksmiths, and others)
  - 2) Fuel and lubricants for maintenance
  - 3) Litigation charges relating to land and other family owned resources used for agricultural purposes
- ii) Imputed costs
- 1) Value of family labor used for crop production and maintenance of livestock and production capital
  - 2) Value of owned bullock labor time used in crop production
  - 3) Value of rents paid for leased-in land
- iii) Overhead costs
- 1) Depreciation
  - 2) Land revenues and other taxes
2. Nonfarm expenses
- 1) Taxes, rents, and fees for trade and handicrafts
  - 2) Transport charges
  - 3) Cost of materials and interest on loans
  - 4) House rents for trading activities
  - 5) Maintenance and repairs of houses
  - 6) House taxes, gifts and remittances
  - 7) Miscellaneous expenses relating to trades and handicrafts

C. Net household income	Gross household income - Expenses C = (A-B)
D. Net farm income	Gross farm income (Crop income + live- stock income + rental income) <u>minus</u> total farm expenses (excluding rents paid for leased-in-land)
E. Net farm (equity) income	Net farm income <u>minus</u> rents paid for leased-in-land <u>minus</u> interest paid out on loans
F. Net return to total (owned + hired-in) farm capital and management	Net farm income <u>minus</u> value of family labor used on all crops, livestock, and capital maintenance (including family labor used on leased-in-land and value of owned bullock time used in crop production)
G. Net return to owned (equity) farm capital and management	Net farm (equity) income <u>minus</u> value of family labor used on all crops, livestock and capital maintenance (including family labor used on leased-in-land and value of owned bullock time used in crop production)
H. Percentage net return to total farm capital and management	Net return to total farm capital (owned + hired-in) and management $\frac{\text{Net return to total farm capital (owned + hired-in) and management}}{\text{Average value of all farm capital (owned + hired-in)}} \times 100$
I. Percent net return to owned (equity) farm capital and management	Net return to owned (equity) farm capital and management $\frac{\text{Net return to owned (equity) farm capital and management}}{\text{Value of own farm capital* (land owned + livestock + implements + stock inventories) minus liabilities}} \times 100$
J. Per caput net return to family labor and manage- ment	Net farm income <u>minus</u> imputed annual interest value on total farm capital (assuming 10 to 14% rate of interest comparable to fixed investments) $\frac{\text{Net farm income minus imputed annual interest value on total farm capital (assuming 10 to 14\% rate of interest comparable to fixed investments)}}{\text{Active family members working on the farm}}$
K. Per caput net return to family members	Net farm income <u>minus</u> imputed annual interest value on total farm capital (assuming 10 to 14% rate of interest) $\frac{\text{Net farm income minus imputed annual interest value on total farm capital (assuming 10 to 14\% rate of interest)}}{\text{Total number of family members}}$

\*Total farm capital does not include buildings because there are no separate farm buildings in these villages and part of the buildings are used for farm purposes. But it is difficult to correctly specify the value of buildings used for farm purposes.

Indian farm management concepts<sup>1</sup>

- A. Gross farm income = Value of crops (main & byproduct) from owned and leased-in-land plus livestock income plus rental income from land, livestock, and farm implements and machinery
- B. Farm expenses
- 1) Cost A<sub>1</sub>
- Value of seed (home produced + purchased)
  - Value of manures and fertilizers
  - Value of pesticides/insecticides
  - Cost of irrigation
  - Value of hired human labor
  - Value of bullock labor (hired + owned)
  - Land revenue and taxes
  - Depreciation
  - Value of fodder and feed (home produced + purchased)
  - Value of concentrates
  - Value of hired human labor for grazing, cattle maintenance and maintenance of production capital
  - Interest on farm loans
  - Cost of veterinary expenses
  - Miscellaneous costs
- 2) Cost A<sub>2</sub> Cost A<sub>1</sub> + rent paid for leased-in-land
- 3) Cost B Cost A<sub>2</sub> + interest on fixed farm capital excluding land (say 10% annual rate of interest) + rental value of owned land approximately 1/6 of gross value of the the crops)
- 4) Cost C Cost B + imputed value of family labor
- C. Net farm income = Gross farm income minus Cost C
- D. Farm business income = Gross farm income minus Cost A<sub>1</sub> or A<sub>2</sub> (as the case may be)
- E. Family labor income = Net farm income plus imputed value of family labor (or) Gross farm income - Cost B

F. Farm investment income = Net farm income plus interest on value of fixed capital plus rental value of owned land.

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1. "Studies in the Economics of Farm Management", Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India, New Delhi 1955-56 and 1966-67.

Appendix B. Detailed description of data sources to estimate income and expenses.

ITEMS	VLS-Schedules/ Source (Account)
<b>A. GROSS INCOME</b>	
1. <u>Crop Income</u>	
- gross value of main and byproduct	PLOT SUMMARY FILES
2. <u>Livestock Income</u>	
- Value of milk, milk products, animal products, eggs, meat, mutton meat, and difference between sales and purchases of animals	VLS-L (A/c 11)
- Value of cow dung	Computed from secondary sources
3. <u>Rental Income</u>	
- Income received from hiring-out bullocks	VLS-L (A/c 18)
- Income received from renting farm implements and machinery	VLS-L (A/c 18)
- Income from leasing-out land	VLS-L (A/c 23)
4. <u>Nonfarm Incomes</u>	
- Income from salaries and wages (casual and permanent)	VLS-L (A/c 51, 57)
- Income from trades, remittances, handicrafts	VLS-L (A/c 41)
- Income from money lending, contract jobs, gambling, gifts, house rents, and other activities	VLS-L (A/c 60, 62, 63, 64, 83)
<b>B. EXPENSES</b>	
1. <u>Farm expenses</u>	
a. Crop expenses	
- Seeds, fertilizers, organic manures, pesticides, insecticides, hired human labor, payments for hiring implements and machinery	PLOT SUMMARY FILES

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\*Details of VLS accounts used in this paper can be obtained from the VLS manual (Binswanger and Jodha 1978).

- Fuels and gasoline VLS-L (A/c 09)
  - Rent paid for leased-in-land Computed from VLS-D supplementary schedule
  - Miscellaneous (land revenue and taxes) VLS-L (A/c 06)
  - Depreciation Calculated from VLS-E, F, and G schedules
- b. Livestock expenses
- Fodder and feed (home produced + purchased) Computed from plot summary files, VLS-L and N schedules
  - Concentrates (purchased + home produced) VLS-L (A/c 13)
  - Other expenses such as veterinary charges VLS-L (A/c 15, 16, 19, 10)
  - Labor costs Computed from VLS-K
- c. Capital maintenance expenses
- Fuels and lubricants VLS-L (A/c 20, 37, 38, 39)
  - Machinery taxes VLS-L (A/c 26)
2. Nonfarm expenses
- Trading, taxes, rents, and others VLS-L (A/c 46)
  - Labor expenses VLS-L (A/c 47)
  - Draft animals/cart and others VLS-L (A/c 48)
  - Interest on loans, expenses owing to gifts, remittances, theft, others VLS-L (A/c 40, 49, 60, 63, 64, 80, 82, 83, 86)