

MANUAL

CSO-M-AHBS-2011

ANIMAL HUSBANDRY STATISTICS

September 2011



Government of India
Ministry of Statistics and Programme Implementation
Central Statistics Office
Social Statistics Division
RK Puram, New Delhi-110066
www.mospi.gov.in

CONTENTS

Chapter	Title	Page No.
I	Introduction	1-7
	1.1 Introduction	1-3
	1.2 Purpose and aspects to be considered for inclusion in the manual	4
	1.3 Significance of livestock sector including poultry, fish, sericulture and bee keeping etc.	4-6
	1.4 Status of various systems of livestock production	6
	1.5 Employment potential of livestock sector	6-7
II	Concepts and definitions	8-26
	2.1 Idea and classification components	8
	2.2 Definitions related with livestock and poultry production enterprises	8-10
	2.2.1 Composition of animals of a farmer	8-9
	2.2.2 Composition of animals on an urban dairy stall	9
	2.2.3 Composition of animals of landless families	9-10
	2.3 Definitions and common terms used in relation to animal husbandry and poultry	10-11
	2.3.1 Household	10
	2.3.2 Farm household	10
	2.3.3 Commercial farm household	10
	2.3.4 Household associated with livestock products	11
	2.4 Activities of household	11-12
	2.4.1 Components of activities – mixed activities, special activities.	11
	2.4.2 Activities of animal, fish and poultry farming	11-12
	2.5 Stocks and Flows	12
	2.6 Cost of production and income assets, liabilities, net work, gross income, cost, net income, net cash flow, net kind flow	12
	2.7 Units equivalent in human and animal	13-14
	2.7.1 Labour units	13
	2.7.2 Consumer units	13
	2.7.3 Animal units	14
	2.8 Cost of production	15-16
	2.8.1 Measurement of cost of production	15
	2.8.2 Methods used for the measurement of cost of production of different species of livestock and their products	15-16
	2.9 International Standards	16-26
	2.9.1 Livestock Numbers	16-19
	2.9.2 Livestock products from slaughtered animals	19-23
	2.9.3 Livestock products from live animals	23-26
III	Sampling methodology and estimation procedure for estimation of production for major livestock products	27-59
	3.1 Estimation of production of milk, eggs, wool and meat	27-59
	3.1.1 Introduction	27-28
	3.1.2 Sampling design and sample size covered under Integrated Sample Surveys	28-29
	3.1.3 Estimation of milk production	29-36
	3.1.3.1 Notations	29-30
	3.1.3.2 Estimate of number of animals in milk/milch and their estimates of variances in a season	30-31
	3.1.3.3 Estimate of average milk yield per animal in	31

milk/milch per day and total milk production and their estimates of variances	
3.1.3.4 Estimate of total milk production	31-32
3.1.3.5 Pooling of the estimates and the estimates of their variances over the different seasons	32-33
3.1.3.6 Tabulation of estimation of number of milk animals, average milk yield per animal per day, total milk production per day and estimation of their variances	34-38
3.1.4 Estimation of egg production	37-43
3.1.4.1 Notation	37
3.1.4.2 Estimate of number of layers and estimate of its variance	38
3.1.4.3 Estimates of average egg production per layer per day and total egg production and estimates of their variances	38-39
3.1.4.4 Pooling of the estimates and the estimates of their variances over different seasons	39-40
3.1.4.5 Tabulation of estimation of number of layers, average egg production per layer per day, total egg production and estimation of their variances	41-43
3.1.5 Estimation of wool production	44-50
3.1.5.1 Notation	44
3.1.5.2 Estimation of sheep population	44-45
3.1.5.3 Estimation of average wool yield per sheep	45-47
3.1.5.4 Estimate of annual wool production	47-48
3.1.5.5 Tabulation of estimation of sheep population, average wool yield per sheep, annual wool production and estimation of their variances	49-51
3.1.6 Estimation of meat production	52-58
3.1.6.1 Notation	52
3.1.6.2 Number of animals slaughtered	53
3.1.6.3 Estimate of average meat production per animal	53-54
3.1.6.4 Estimate of total meat production	55
3.1.6.5 Tabulation of estimation of number of animals slaughtered, average meat production per animal, total meat production and estimation of their variances	56-58
3.2 Precision of the estimates for estimation of livestock numbers and products	59

IV	Sampling methodology and estimation procedure for estimation cost of production of milk and egg	60-76
4.1	Estimation cost of production of milk and egg	60-62
4.1.1	Introduction	60
4.1.2	Sampling design	60-61
4.1.3	Field-work	61-62
4.2	Estimation of Cost of Milk production	62-67
4.2.1	Components of cost	62-63
4.2.2	Estimation procedure	63-65
4.2.2.1	Notation	63
4.2.2.2	Estimate of cost of per kg of milk	63-65
4.2.2.3	Tabulation of estimation of cost per kg. of milk and estimation of its variances	66-67
4.3	Estimation of Cost of Egg Production	68-76
4.3.1	Components of cost	68-69
4.3.2	Estimation procedure	69-76
4.3.2.1	Method of calculation for average of different costs incurred for maintaining a bird	69-73
4.3.2.2	Tabulation of estimation of cost of maintenance of bird	74-76
V	Sampling methodology and estimation procedure for estimation of hides and skins	77-82
5.1	Estimation of production of hides and skins	77-82
5.1.1	Introduction	77
5.1.2	Sampling plan	77-78
5.1.3	Type of data collected	78
5.1.4	Estimation procedure	78-82
5.1.4.1	Notation	78-79
5.1.4.2	Estimate of quantum of hides/skins	79-80
5.1.4.3	Tabulation of estimation of quantum of hides/skins and estimates of its variances	81-82
VI	Problems in data collection, the gaps therein and suggestions for improvement in animal husbandry statistics	83-88
6.1	Problems in data collection	83-84
6.1.1	Measurement problems	83-84
6.1.2	Problems in estimation of wool	84
6.1.3	Problems of estimation of meat	84
6.2	Data gaps in Animal Husbandry Statistics	84-85
6.2.1	Data gaps in the methodology under integrated sample surveys	84
6.2.2	Data gaps in livestock statistics	84-85
6.3	Suggestions for the improvement of Animal Husbandry and livestock statistics	85-88
6.3.1	Wool production	85-86
6.3.2	Meat production	86
6.3.3	Hides and skins production	86-87
6.4	General suggestions for improvement of livestock statistics	87-88
VII	Summary	89
	References	90-91
	Appendix I	92-134
	Schedules for estimation of production of milk, eggs, wool and meat and study of animal husbandry Practices under Integrated	93-103

Sample Survey (ISS) Scheme	
Instructions for filling in the schedules under Integrated Sample Survey (ISS) Scheme	104-110
Schedules for estimation of cost of production of milk	111-116
Instructions for Filling in the Schedule Cost of production of Milk	117-118
Schedules for estimation of cost of production of eggs	119-124
Instructions for Filling in the Schedule Cost of production of Egg	125
Schedules for estimation of production of hides and skins	126-131
Instructions for filling in schedules for production of Hides and Skins	132-134
Appendix II	135-149
Appendix III	150-153



PREFACE

One of the mandates of the Central Statistical Organisation [CSO] is laying down norms and standards and evolving concepts, definitions, methodology and classification in relation to statistics. Even though the CSO has been performing these mandates in many fields of statistics, the absence of proper documentation in this regard led to a decision to prepare statistical manuals in respect of 28 subjects detailing concepts, definitions, classification procedures, compilation of data, estimating procedures, dissemination and other relevant explanatory notes, including methodological framework in the statistical indicators/statistics to make the manual comprehensive reference books comparable to the manuals being proceeded by the UNSD from time to time.

This manual on Animal Husbandry Statistics is one of series of 28 manuals on statistical indicators proposed to be brought out by the CSO. The basic purpose of this manual, like those of all other in the series, is to provide the users of Animal Husbandry data with a ready-to-use reference guide on methodological aspects of data (metadata) on Animal Husbandry based on harmonised concepts and methodologies that facilitate international comparison and help in aggregation of statistics to derive meaningful conclusions. The other purpose of this manual is to provide the statistical offices both at the national and state levels with guidelines in the compilation of Animal Husbandry data.

The materials included in this manual are expected to bring in harmonization in concepts, definitions and methodology of compilation of Animal Husbandry data. The adoption of the methodology suggested in this manual will go a long way in facilitating data aggregation and data comparison both at intra-regional and inter-regional levels, including international levels.

This manual has been prepared by Indian Agricultural Statistics Research Institute (IASRI) under the guidance of Steering Committee for Preparation of Manuals on Statistical Indicators headed by the Director General, CSO. I congratulate to the team of officers from the Social Statistics Division comprising Smt. S. Jeyalakshmi, Additional Director General, Shri Inderjeet Singh, Deputy Director General and Shri M.P. Diwakar, Assistant Director for their excellent work in bringing out this manual.

I hope that the manual will serve as a useful reference document on the subject. Any suggestion to further improve the contents of the manual is welcome.

(S. K. Das)

Director General

Central Statistical Organisation

New Delhi

Dated: 29-09-2011

CHAPTER I

INTRODUCTION

1.1 Introduction

With the proliferation of different media and use of these information media for education and transfer of technologies awareness about the important role of good quality complete proteinous foods of animal origin for balancing the higher cereal based diet is increasing and the demand of proteinous foods of animal origin is increasing at a fast rate. For the supply of essential amino acids in the diets of human being, supply of about 20-25 per cent of total daily protein requirement has to be made through the incorporation of good quality proteinous foods of animal origin. Milk is one of the most important sources of animal's protein in the diets of predominately vegetarian population of Indian people. The other proteinous foods of animal origin are the meat of different animals, chicken, eggs and fish. Although average supply of milk, meat, eggs, poultry meat and fish has increased significantly since independence and also continuing to grow linearly at a reasonably good growth rate, yet the production is not sufficient to meet the requirement of the people of all economic classes due to lack of purchasing capacity in the families of low income group and lower strata of middle income group, though capable of supplementing their diet for balancing protein requirement through the incorporation of proteinous foods of animal origin, suffer from protein malnutrition due to diversion of their limited resources for other purposes in order to maintain a pseudo-satisfying social status. The imbalance in the distribution of proteinous foods of animal origin is mainly due to great variation in the purchasing power of the families of different economic group.

Although periodic data are being published on the population of livestock and poultry, production of milk, meat, eggs, poultry meat and fish, and average supply of these foods in the diet of Indian people, yet validity of this information is usually doubted by a considerable proportion of Indian people. In a fast changing Indian society, migration of people from rural to urban area has shown a great increase during the past 25 years, and the rate of migration to urban areas is increasing every year. This leads to the increase in the demand of food including the foods of animal origin. Due to highly unstable nature of most of the foods of animal origin, the population of dairy animals is increasing in the urban and peri-urban areas and this is a highly unstable livestock population because the movement of dairy animals from rural areas to urban and peri-urban areas during the productive phase and reversal to rural areas or termination in the abattoirs at end of lactation phase is quite common in India. Besides this some

malpractices in the measurement of liquid milk and production of some kind of milk like fluid have created problems in the assessment of the livestock population and production of the livestock products specially the milk.

The livestock production practices have changed significantly and now everything is cost based and for sustaining or profitable livestock production, more reliable information are required regarding the requirements of the livestock products, production potential, cost of production and available market (domestic and export). Under Indian system of mixed farming livestock production is largely a source of subsidiary income of more or less regular nature like marketing of liquid milk and milk products and poultry eggs. Some other livestock products are seasonal or periodic in nature requiring production period ranging from 6 to 8 weeks for broilers to 12 to 18 months for fattening buffaloes. The expenditure on rearing of meat animals has low revolving quality and cumulative expenditure may be much more than the actual input due to accumulation of interest on the fixed and revolving capital investment for the production.

So far the methods used for the calculation of cost of production of livestock products have been non-systematic and in most of the rural production systems, cost of the labour input of family members and feeds grazed on the waste lands are ignored, but in the changing scenario all expenditure involved in the production including the wages of the family working hands involved in the production are to be included. This will definitely present a different picture and producers may change the marketing strategy. However, such beneficial changes for the livestock owners will depend on the demand of the products.

Collection of statistics is mostly dependent on the basis of sample survey which inherited scope of error, known as sampling error. This sampling error is due to limited observations from a population and accuracy of the estimate for all practical uses depends on the magnitude of the sampling error. The persons engaged for the collection of statistics may be biased also. Thus, different methods of calculations may be required. In many cases estimates become inadvertently biased like lack of correction for the animal movement due to marketing of animals. The marketing systems for animals are highly variable and ranges from door to door purchase to sale and purchase in weekly, fortnightly, monthly, quarterly, half yearly and annual markets and animal fairs. Such marketing often increases the scope of duplication of the data as animals counted with one family may be again counted with another family of a different village.

Correct information on the cost of production and return from the livestock production except the farm poultry are not available for most of the species. Since animal husbandry specially the keeping and rearing of cows and buffaloes is largely limited to rearing 1 to 5 dairy buffaloes or cows, depending on the availability of unemployed or casually employed members in the family and also the carrying capacity of the wasteland, fallow land, canal bunds and road sides, are kept for supplementing the income of the family. Dairy animals in most of the economically weaker families are limited to one or two, and dung for fuel is the main saving because almost entire milk produced is sold for the payment of debt and interest. The animals reared in somewhat better economic classes are mostly exchanged with the dry cows and buffaloes of the urban and peri-urban areas after paying the difference between the prevalent market price of such animals.

The situations of remote areas, hilly regions, mountainous regions and human habitation in deep forest are quite different. The assessment of human population, livestock population and trade in livestock and livestock products has become very different due to non-accessibility caused by emergence of different anti-social activist groups as persons engaged for sample surveys of such regions avoid data collection by actual information gathering and reports are usually prepared on the basis of where say or almost similar kind of data available in the revenue department and the offices of Block Development Officers or Veterinary Officers. Supervision of work is also highly irregular and uncertain due to fear of anti-social or so-called liberation groups infesting significant areas in North-East states, Bihar, Orissa, Jharkhand, Madhya Pradesh, Chhattisgarh, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.

On the perusal of periodic reports on the situation of feeds and fodder supply in India, one can see very little differences in the proportional shortage of concentrates, dry roughages and green fodder supply, but the production of milk, meat, eggs and poultry meat is increasing every year at a reasonably high rate of annual growth ranging from 4-5 % for milk to more than 15% for poultry meat production. Such contradiction in supply of feeds and fodder and the production of livestock and poultry products appears to be due to some kind of error or vices in the collection of statistics from such areas.

Therefore, there is need for the selection of a suitable method of statistics collection or to develop method (s) for the collection of statistics in a country like India having high diversity in topography, agro-climatic conditions, distribution pattern of human and animal population, some migratory population and some very different areas.

1.2 Purpose and aspects to be considered for inclusion in the manual

Since economics has taken upper hand in the changing socio-cultural system of Indian people, the prevalent age old practice of gifting (free of cost) milk and milk products and other kinds of foods of animal, poultry and aquatic origin has almost vanished or it has shrunk to some festive occasions only in many parts of the country. With such changing scenario it appears that all commodities will be available against the payment of price. Animal husbandry, poultry farming, aqua culture, bee keeping and silk worm farming (sericulture) are either the sources of subsidiary income, sustainable income or large scale business, there is need of evolving system(s) of statistics collection for accounting the all inputs in terms of rupees for working out the cost of production. For reasonable accuracy in statistics collection the following criteria may need due consideration:

1. The importance of livestock and other animal species as the sources of foods of high nutritive value containing the protein of high biological value, supply of energy for agro-industrial operations, supply of hides, skins and fibre for industrial uses, and production of valuable by-products like bones for manure, dung and droppings for manure and fuel and horns for the manufacture of fancy items.
2. Methods of production viz. small scale cottage industry or large scale manufacturing units.
3. Identification or/and creation of indicators to be used for the collection of statistics on various aspects of animal and poultry production industry.
4. Development of sampling methods for survey in highly diversified conditions ranging from plain to hills and mountain, dry to wet zone, river basins to deep forest and coastal areas with great variation in animal population in different zones.
5. Identification of organizations capable of performing the job of statistics collection.
6. Determination of interval for data collection which may not be same for all the species particularly the great difference between reproductive age of bovines and poultry birds.
7. Identification of methods and procedure for their validation for data collection in different species.
8. Development of simple methods for the determination of cost of production of different kinds of products considering all kind of inputs, and a procedure for the determination of marketing price and system to keep the profession sustainable.

1.3 Significance of livestock sector including poultry, fishery, sericulture and bee keeping etc.

Livestock rearing provides part time to full employment and enterprises like dairy farming and laying birds farming which are the sources of regular income due to daily production of salable products like milk and eggs. Even families of low income group have been

found to sustain or at least supplement the family income by keeping one or two lactating bovine and/or few (10 to 100) laying hens or mixed sex poultry birds. In later case male chickens are fattened to be sold for table purpose. Similarly other enterprises like bee keeping and sericulture are gradually attracting more persons specially the unemployed youth. However, important information regarding the (i) sources of availability of good breeds of productive animals, (ii) Cost of the animals, (iii) cost of rearing to marketing stage that includes expenditure on feeding, housing and management, and (iv) market for disposal of products at a reasonable profit. In addition to these information, there is also need of providing information about the sources of financing institutions.

In livestock production sector so far there is no scheme like minimum support price and procurement of products by the government or some other organized agencies except the limited provision in dairy sector and some other enterprises. A comprehensive statistics on the cost of production and return from marketing in different regions will help in the selection of animal husbandry practice for gainful enterprise and sustainability of generating resources for reasonably compatible livelihood. Development of complete packages of different animals, poultry, fish and other species based enterprises for landless farm labourer families, marginal, small, middle and large farmers and also the big livestock enterprises of industrial houses will be helpful in the selection of suitable enterprise on the basis of (i) Social acceptance of the animals species in the family, (ii) management capacity of the farmer, (iii) interest of the persons initiating the animal enterprise and support of the other family members and their involvement in the management of livestock production. Establishment of small units of livestock production will be helpful in supplementing the income of the family which will help in the improvement of living standard and social status. Some larger units will provide employment to unemployed youth for generating sufficient resources (income) for supporting the family requirements. A livestock enterprise of big size establishment by industrial houses may be helpful in the establishment of a chain of industries for the processing, production and marketing of value added products. The smaller units will normally provide employment for the family members at the primary stage and their products may or may not enter in the processing chain, whereas livestock enterprises of big size will provide much more employment at different stages starting from production of raw material to their processing and marketing.

The collection of statistics on the cost of production, level of profit, sustainability of the enterprise and pattern of demand of products in different areas may need periodic

review for recording the change in the pattern of demand and supply. The past experience shows that farmers suffer frequently due to non-logical selection of enterprises, for example it has been frequently observed that an abnormal increase in the marketing price of a commodity in a particular year showing much higher return prompt majority of farmers to produce the same crop next year resulting even in the loss due to drastic fall in the sale price caused by flooding of market with that commodity. Therefore, there is also need of the collection and display of such statistics for helping in the selection of the right type of enterprise. Such statistics will also be useful for monitoring the growth in the livestock production sector for evolving future strategies required for the preparation of five years development plans.

1.4 Status of various systems of livestock production

Perhaps real scenario not being projected through the statistics collected on various aspects of livestock production systems.

The increasing role of milk producers' cooperatives has brought conspicuous changes in the life style of villages. With the available marketing facilities almost at door step due to establishment of milk collection centers, most of the families selling even the last drop of milk produced for earning money for other purposes. The system has both merits and demerits and utilization of resources are till managed by the elder or dominant male member of the family. No doubt in many areas living standard of most of the families have improved, but there are also considerable number of families in several parts of the country whose income from dairy is being diverted (mostly misused) for more productive or other items of secondary importance depriving the young and aged members from milk intake and even younger generations are deprived of schooling and engaged in the keeping and management of livestock. This aspect needs detail observations and system of statistics collection for such changes in the society. It is very important particularly for the liberation and families trapped in such vicious circle.

1.5 Employment potential of livestock sector

The employment potential of livestock sector may be considered enormous as it has potential of providing part time as well as full time job for almost every member of a household. The management of dairy animals require following jobs.

1. Collection of feeds & fodders.
2. Processing feeds & fodders.
3. Feeding & watering of dairy animals and their fellows, if any.
4. Disposal of dung and urine.
5. Cleaning of animal shed.
6. Grooming/cleaning of animals.

7. Milking.
8. Processing of milk, if used for products making.
9. Marketing of milk and/or milk products.
10. Processing of dung cake and or manure preparation.
11. Marketing of dung cake and/or manure.
12. Sale of calf/old animals/non productive animals
13. Miscellaneous works associated with livestock keeping like grazing breeding and veterinary aid etc.

CHAPTER II

CONCEPTS AND DEFINITIONS

2.1 Idea and classification components

There should not be any confusing aspect in the list of items related with livestock production, processing and marketing systems. Every indicator must be well defined and whenever there is more than one character to be considered, these should be well defined and accordingly classified to avoid any kind of doubt during the collection of data. The information on various inputs in an animal production system may not be similar in an area especially in the population inhabited at such borders where the movement by many farm produce is controlled or restricted. Many times cost of input particularly feed items is found to be highly variable due to state policies in the two adjoining areas. The information collected on fixed cost are more stable in nature than the cost of consumables like feeds and fodder which show high fluctuation due to seasonal nature than of production. Cost of production in an animal enterprise generally include fixed expenditure like erection of infrastructure, purchase of animals and purchase of utensils and equipments, and average working life of all such fixed expenditures for determining the rate of depreciation as fixed items need replacement after certain interval. While working out the rate of depreciation, rate of inflation must be kept in mind.

2.2 Definitions related with livestock and poultry production enterprises

Unlike agriculture animal husbandry and poultry production are not limited to rural areas and a good percentage of dairy animals are reared on the dairy stalls of urban and peri-urban areas. The size of these stalls is highly variable and number of animals may range from 10 to 20 under a thatch shed or beneath the few trees on road sides or an abandoned place in the town to bigger stalls housing 100 to even more than 500 heads of animals. Most of the dairy stalls of north, west and east states are buffalo dominated. Most of dairy animal stalls of north-east states rear crossbred and exotic animals exclusively. Buffaloes are reared by few families in the deep forest or along the river. There is apparent difference in the composition of animals in the rural areas, dairy animal stalls of northern, central and western states and that of north-east and southern states. The systems of animal keeping have significant impact on the composition of animals, which may be described as follows though there will be regional variations:

2.2.1 Composition of animals of a farmer: These include one to two or more pairs of bullocks and/or working male buffaloes, a few lactating buffaloes and/or cows or both and their followers. In some of the regions, working animals may be also horses &

ponies and camels. Some goats (5 to 15) are also found in some families belonging to landless and marginal farmers.

2.2.2 Composition of animals on an urban dairy stall: There are only lactating buffaloes or cows or a mixture of two but dominated by buffaloes in the northern states. The followers mostly disappear from the scene due to engineered under feeding (almost starvation). A few survivors kept for let down of milk are mostly offered the residue left by the other animals.

2.2.3 Composition of animals of landless families: Majority of landless families live in villages and depend on daily wages. The casual job is uncertain and mostly seasonal for sowing, harvesting, thrashing and storage of the grains and their residues. Such landless labourers generally keep one to five animals, which are mostly non-productive like growing calves spared on drying of the females, dry cows and buffaloes. The landless farmers belonging to OBC/SC families keep 2 to 10 goats and sell them at the age of 1 to 2 years. These animals are reared only on grazing and plant leaves. Some families also keep lactating animals for regular income from the sale of milk. Non productive animals like weaned calves and dry females are procured by the local families on barter basis. The male calves are reared upto about three years of age or eruption of first pair of permanent incisors, considered to be age for breaking the animals for working. The female calves are reared upto last month of gestation, that is upto 4-5 years of age and the dried females are also reared upto last month of pregnancy which is quite variable and may be one to two years in normal animals. All expenditure on the rearing of these animals is made by the borrower (landless farm families). At the marketable stage a group of experienced persons in livestock marketing are requested for the evaluation of the animal. Once the assessment of price of the animal is completed, the original owner of the animal is given first option for taking the animals. If he is not interested the family that reared the animals may retain it. In either case party retaining the animal has to pay half of the assessed value to other party. If both parties are not interested in the animal then it is sold and money is equally distributed between the two parties. In event of death or irreparable deformity no claims are made by the either party. The system is not remunerative for the family rearing such animals but in absence of employment and market for grasses collection from the waste lands such families rear these animals as a recurring deposit that fetch some lump-sum amount and daily supplies of dung for fuel which is partly used and partly sold.

Thus, in this system such landless families not only get dung for fuel but also some money at regular interval of few days, week or fortnight. In certain areas stored dung is

also purchased by large farmers for manure. Perhaps there is no system of assessment for determining the input-output relationship.

2.3 Definitions and common terms used in relation to animal husbandry and poultry

2.3.1 Household: All families in a village, town or city are households. The number of persons in a household may range from 1 to many (normally 5 to 10 in many parts of the country). The household also depicts the economic inputs-outputs shared by all the members (earning and non-earning).

2.3.2 Farm Household: The farm household depicts the earning from various activities of farming (in this case mainly the livestock farming) and other works directly or indirectly associated with the livestock farming. In case of dairy farming the various works include fetching of fodder and feeds, processing of feeds and fodder, feeding of animals, cleaning of animals and animal house, collection and processing of cow dung, milking and processing of milk etc. These activities are followed by marketing of milk and milk products, dung cake and manure. Similarly in case of sheep the grazing, shearing, wool processing and marketing of the lambs, wool and woollen products. Likewise some of the husbandry practices are common for all the species whereas a few are specific for the species. Scavenging of indigenous and crossbred pigs is followed throughout the country by greater proportion of pig rearing families. Poultry farming in the country is clearly distinguished into backyard system of rearing few birds and their progeny for domestic consumption and some small income to supplement the household needs. This group is included in household enumeration but commercial poultry production system should be considered independently.

The economic analysis of this group of farm household should be considered as a separate group of large number of households. These families may or may not own land but they are definitely engaged in at least one of the activities related to livestock, poultry, fisheries, bee keeping etc.

2.3.3 Commercial Farm Household: The families engaged in business of large number of livestock industry in intensive or semi intensive system as in case of dairy animal stalls of more than 100 animals, poultry farms of more than thousand birds, turnover of a million or so from fisheries and other activities like bee keeping and silk worm rearing etc. A suitable scale of either number of animals, quantity of products or turnover rate from the animal enterprise may be determined for the identification of commercial farm households.

2.3.4 Household associated with livestock products: These are the families involved in the processing of livestock and other animal products for the manufacture of edible and other utility items for marketing. These may be small and medium level cottage Industries associated with preparation of milk products like Khoa, Chhena, Ghee, Curd etc., meat products, egg products and other activities like wool processing, leather processing, etc. These two groups of families mostly use indigenous process to meet the local supply. Commercial houses process large quantity of animal products for the inland and in some cases export marketing.

2.4 Activities of Household

Different activities of farm households and other households depend on the economic status, quantity handled and turnover rate etc. Most of the activities are linked with the entrepreneurship ability of the families. Since animal husbandry is mostly limited to farming community, it is mostly a subsidiary activity with land holding families for supplementing the agricultural income, whereas it is a source of earning livelihood for many landless families dependent on casual and seasonal employment of farming. The activities may be either mixed or special.

2.4.1 Components of activities: Various activities involved for the production and marketing products are individually known as components. In some cases it may be difficult to differentiate individually components in some of the agricultural practices like cultivation of the mixture of wheat and gram was quite popular in earlier days. Such situations are limited in animal husbandry practices. The number of components may be few or many depending on the need and management ability of the house hold.

Mixed activities: The number and combinations in the mixed activities associated with animal husbandry are highly variable. These may be crop-Dairy animal (cows or buffaloes), crops-bullock-calf rearing, livestock-fish farming, crop-livestock-bee keeping, crop-livestock-fish farming and so on. Some of the inputs are inter-dependent for the production of an output.

Special activities: Special activities are usually associated with the commercial animal farming like production of milk products in addition to fluid milk marketing, processing of meat for production of value added products for marketing. Similarly such special activities are also in poultry farming, fish farming and sericulture etc.

2.4.2 Activities of animal, fish and poultry farming: A few examples of activities used in some part of India are given to have an idea so that these components may be utilized during the preparation of programmes for improvement and refinement of these activities for increasing the return from the enterprise (table 1)

Table 1: Activities associated with the livestock and poultry production

Activity	Components	Main out put	By-products	Subsidiary Products	Processed Product
Dairying	Cow	Liquid milk	Dung & Urine	Calf	Curd, ghee, paneer etc.
	Buffaloes	Liquid milk	Dung & Urine	Calf	Curd, ghee, khoa etc.
Crop + Dairy animal	Wheat/Rice/both	Grain	Straw	-----	Curd, ghee, khoa, paneer
	Cow / buffaloes	Liquid milk	Dung & Urine	Calf	
Mutton & Wool	Sheep	Fattened lambs & wool	Dropping & Urine	Lamb	Woolen products
Dairying + Meat	Goats	Fattened castrates & Milk	Droppings & Urine	Goat for meat	(mostly marked as intact animal & liquid milk)
Poultry (Backyard)	Chicken	Eggs	Droppings	-----	(Eggs are marketed)
	Chicken & Broiler	Eggs & Chicken meat	Droppings & feathers		(Dressed broiler-ready to cook, processed feathers for cottage industry)

2.5 Stocks and Flows

Stocks: The number /quantity or value of a resource or its product(s) actually present in household at a particular time is called stocks.

Flows: The quantity of a product produced at a particular time or its value is known as flows. The direction of flows indicates the inputs and outputs. The direction of flow of resource in the processing of the production is called input and that flowing out of production process is output.

2.6 Cost of production and income

When resources are assessed in terms of value, the expenditure incurred from the household is called cost of production and the value received from the marketing of product is called income.

These two terms are used for financial and economic measures, and for these purpose items are converted into value at the time of assessment.

Assets: Total stock of resources and products in the household on a particular (fixed) date.

Liabilities: Total stock of loan and/or borrowed item on that date.

Net worth: Assets minus liabilities on the said date for the measurement of potential income.

Gross income: In flow of value of product in the household during a predetermined period ending on the said date.

Cost: Out flow of resources in term of value for the production during that period.

Net income: Gross income minus Cost.

Net cash flow: In flow of cash for all activities minus out flow of cash from all products during a pre-determined or fixed period.

Net kind flow: In flow of all non cash value during the earlier pre determined period. This is an indicator of requirement of kinds during that period.

2.7 Units equivalent in human and animal

2.7.1 Labour Units: The manpower engaged in the activities for an enterprise is converted into labour unit for the assessment of time spent or contributed for the job under economic evaluation. More or less every human unit of a house hold spent some time on performing one or the other animal husbandry activity and that proportion of his/her time is converted into labour unit as follows (as per FAO standard) for working out the input of each member in terms of value.

Table 2: Labour Units Equivalent (LUE)

Age group	Age (Years)	Units Equivalent
Child	Below 9	0.0
Youth	9 yrs 1 day to 15	0.5
Adult	15 yrs 1 day to 59	1.0
Old	59 yrs 1 day onwards	0.5

Sex differentiation is quite prevalent in many countries including some regions of India. Probably it is not official in India but it is definitely in practice in many parts. The system is in vogue despite equal performance of both sexes though sex effect on some specialized work can not be denied but it is true for both sexes viz. women are more efficient in handling the animals and products while men are more efficient in field operations.

2.7.2 Consumer Units: There are standard units worked out for the estimation of the requirements of a household. The units for males and females are common for child, youth and old persons but different for adult man and women as shown in table 3 as per FAO nutrition service recommendations.

Table 3: Consumer Units Equivalent of standard units for an adult man

Age/Sex		Age range(Years)	Consumer units equivalent (CUE)
Male	Child	0-9 yrs	0.50
	Youth	above 9 yrs-15 yrs	0.75
	Adult	above 15 yrs-60 yrs	1.00
	Old	more than 60 yrs	0.90
Female	Child	0-9 yrs	0.50
	Youth	above 9 yrs to 15 yrs	0.75
	Adult	above 15 yrs to 60 yrs	0.80
	Adult(Pregnant/ Lactating)	--do--	1.00
	Old	Above 60 yrs	0.70

2.7.3 Animal Units: There is great difference in the body weight of different species of livestock and there is also significant effect of age and physiological state of body like pregnancy, lactation, wool growth and egg production etc. For removing such difficulties different animal species have been equated with the adult horses, donkey and mules and for this purpose FAO has used the factors (Table 4) suggested by Dr. John de Boer of Winrock International.

These factors are being used by various countries including India. However, use of these factors is not appropriate and there is an acute need for evolving suitable factors for equating different species of farm animals using a standard and dominant breed of cattle like Haryana, Kankrej or Tharparker, or a popular breed of buffalo like Murrah. The factors suggested are also incomplete for countries like India having other species of farm animals like Mithun and Yak besides great variation in the body size of native breeds of cattle, buffalo, sheep, goats, horses and donkeys. The differences between the size of breeds are not only significant by calculations but quite apparent by naked eyes.

In the animal equivalent system of FAO buffaloes and camels, sheep and goats, and horses, donkeys and mules have been grouped together for the purpose of determining animal units in comparison to horse group (horse, donkeys and mules) as 1 unit.

Table 4: Animal Units Equivalent (AUE)

Species	Animal Unit Equivalent		
	Young	Immature	Adult & Old
Horses, donkey and mules	0.330	0.750	1.000
Cattle	0.260	0.600	0.800
Buffaloes & Camels	0.366	0.825	1.100
Sheep & goats	0.033	0.075	0.100
Pigs	0.066	0.150	0.200
Poultry & other small animals	None	None	None

Any statistics collected for Indian Livestock using the animal unit equivalent (AUE) suggested by FAO will be definitely misleading. An Assamese or Black Bengal goat of 10-15 kg. adult body weight can not be equated with the Jamunapari and Sirodhi goats of about 40 to 60 kg. adult body weight. Similarly small cattle of northern hills, Bundelkhand and most of the coastal areas weighing 150 to 250 kg. cannot be equated with Hariyana, Tharparker, Gir etc. of 300 to 500 kg. or even higher adult body weight. Under such situation any estimate and projections for future development on the basis of such estimates will fail to produce the real scenario and will be misleading.

2.8 Cost of production

2.8.1 Measurement of cost of production: It is one of the most important factors of any enterprise as the success of any enterprise depends on sustainability and livelihood generation capacity. For the estimation of cost of production of a commodity, the values of all the inputs are added. Estimation of cost of production of livestock and its products in diversified systems of livestock rearing in India is not an easy task. So far in most of the estimated cost of livestock production, several inputs like the cost of family labour, value of grass/fodder collected from scrub land etc. have often been ignored. These values are also not considered by the small holders because the scene will be highly depressing for such families. In India these families are engaged in livestock rearing because they do not have other kind of more remunerative jobs of considerable persistency or continuity.

The cost of production is considered as (i) fixed cost and (ii) variable costs. However, there definitions may change with the situation like employment of a labourer for performing regular activities of animal rearing on monthly payment or otherwise for longer period is fixed cost, while wages paid to workers employed intermittently for few days only is considered as a variable cost. Value of work done by family members are usually not included in the cost of production because such family members associated with animal rearing do not have alternate employment.

2.8.2 Methods used for the measurement of cost of production of different species of livestock and their products

1. Expenditure on purchase of item(s) required for the direct or indirect use of animals.
2. Normal market values are considered for certain items for which cost is less variable for longer period.
3. Current market values are usually used on the expenditure of consumables used from own sources like feeds produced by the farmers and not purchased from the market.
4. Expenditure on housing.
5. Expenditure on harnesses etc.
6. Expenditure on veterinary and other services.
7. Expenditure on other items.

All these values are added together for determination of cost of production of an animal to market age or cost of livestock products like milk, egg, etc. A tentative example of expenditure and return on the rearing of a dairy cow may be considered as follows:

1. Cost of purchase of cow.
2. Cost of feeds.
3. Cost of maintenance.

4. Rent of land or its value.
5. Value of labour.
6. Value of milk and return from the sale of milk and/or milk products.
7. Value of calf at weaning.
8. Value of manure produced during the period.
9. Value of dung cake for fuel
10. Depreciation on various fixed expenditure.
11. Interest on loan or such value requiring capital.

2.9 International Standards

As per the International Standards the terms "livestock" and "poultry" are used in a very broad sense, covering all domestic animals irrespective of their age and location or the purpose of their breeding. Non-domestic animals are excluded from the terms unless they are kept or raised in captivity, in or outside agricultural holdings, including holdings without land.

Cattle, buffaloes, camels, sheep, goats, pigs, horses, mules, asses and chickens are raised and enumerated in many countries. Some countries raise and enumerate ducks, geese, turkeys and beehives, whereas rabbits, guinea fowl, pigeons, silkworm cocoons, fur animals, reindeer and various kinds of camelids are limited to far fewer countries.

Many factors are known to affect the comparability of statistics of livestock numbers between countries. The main ones relate to the coverage of data, the date and frequency of enumeration and the classification of animals.

2.9.1 Livestock Numbers

2.9.1.1 Classification: Livestock is generally classified by countries by genera, subdivided in a few cases by species. More frequently, individuals of various genera or families are being aggregated into a single group, e.g., the term "poultry" covers domestic fowls, guinea fowl, ducks, geese and turkeys.

It is recommended by FAO that countries enumerate, when applicable, at least the animals listed below, classified according to this list, also taking into account national perspectives.

CATTLE, total

- A. Calves and young stock under 1 year of age
- B. Young stock, 1 year of age and under 2 years
- C. Cattle, 2 years of age and over
 - a) Females
 - i) Cows - mainly for milk production
 - ii) Heifers (including in calf)

b) Males - mainly for meat production (including spent) and for Work and Breeding, separately

BUFFALOES, total

A. Buffaloes under 3 years of age

B. Buffaloes, 3 years of age and over Buffalo cows - mainly for milk production

SHEEP, total

A. Lambs under 1 year of age

B. Sheep, 1 year of age and over Females - intended for breeding - intended for

SLAUGHTER MALE GOATS, total

A. Goats under 1 year of age

B. Goats, 1 year of age and over - Females

PIGS, total

A. Young pigs, less than 50 kg

B. Pigs for breeding, 50 kg and over - Gilts - gilts in pig - Sows - sows in pig

C. Pigs for fattening, 50 kg and over

a) 50 kg and less than 80

b) 80 kg and over

Note that above categories given under pigs for meat production is for exotic/crossbred.

An equivalent indigenous part is as follows. The body weights of adult indigenous pigs generally vary between 30 to 45 kg which are considered as young pigs, less than 50 kg.

HORSES, total

A. Horses for agricultural production or use

B. Other horses

CAMELS

MULES, total

ASSES, total

CHICKENS (domestic fowl), total

A. Chickens for breeding and egg production - Laying hens and pullets

B. Chickens for meat production (slaughter) - Broilers - Other (capons, etc.)

C. Other chickens (multi-purpose mixed stock) - Laying hens and pullets

TURKEYS, total

DUCKS, total

GEESE, total

GUINEA FOWL, total

RABBITS, total

BEEHIVES, total

It is suggested that countries collect data on births and natural losses of various livestock categories, as well as further sub-divisions, according to age and/or utilization. These data are important indicators of productivity of the livestock herd and are used for the construction of herd balances and herd models.

In the poultry sector, considerable changes have taken place over the last twenty years in many countries, particularly with regard to the growth of a modern specialized and intensive sector alongside the traditional sector. It is, therefore, desirable to collect and publish, whenever possible, poultry data for the modern sector separate from the traditional sector. For the modern sector, several countries conduct monthly enumerations to collect data on poultry numbers, as well as on closely related items, such as number of eggs put in incubators, chicks hatched and chicks placed, all separately for laying hens and for broiler production.

It is recommended that countries collect and publish this information which is usually available from commercial hatcheries.

2.9.1.2 Date of frequency of enumeration: The livestock population is subject to marked seasonal fluctuations, resulting in periods of maximum and minimum numbers within the course of the year. These periods are different for various species of livestock and are, also, different from country to country.

While recognizing the need for estimating livestock numbers more than once a year, particularly pigs and poultry,

It is recommended that at least one enumeration should be made towards the end of the year.

2.9.1.3 Coverage of the data: All domestic animals should be taken into account in an enumeration, irrespective of their age or purpose of breeding. The number of born and the disease wise number affected and died animals for each species should be recorded every year

In areas where nomadism and transhumance are practiced, livestock may be enumerated twice, or may not be enumerated at all if enumerators fail to pay sufficient attention to these livestock-rearing practices. Nomadic animals are those without any fixed installation which continually or periodically shift from place to place. The seasonal migration of livestock from pastures on plains and lowlands (autumn-winter) to pastures on mountain-sides (in spring and summer) and vice versa is known as transhumance. The phenomenon of nomadism exists in Africa and in the Near East. The transhumance, including alpine pasture, is no longer as important as it was at one time in Spain, Italy and other European countries, but it is still widely practiced in some other countries.

2.9.1.4 Elements applicable to all or main species of livestock

Total numbers: Animals enumerated in a given day, or in few consecutive days of the year.

Females in reproductive age: This includes females of 3 years of age and over for horses and buffaloes; 2 years of age and over for cattle; one year of age and over for sheep and goats; and six months of age and over for pigs.

Females actually reproducing during the year: The number of females which have had offspring during the year. In the case of species which can have more than one offspring during the year, the breeding female has to be included for each litter.

Birth rate: The number of animals born alive as a percentage of number of females actually reproducing.

Number born: The number of animals born alive during the year.

Natural deaths: The number of animals which died during the year because of any natural event.

Number of animals slaughtered: Includes all animals slaughtered during the year, of both indigenous and foreign origin, within the national boundaries.

Take off rate: The percentage of all animals of the species which are taken from the national herd during the year, for slaughter in the country or in other countries.

2.9.2 Livestock products from slaughtered animals

1. Primary products: Those products, coming directly from the slaughtered animals, including meat, offals, raw fats, fresh hides and skins.

2. Processed products: These are derived from the processing of primary products and include sausages, lard and salted hides.

2.9.2.1 Concepts, Definitions, Coverage and Recommendations

1. Slaughterings and meat production

1.1 Definition: Meat can be defined as "the flesh of animals used for food". In the statistical language, meat is intended to be with bone-in, unless otherwise stated, and to exclude meat unfit for human consumption. From the term "meat" are to be excluded edible offals and slaughtered fats.

1.2 Concept of production: Data on meat production are usually reported according to one or more of the following concepts:

1.2.1 Live weight of animals intended for slaughter: It is the weight taken immediately before slaughter. It is assumed that animals intended for slaughter are kept in the slaughterhouse premises for 12 hours and are not fed or watered during this time.

1.2.2 Killed weight: It is the gross weight of the carcass including the hide or skin, head, feet and internal organs, but excluding the part of the blood which is not collected in the course of slaughter.

1.2.3 Dressed carcass weight: is the weight of the carcass after removal of the parts indicated for each of the livestock species listed below:

Cattle, Buffaloes, Horses, Mules, Asses, Camels

- the hide or skin
- the head where it joins the spine
- the fore feet at the knee joint, and the hind feet at the hock joint
- the large blood vessels of the abdomen and thorax
- the genito-urinary organs (other than the kidneys)
- the offals (edible and inedible)
- the tail
- the slaughter fats other than kidney fats

Sheep and Goats

- the skin
- the offals (edible and inedible)
- the genito-urinary organs (other than the kidneys)
- the feet
- the slaughter fats other than kidney fats

Pigs

- the offals (edible and inedible)
- the genito-urinary organs (other than the kidneys)
- the slaughter fats other than kidney fats and back fat which are butchering fats)

1.2.4 Carcass weight: It is the weight of the carcass as defined above, including slaughter fats.

1.2.5 Data on production of meat for minor animals (poultry, rabbits, game, etc.):

These are usually reported according to one or the other of the following concepts:

a = Thighs + Wings + Breast + Ribs + Back = Ready-to-cook (oven ready)

b = a + Heart + Liver + Gizzard + Neck = Ready-to-cook (incl. giblets)

c = b + Feet + Head = Eviscerated weight

d = c + Viscera (inedible offals) = Dressed weight

e = d + Blood + Feathers + Skins (when applicable) = Live weight

The concept of meat production changes with the coverage of production as follows:

1.2.6 Production from slaughtered animals (SP): All animals of indigenous and foreign origin, slaughtered within the national boundaries.

1.2.7 Production from indigenous animals (GIP): Indigenous animals slaughtered plus the exported live animals of indigenous origin.

1.2.8 Total indigenous production (TIP) or biological production: Indigenous animals slaughtered, plus the exported live animals of indigenous origin and net additions (plus/minus) to the stock during the reference period. If it is expressed in weight, this measure should take into account also the change in the total live weight of all the animals.

1.2.9 In calculating indigenous production: It should be noted that as imports and exports of live animals are generally recorded in numbers, not weight, it is important to know what kinds of animals (large or small) are imported and exported. For example, the meat equivalent of two million chicks can vary by 80 to 250 tons, while the meat equivalent of two million adult chickens can vary by 2000 to 4000 tons.

1.3 Coverage of production: Most countries distinguish in their statistics between controlled or inspected or commercial slaughterings and other slaughterings, called variously, farm or private, non-commercial or uncontrolled slaughterings.

Under the first category, slaughterings in public and industrial slaughterhouses, meat processing plants and major poultry farms are usually included. Statistics on those slaughterings, and corresponding meat production, are easy to obtain from the administrative records of the establishments concerned. They report normally on a monthly basis; in some countries, weekly.

Under the second category are included slaughterings in small slaughterhouses, butchers' shops and on farms, mainly for the farmers own consumption. Statistics on non-commercial slaughterings, which can be derived from various sources, are essentially rough estimates and should be established once a year.

1.4 Recommendations

1.4.1 On the different possibilities of measuring the production of meat, it is recommended that countries collect and publish data primarily in terms of dressed carcass weight. However, in view of the fact that national practices regarding the definition of carcass weight are still far from homogeneous, each country should clearly indicate which parts of the animal are included in or excluded from its carcass weight concept. It would be desirable if countries would provide conversion factors from carcass weight to live weight or vice versa.

1.4.2 Countries not reporting according to the dressed carcass weight concept should clearly indicate which concepts they use when reporting production figures. They should provide appropriate conversion factors to convert their production into carcass weight equivalent, indicating also which parts or organs of the animal are excluded for the conversion to dressed carcass weight.

1.4.3 Production of meat of small animals should be reported, preferably according to the concept "ready-to-cook", specifying whether giblets are included or excluded. It is important that whatever concept is used be clearly explained.

1.4.4 It is recommended that all countries collect and report meat production data and corresponding numbers of slaughterings according to the concept of slaughtered production and indigenous production, both in line with FAO definitions, (see 1.2.9 above). In all cases, production should cover only that "approved for human consumption".

1.4.5 It is also recommended that countries which report edible offals and fats together with meat production in one figure provide the approximate percentage of edible offals and fats in the aggregated meat figures.

1.4.6 It is recommended that countries report at least annual figures covering all slaughterings, commercial and non-commercial, and corresponding meat production, for the following livestock species as applicable: cattle, buffaloes, sheep, goats, pigs, horses, chickens, turkeys, ducks, geese, guinea fowl, rabbits, other.

1.4.7 Countries reporting commercial figures only should indicate this limitation in a note or footnote and furnish, at least from time to time, estimates on non-commercial production. In general, separate figures should be reported for commercial and non-commercial production, particularly when the estimates of the last category are considered to be weak.

1.4.8 It is recommended that slaughterings data be reported in terms of both numbers slaughtered and meat production. In case any country collects and publishes statistics only in terms of one or the other, appropriate conversion factors should be provided, i.e., average carcass weight figures. If possible, countries should report, in addition to annual data, also monthly or quarterly data, at least for commercial slaughterings and production.

1.4.9 It is recommended that figures for cattle slaughterings be shown separately for calves and adult cattle, a suggested borderline between the two being 220 kg, live weight. Other animals, for which a breakdown of the total slaughterings between young and adult animals are considered to be useful, are sheep, goats and pigs.

1.5.0 It is suggested that countries collect and release also statistics on meat production from non-domestic animals, such as game meat, etc.

2.9.2.2 Hides and Skins

1. It is suggested that all countries collect and release production data for hides, skins and fur skins. Data should be given in terms of weight (fresh or green), except for fur skins which should be reported in numbers.

2. Countries reporting production in numbers or expressed in dry, cured or salted weight, should provide appropriate conversion factors to green weight.

3 Production figures for hides and skins may include also those coming from fallen animals, in addition to those from slaughtered animals.

2.9.3 Livestock products from live animals

1. Primary products: It includes the following: milk, eggs and fibres of animal origin.

2. Processed products: Those products are derived from primary products.

Concepts, Definitions, Coverage and Recommendations

1. Milking animals and milk production

1.1 Concepts, definitions and coverage

1.1.1 The definition of milking animals varies considerably among countries, from those which include all females in reproductive age to those which include only dairy females bred especially for milk production which were actually milked during the year.

1.1.2 On the other hand, estimates of milk production given by countries may refer to one or more of the following concepts: gross production includes milk actually milked and milk sucked by young animals; net production excludes milk sucked by young animals but includes amounts of milk fed to livestock; production available for consumption is net production minus milk fed to animals and waste at the farms; milk deliveries to dairies or dairy plants, excludes also quantities retained by farmers for food, feed and direct sales to consumers.

1.1.3 The FAO concept relates to net milk production as defined above, and, as regards milking animals, to all the animals which have contributed to produce that milk.

1.1.4 Data on production delivered to dairies are easily obtained from the dairy plants. Estimates for the balance of the production may be obtained from various sources, such as ad hoc surveys or subjective estimates.

1.2 Recommendations

1.2.1 In view of the differences identified above, it is recommended that countries report the number of milking animals along with milk production, and also that countries at least ensure that the concept of milking animals adopted is in line with the estimated average milk yield per animal. Countries are encouraged to refine their concept of milking animals to gradually approach to the concept of animals actually milked during the year, keeping, when possible, separate records for dairy females bred especially for milk production and for other females milked.

1.2.2 Countries should report data on milking animals by animal type, i.e. cows, buffaloes, sheep, goats, etc.

1.2.3 It is recommended that all countries report (at least annually) total net milk production as defined above, in addition to the data on deliveries to dairies or milk plants. Such data are to be given by kind of milking animal (cows, buffaloes, sheep, goats) and they should relate to whole milk. If possible, they should be reported in terms of weight rather than in liquid measures.

1.2.4 Countries reporting on a different basis should indicate the concept behind their figures.

1.2.5 Countries are advised to report production, or at least deliveries, either monthly or quarterly, and to report the average fat content of their milk production.

2. Layers and egg production statistics of hatcheries

2.1 Concepts, definitions and coverage

2.1.1 The definition of layers is not yet uniform among countries. Under this term, some countries recognize all females in laying age, whether laying or not, while in other countries the term is much more limited, covering only those females of egg-type breeds which have laid eggs during the year.

2.1.2 Female layers are classified by breed according to dominant production characteristics. There are egg-type females, as well as meat-type and mixed-type. They may also be classified according to the agricultural sector in which they are bred: the traditional sector (widely scattered and individually-owned small flocks in farms and backyards), and the modern sector (large scale, semi-intensive and intensive commercial poultry farms).

2.1.3 On the other hand, egg production is generally reported by countries as total or gross production, i.e., production from all types of females and from females kept in all agricultural sectors. Few countries report net production, i.e., gross production minus eggs used for hatching. Certain countries report data for both categories.

2.1.4 Several countries also report figures for commercial production, i.e., the part of the net production which enters into commercial channels. Data on commercial production are easily obtained from the modern sector where most, if not practically all, of the commercial production is produced. Data on the traditional sector are rather weak in certain countries as they are based on assumptions of the number of females and/or rates of egg laying, or are rough estimates based on food consumption surveys and similar indirect sources.

2.1.5 The FAO concept of egg production covers all domestic birds which have contributed to the egg production during the year, wherever they lay and the corresponding total production, including eggs intended to be used for hatching but excluding waste on farms.

2.2 Recommendations

2.2.1 In line with the FAO concept, it is recommended that countries report at least annually on layer numbers and egg production. Layers of all types and from all sectors which have laid eggs during the year should be included. Whenever possible, a distinction should be made between layers of the traditional sector and those of the semi-intensive and intensive sectors.

2.2.2 It is recommended that all countries report, at least annually, both total production of eggs, excluding only waste on farms, as defined by FAO, and production available for consumption, i.e., total production excluding hatching eggs and all types of waste. Countries reporting on different basis should indicate how their data differ from the recommended coverage.

2.2.3 It is further recommended that in reporting production data, countries should use both numbers and weight, or, at least, provide a conversion factor from one unit of measurement to the other. In addition to annual figures, countries should release also monthly or quarterly data, at least for commercial production. It is suggested that countries report production figures separately for the traditional sector and for the modern sector, particularly when the data of the traditional sector have a certain importance and are much less reliable than those of the modern sector.

2.2.4 In all cases, it is recommended that separate data be collected and released by countries according to various kinds of domestic birds: hens, ducks, goose, turkeys, etc.

2.3 Statistics of Hatcheries

Considerable changes have taken place in the poultry sector (eggs and meat) during the last two decades in most countries, resulting in the rapid growth of a modern and specialized sector alongside the traditional sector.

An important role in the development of the poultry sector is played by commercial hatcheries. In fact, several countries collect and publish monthly data on various hatcheries' operations, e.g. number of eggs placed, chicks hatched and chick placements.

It is recommended, therefore, that all countries collect data (monthly, if possible) on the number of eggs placed in incubators, chicks hatched and chicks placed, separately for chickens, ducks, geese, turkeys and guinea fowl. Figures for chickens should be divided into, at least, two categories: eggs/chicks for the laying stock and eggs/chicks for the meat stock.

3. Wool and Fine Hair

3.1 It is recommended that wool production data should be collected and released by all countries, including both shearing wool and pulled wool i.e. that recovered from skins.

3.2 Wool production figures should be reported on both a greasy basis and a clean or scoured basis. When reported in one way only, appropriate conversion factors should be included.

3.3 Countries producing significant quantities of fine hair or wool, such as cashmere and mohair, should report relevant production figures separate from common wool figures.

CHAPTER III

SAMPLING METHODOLOGY AND ESTIMATION PROCEDURE FOR ESTIMATION OF PRODUCTION FOR MAJOR LIVESTOCK PRODUCTS

3.1 Estimation of production of milk, eggs, wool and meat

3.1.1 Introduction

The only source of livestock statistics in the country prior to 1950 was quinquennial livestock census which was started in 1919. The last one was conducted in 2003. The census provides statistics on age-wise, sex-wise, breed-wise (crossbred and non-descript) number of animals at one point of time. Since these censuses are normally conducted after every five years. Intercensal estimates are not available from this source. Sample surveys provide an answer to such problems. Before start of regular surveys, for livestock products, the available official estimates of production were those obtained by the Directorate of Marketing and Inspection (DMI), Ministry of Food and Agriculture, Government of India through market surveys. These surveys were not based on objective criteria and as such had limited utility. For obtaining the estimates based on objectively planned sample surveys. IASRI carried out a series of methodological studies for estimation of major livestock products viz. milk, eggs, wool and meat on individual basis and also pilot surveys with the concept of integrated approach for simultaneous estimation of all these products in a single survey.

The methodology developed under the integrated approach was passed on to Department of Animal Husbandry and Dairying, Ministry of Agriculture, Government of India for adoption by Directorate of Animal Husbandry and Veterinary Services of different states for estimation of these products. The scheme of Integrated Sample Survey was initially started in 1972 and implemented as full-fledged scheme during 1975-76 by different states under the overall control of Department of Animal Husbandry and Dairying, Ministry of Agriculture, Government of India. Since then the department maintains database for animal husbandry, dairying and fisheries activities. The department coordinates data collection concerning production of major livestock products viz. milk, eggs, wool and meat and other livestock statistics through state governments and other central departments/organizations. Major livestock products are estimated on the basis of sample surveys being conducted throughout the year under the centrally sponsored scheme **Integrated Sample Survey**. The estimates are worked

out on seasonal basis which are published in the consolidated annual report of the sample survey prepared by the states/UTs.

3.1.2 Sampling design and sample size covered under Integrated Sample Surveys

The sampling design being adopted for the surveys for the estimation of production of milk, eggs, wool and meat is a stratified multi-stage random sampling with villages as the first stage unit, households / cluster of households as the second stage unit and the animals within the households as the third and ultimate unit whereas no sub-sampling of layers within a household is done for recording data on egg production. The animal husbandry districts in the states are taken as strata. For the estimation of livestock numbers a sample of 15% of the villages are selected in the state for complete enumeration of livestock population (5 % villages in each season viz. rainy, winter and summer). The samples of villages in each season are allocated to different strata in proportion to the population of livestock in them. From the selected villages a representative sample of 10-12 villages are selected for collection of detailed information for the estimation of district level estimates of milk, eggs, wool and meat. The sample of 10-12 villages is allocated to different tehsils/group of tehsils which constitutes a sub-strata according to livestock population in them. The selection of second stage units was done with equal probability and without replacement with sample size as follows:

1st Round

Milk: 2 clusters of 2 households each

Eggs: 2 clusters of 5 households each

Wool: Sample of 5 households (Flocks)

Meat: 2 recognized slaughter houses.

2nd, 3rd and 4th Rounds

Milk: 4 clusters of 2 households each

Eggs: 4 clusters of 5 households each

Wool: Sample of 8 households (Flocks)

Meat: 2 recognized slaughter houses

The recording of wool yield will be done in the shearing season in the selected villages from the sample of 5/8 households having sheep. The selection of ultimate unit of sampling was also done with equal probability and without replacement and the sample size covered as follows.

Milk: Two animals in milk (one cow and one buffalo or both cows or both buffaloes as the case may be) and all goats in milk.

Eggs: All the laying birds (this will include all laying ducks where the same are available)

Wool: Two rams / two whether, two ewes, two lambs

Meat: Three sheep, three goats, three pigs.

For estimation of meat production, an additional sample of two registered slaughter houses are selected at random in each stratum in a round and the information on meat production are collected from the sample of three animals of each species viz. sheep, goats, pigs and buffaloes.

3.1.3 Estimation of milk production

The estimates of number of animals in milk / milch animals, average milk yield per day per animal in milk / per milch animal and total milk production and their estimates of variances are given below. The procedure, in the first instance, is discussed for one season and for one category of animals, say, cows. Methods of pooling the estimates over different seasons are given subsequently. The procedure in the case of buffaloes is similar to that for cows.

3.1.3.1 Notations

Let V = total number of villages in the State;

n' = total number of villages selected during the year which is 15 per cent of total number of villages in the State i.e. $n' = 0.15 \times V$.

$$n = \frac{n'}{3} = \text{number of villages selected in a season}$$

T = number of strata formed in the State.

V_h = total number of villages in the stratum;

n_h = number of villages allocated to the h -th stratum for complete enumeration of livestock numbers.

$$\text{Thus } n = \sum_{h=1}^T n_h$$

$v_h = 1$ sub-sample of villages selected from the n_h villages in the h -th stratum for yield estimation.

M_{srhi} = number of animal in milk as enumerated in the i -th village of the h -th stratum during the r -th round of the s -th season. It may be noted here that the changes in the number of animals within a season are not substantial and may be ignored.

Thus, $M_{srhi} = M_{shi}$ for $r = 1, 2, 3, 4$

U_{srhi} = number of households in the sample from i -th village in the h -th stratum during the r -th round of the s -th season.

m_{srhij} = number of animals in milk for which a day's yield is recorded from the j-th household in the i-th village of the h-th stratum during the r-th round of the s-th season.

m'_{hi} = number of animals in milk in the i-th village of the h-th stratum according to the latest livestock census.

$$M'_h = \sum_{i=1}^{V_h} M'_{hi} \quad , \quad M' = \sum_{h=1}^T M'_h$$

Similarly, let N_{shi} , N'_{hi} , N'_h and N' be the corresponding notation for the number of milch (in milk + dry) animals.

Let Y_{srhijk} = milk yield of the k-th animal in the j-th household of the i-th village in the h-th stratum during the r-th round of the s-th season.

3.1.3.2 Estimates of number of animals in milk/milch and their estimates of variances in a season is given by

$$\hat{M}_s = \sum_{h=1}^T \hat{M}_{sh}$$

where $\hat{M}_{sh} = \hat{R}_{sh} \times M'_h$ $\hat{R}_{sh} = \frac{\sum_{i=1}^{n_h} M_{shi}}{\sum_{i=1}^{n_h} M'_{hi}}$

Similarly, estimate of number of milch animals in a season is given by

$$\hat{N}_s = \sum_{h=1}^T \hat{N}_{sh} \quad , \quad \text{where} \quad \hat{N}_{sh} = \hat{R}'_{sh} \times N'_h \quad \hat{R}'_{sh} = \frac{\sum_{i=1}^{n_h} N_{shi}}{\sum_{i=1}^{n_h} N'_{hi}}$$

Estimate of variance of \hat{M}_s is given by

$$\text{Est.V}(\hat{M}_s) = \sum_{h=1}^T \text{Est.V}(\hat{M}_{sh}) \quad ,$$

where approximately $\text{Est.V}(\hat{M}_{sh}) = \frac{V_h^2 \sum_{i=1}^{n_h} (M_{shi} - \hat{R}_{sh} M'_{hi})^2}{n_h (n_h - 1)}$

Similarly, estimates of variance of \hat{N}_s is given by

$$\text{Est.}V(\hat{N}_s) = \sum_{h=1}^T \text{Est.}V(\hat{N}_{sh}),$$

$$\text{where approximately } \text{Est.}V(\hat{N}_{sh}) = \frac{V_h^2 \sum_{i=1}^{n_h} (N_{shi} - \hat{R}'_{sh} N'_{hi})^2}{n_h (n_h - 1)}$$

3.1.3.3 Estimate of average milk yield per animal in milk/milch per day and total milk production and their estimates of variances

Estimate of average milk yield per animal in milk per day is given by

$$\bar{y}_{sh} = \frac{\sum_{i=1}^{v_h} M_{shi} \bar{y}_{shi}}{\sum_{i=1}^{v_h} M_{shi}}, \quad \bar{y}_{shi} = \frac{1}{d_s} \sum_{r=1}^{d_s} \bar{y}_{srhi} \quad \text{and} \quad \bar{y}_{srhi} = \frac{\sum_{j=1}^{u_{srhi}} \sum_{k=1}^{m_{srhij}} y_{srhijk}}{\sum_{j=1}^{u_{srhi}} m_{srhij}}$$

where d_s = number of rounds (months) in the s-th season.

Similarly, estimate of average milk yield per milch animal per day is given by

$$\bar{Z}_{sh} = \frac{\sum_{i=1}^{v_h} M_{shi} \bar{y}_{shi}}{\sum_{i=1}^{v_h} N_{shi}}$$

Estimate of variance of \bar{y}_{sh} is given by

$$\text{Est.}V(\bar{y}_{sh}) = \frac{1}{v_h (v_h - 1)} \sum_{i=1}^{v_h} \frac{M_{shi}^2}{\hat{M}_{sh}^2} (\bar{y}_{shi} - \bar{y}_{sh})^2 \quad \text{where} \quad \hat{M}_{sh} = \frac{\sum_{i=1}^{v_h} M_{shi}}{v_h}$$

Similarly, $\text{Est.} V(Z_{sh})$ can be worked out exactly in a similar manner.

3.1.3.4 Estimate of total milk production

Estimate of total milk production per day in the h-th stratum and in the s-th season is given by

$$\hat{P}_{sh} = \hat{M}_{sh} \times \bar{y}_{sh}$$

Estimate of the variance of P_{sh} is given by

$$\text{Est.}V(\hat{P}_{sh}) = \hat{M}_{sh}^2 \text{Est.}V(\bar{y}_{sh}) + \bar{y}_{sh}^2 \text{Est.}V(\hat{M}_{sh})$$

where $\text{Est.} V(y_{sh})$ and $\text{Est.} V(M_{sh})$ are already defined.

Estimate of total milk production per day in a season over all the strata is given by

$$\hat{P}_s = \sum_{h=1}^T \hat{P}_{sh}$$

$$\text{Est. V}(\hat{P}_s) = \sum_{h=1}^T \text{Est. V}(\hat{P}_{sh})$$

An estimate of average milk yield per animal in milk per day pooled over all the strata is given by

$$\bar{y}_s = \frac{\hat{P}_s}{\hat{M}_s} = \frac{\sum_{h=1}^T \hat{P}_{sh}}{\sum_{h=1}^T \hat{M}_{sh}}$$

Estimate of the variance of \bar{y}_s is given by

$$\text{Est. V}(\bar{y}_s) = \frac{1}{\hat{M}_s^2} \left[\text{Est. V}(\hat{P}_s) + \bar{y}_s^2 \text{Est. V}(\hat{M}_s) - 2 \bar{y}_s \text{Cov.}(\hat{P}_s, \hat{M}_s) \right], \text{ where}$$

$$\text{Est. Cov.}(\hat{P}_s, \hat{M}_s) = \sum_{h=1}^T \text{Est. Cov.}(\hat{P}_{sh}, \hat{M}_{sh})$$

$$\text{Est. Cov.}(\hat{P}_{sh}, \hat{M}_{sh}) = \frac{V_h^2 \sum_{i=1}^{v_h} (M_{shi} \bar{y}_{shi} - \hat{R}_{sh}'' M'_{hi}) (M_{shi} - \hat{R}_{sh} M'_{hi})}{v_h (v_h - 1)},$$

$$\hat{R}_{sh}'' = \frac{\sum_{i=1}^{v_h} M_{shi} \bar{y}_{shi}}{\sum_{i=1}^{v_h} M'_{hi}}$$

3.1.3.5 Pooling of the estimates and the estimates of their variances over the different seasons

Let M, N, y, z and P be the estimates of animals in milk, milch animals, average milk yield per day per animal in milk / per milch animal and total milk production per day in the entire year.

$$\text{Then, } \hat{M} = \sum_{s=1}^3 Q_s \hat{M}_s$$

Q_s is the relative period of the season viz $\frac{d_s}{12}$ and $\sum_{s=1}^3 Q_s = 1$

Similarly, $\hat{N} = \sum_{s=1}^3 Q_s \hat{N}_s$

$$\hat{P} = \sum_{s=1}^3 Q_s P_s$$

$$\text{Est. V}(\hat{M}) = \sum_{s=1}^3 Q_s^2 \text{Est. V}(\hat{M}_s) \quad \bar{y} = \frac{\sum_{s=1}^3 \hat{M}_s \bar{y}_s}{\hat{M}}; \quad \bar{y} = \frac{\hat{P}}{\hat{M}} \text{ approximately}$$

$$\text{Est. V}(\hat{N}) = \sum_{s=1}^3 Q_s^2 \text{Est. V}(\hat{N}_s) \quad \bar{z} = \frac{\sum_{s=1}^3 \hat{N}_s \bar{z}_s}{\hat{N}} \quad \text{and} \quad \bar{z} = \frac{\hat{P}}{\hat{N}} \text{ approximately}$$

$$\text{Est. V}(\hat{P}) = \sum_{s=1}^3 Q_s^2 \text{Est. V}(\hat{P}_s)$$

$$\text{Est. Cov.}(\hat{P}, \hat{M}) = \sum_{s=1}^3 Q_s^2 \text{Est. Cov.}(\hat{P}_s, \hat{M}_s)$$

Est. V(\bar{y}) may be taken as approximately equal to:

$$\frac{1}{\hat{M}^2} \left[\text{Est. V}(\hat{P}) + \bar{y}^2 \text{Est. V}(\hat{M}) - 2 \bar{y} \text{Est. Cov.}(\hat{P}, \hat{M}) \right]$$

$$\text{Similarly } \text{Est. V}(\bar{z}) = \frac{1}{\hat{N}^2} \left[\text{Est. V}(\hat{P}) + \bar{z}^2 \text{Est. V}(\hat{N}) - 2 \bar{z} \text{Est. Cov.}(\hat{P}, \hat{N}) \right]$$

3.1.3.6 Tabulation of estimation of number of milk animals, average milk yield per animal per day, total milk production per day and estimation of their variances

Table 1: Estimation of number of milk animal (cattle) and estimation of its variances

season	stratum	Total no of village	No of villages for complete enumeration	No of enumerated milk animal M_{srhi}	Census no of milk animal M'_{hi}	M'_h	\hat{R}_{sh}	\hat{M}_{sh}	$\hat{R}_{sh}^* M'_{hi}$	$M_{srhi} - \hat{R}_{sh}^* M'_{hi}$	$(col.11)^2$	$\hat{V}(\hat{M}_{sh})$	%SE
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	I		1										
			2										
			.										
			10										
	Total	V_h	n_h	Σ	Σ	$M'_h = \sum_{i=1}^{V_h} M'_{hi}$	col.5/col.6	col. 8*col. 7	col. 8*col. 6	col.5-col.10	Σ	$(col.3)^2 * col.12 / col.4(col.4-1)$	$\sqrt{col.13*100 / col.9}$
	Pooling of the stratum in the season												
	I	V_h	n_h	Σ	Σ	$M'_h = \sum_{i=1}^{V_h} M'_{hi}$	col.5/col.6	col. 8*col. 7	col. 8*col. 6	col.5-col.10	Σ	$(col.3)^2 * col.12 / col.4(col.4-1)$	$\sqrt{col.13*100 / col.9}$
	II												
	III												
	overall							$\Sigma = \hat{M}_s$				$\Sigma = \hat{V}(\hat{M}_s)$	$\sqrt{col.13*100 / col.9}$

Table 2: Estimation of average milk yield per animal (cattle) per day

season	Stratum	village V _h	Round	house- hold u _{srhij}	No of milk animal M _{srhij}	Yield of selec- ted animal		Total	\bar{Y}_{srhi}	\bar{Y}_{shi}	No of enumerated animal in milk M _{shi}	M _{shi} * \bar{Y}_{shi}	$\hat{\bar{Y}}_{sh}$	M _{shi} ² * ($\bar{Y}_{shi} - \bar{Y}_{sh}$) ²	$\hat{V}(\bar{Y}_{sh})$	%SE	M _{hi}	\hat{R}_{sh}''	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
1	1	1	1	1															
				-															
				4															
					Σ				Σ	col.9/col.6									
			2	1															
				-															
				8															
					Σ				Σ	col.9/col.6									
			3	1															
				-															
				8															
					Σ				Σ	col.9/col.6									
		4	1																
			-																
			8																
				Σ				Σ											
	overall							Σ	col.10/ col. 4	M _{shi}	col.11* col.12		$[col.12(col.11 - col.14)]^2$						
Pooling over village of the stratum																			
1	1	1	4						Σ	col.10/ col. 4	M _{shi}	col.11* col.12		$[col.12(col.11 - col.14)]^2$					
		2	4						Σ	col.10/ col. 4	M _{shi}	col.11* col.12		$[col.12(col.11 - col.14)]^2$					
		3	4						Σ	col.10/ col. 4	M _{shi}	col.11* col.12		$[col.12(col.11 - col.14)]^2$					
		4	4						Σ	col.10/ col. 4	M _{shi}	col.11* col.12		$[col.12(col.11 - col.14)]^2$					
		5	4						Σ	col.10/ col. 4	M _{shi}	col.11* col.12		$[col.12(col.11 - col.14)]^2$					
	overall	5								$\hat{M}_{sh} = \frac{\sum}{col.3}$	Σ	col.13/ col.12	Σ	col.15/ (col.12) ² × col.3(col.3-1)	√col.16 *100/ col.14	Σ	col.13 /col.18		

Table 3: Estimation of total milk production per day

season	stratum	$\hat{\bar{Y}}_{sh}$	$\hat{V}(\bar{Y}_{sh})$	\hat{M}_{sh}	\hat{P}_{sh}	$\hat{V}(\hat{M}_{sh})$	$\hat{V}(\hat{P}_{sh})$	\bar{Y}_s	\hat{R}_{sh}''	M'_{hi}	$\hat{R}_{sh}'' * M'_{hi}$	$M_{srhi} - \hat{R}_{sh}'' * M'_{hi}$	$M_{shi} * \bar{Y}_{shi}$
1	2	3	4	5	6	7	8	9	10	11	12	13	14
I	I				col.3*col.5		$(col.5)^2 * col.4 + (col.3)^2 * col.7$		from col. 19 of table2	from col. 6 of table1	col.10*col.11	from col. 11 of table1	from col.13 of table2
	II				col.3*col.5		$(col.5)^2 * col.4 + (col.3)^2 * col.7$				col.10*col.11		
	III				col.3*col.5		$(col.5)^2 * col.4 + (col.3)^2 * col.7$				col.10*col.11		
	overall			$\Sigma = \hat{M}_s$	$\Sigma = \hat{P}_s$	$\Sigma = \hat{V}(\hat{M}_s)$	$\Sigma = \hat{V}(\hat{P}_s)$	col.6/col.5					

$M_{shi} * \bar{Y}_{shi} - \hat{R}_{sh}'' * M'_{hi}$	$(M_{shi} * \bar{Y}_{shi} - \hat{R}_{sh}'' * M'_{hi}) * (M_{srhi} - \hat{R}_{sh}'' * M'_{hi})$	$V^2_h / V_h (V_h^{-1})$	$EstCov(\hat{P}_{sh}, \hat{M}_{sh})$	$\hat{V}(\bar{Y}_s)$	%SE
15	16	17	18	19	20
col.14-col.12	col.15*col.13	$(from\ col.3\ of\ table1)^2 / from\ col.3\ (col.3-1)\ of\ table2$	col.17*col.16		
col.14-col.12	col.15*col.13		col.17*col.16		
col.14-col.12	col.15*col.13		col.17*col.16		
	Σ		$\Sigma = EstCov(\hat{P}_s, \hat{M}_s)$	$[col.8\ (col.9)^2 * col.7 - 2*col.9*col.18] / (col.5)^2$	$\sqrt{col.19*100 / col.9}$

Table 4: Pooling of the estimates and estimates of their Variances over the different Seasons

season	\bar{Y}_s	\hat{M}_s	Q_s	$Q_s^* \hat{M}_s$	\hat{P}_s	$Q_s^* \hat{P}_s$	\bar{Y}	$\hat{V}(\hat{M}_s)$	$Q_s^2 * \hat{V}(\hat{M}_s)$	$\hat{V}(\hat{P}_s)$	$Q_s^2 * \hat{V}(\hat{P}_s)$	$Est.Cov.(\hat{P}_s, \hat{M}_s)$	$Q_s^2 * EstCov(\hat{P}_s, \hat{M}_s)$	$\hat{V}(\bar{Y})$	%SE
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
I	from col. 9 of table3	from col.5 of table3	1/3	col.3*col.4	from col.6 of table3	col.4*col.6		from col.7 of table3	$(col.4)^2 * col.9$	from col.8 of table3	$(col.4)^2 * col.11$	from col.18 of table3	$(col.4)^2 * col.13$		
II			1/3	col.3*col.4		col.4*col.6			$(col.4)^2 * col.9$		$(col.4)^2 * col.11$		$(col.4)^2 * col.13$		
III			1/3	col.3*col.4		col.4*col.6			$(col.4)^2 * col.9$		$(col.4)^2 * col.11$		$(col.4)^2 * col.13$		
overall				$\Sigma = \hat{M}$		$\Sigma = \hat{P}$	col.7/col.5		$\Sigma = \hat{V}(\hat{M})$	Σ	$\Sigma = \hat{V}(\hat{P})$		$\Sigma = EstCov(\hat{P}, \hat{M})$	$[col.12 + (col.8)^2 * col.10 - 2*col.8*col.14] / (col.5)^2$	$\sqrt{col.15*100 / col.8}$

3.1.4 Estimation of egg production

The estimates of number of layers (adult female birds), average egg production per layer and total egg production and estimates of variances of these estimates are given. The procedure, in the first instance, is discussed for one season and with reference to one species and breed of poultry birds. The procedure for other species and breeds will be identical. Methods of pooling the estimates and estimates of their variances over different seasons are also given at the end.

3.1.4.1 Notation

Let there be T strata in the population and the number of villages in the h -th stratum be V_h . A sample of n' villages is selected from the total number of villages, say V , in the state during the year which is 15 percent of total number of villages i.e. $n' = 0.15 \times V$

Further let,

n = number of villages selected in a season i.e. $n = n'/3$

n_h = number of sampled villages allocated to the h -th stratum for complete enumeration of livestock numbers.

$$n = \sum_{h=1}^T n_h$$

v_h be a sub-sample of villages selected from the n_h villages in the h -th stratum for yield estimation.

M_{srhij} be the number of layers (of the breed and species under consideration) in the i -th village of the h -th stratum during the first round of the s -th season.

U_{rhi} be the number of households in the sample (observed for recording egg production) from the i -th village in the h -th stratum during r -th round of the s -th season. m_{srhij} be the number of layers on the day of visit in the j -th household of the i -th village of the h -th stratum during the r -th round of the s -th season.

y_{srhij} be the number of eggs laid by m_{srhij} birds defined above.

M'_{hi} be the number of layers in the i -th village of the h -th stratum according to the latest livestock Census data.

$$M'_h = \sum_{i=1}^{v_h} M'_{hi} \quad \text{and} \quad M' = \sum_{h=1}^T M'_h$$

3.1.4.2 Estimate of number of layers and estimate of its variance

Estimate of Number of Layers in a season is given by

$$\hat{M}_s = \sum_{h=1}^T \hat{M}_{sh} \quad \text{where} \quad \hat{M}_{sh} = \frac{\sum_{i=1}^{n_h} M_{slhi}}{\sum_{i=1}^{n_h} M'_{hi}} \times M'_h$$

Estimate of variance of M_{sh} may be approximately taken as,

$$\text{Est. } V(\hat{M}_{sh}) = \frac{V_h^2 \sum_{i=1}^{n_h} (M_{slhi} - \hat{R}_{sh} M'_{hi})^2}{n_h (n_h - 1)} \quad \text{where} \quad \hat{R}_{sh} = \frac{\sum_{i=1}^{n_h} M_{slhi}}{\sum_{i=1}^{n_h} M'_{hi}}$$

$$\text{Est. } V(\hat{M}_s) = \sum_{h=1}^T \text{Est. } V(\hat{M}_{sh})$$

3.1.4.3 Estimates of average egg production per layer per day and total egg production and estimates of their variances

Estimate of average egg production per layer per day in the h-th stratum during the s-th season is given by

$$\bar{y}_{sh} = \frac{\sum_{i=1}^{v_h} M_{slhi} \times \bar{y}_{shi}}{\sum_{i=1}^{v_h} M_{slhi}} \quad \text{where} \quad \bar{y}_{shi} = \frac{1}{d_s} \sum_{r=1}^{d_s} \bar{y}_{srhi} \quad \text{and}$$

$$\bar{y}_{srhi} = \frac{\sum_{j=1}^{u_{srhi}} y_{srhij}}{\sum_{j=1}^{u_{srhi}} m_{srhij}}$$

d_s being the number of rounds in the s-th season.

Estimate of the variance of \bar{y}_{sh} is given approximately by

$$\text{Est. } V(\bar{y}_{sh}) = \frac{1}{v_h (v_h - 1)} \frac{\sum_{i=1}^{v_h} M_{slhi}^2 (\bar{y}_{shi} - \bar{y}_{sh})^2}{\hat{M}_{sh}^2} \quad \text{where} \quad \bar{M}_{sh} = \frac{\sum_{i=1}^{v_h} M_{slhi}}{v_h}$$

Estimate of total egg production per day in the h-th stratum and in the s-th season is given by

$$\hat{P}_{sh} = \hat{M}_{sh} \times \hat{y}_{sh} \quad \text{Est. } V(\hat{P}_{sh}) = \hat{M}_{sh}^2 \text{Est. } V(\bar{y}_{sh}) + \bar{y}_{sh}^2 \text{Est. } V(\hat{M}_{sh})$$

Estimate of total egg production per day in a season for the entire population is given by

$$\hat{P}_s = \sum_{h=1}^T \hat{P}_{sh} \quad \text{Est. } V(\hat{P}_s) = \sum_{h=1}^T \text{Est. } V(\hat{P}_{sh})$$

An estimate of average egg production per layer per day pooled over all the strata will be given by

$$\bar{y}_s = \frac{\hat{P}_s}{\hat{M}_s} = \sum_{h=1}^T P_{sh} / \sum_{h=1}^T \hat{M}_{sh}$$

Estimate of the variance of \bar{y}_s is given by

$$\text{Est. } V(\bar{y}_s) = \frac{1}{\hat{M}_s^2} \left[\text{Est. } V(\hat{P}_s) + \bar{y}_s^2 \text{Est. } V(\hat{M}_s) + 2 \bar{y}_s \text{Est. } \text{Cov.}(\hat{P}_s, \hat{M}_s) \right]$$

$$\text{Est. } \text{Cov.}(\hat{P}_s, \hat{M}_s) = \sum_{h=1}^T \text{Est. } \text{Cov.}(\hat{P}_{sh}, \hat{M}_{sh})$$

$$\text{Est. } \text{Cov.}(\hat{P}_{sh}, \hat{M}_{sh}) = \frac{V_h^2}{v_h(v_h - 1)} \sum_{i=1}^{v_h} (M_{slhi} \bar{y}_{shi} - \hat{R}'_{sh} M'_{hi}) (M_{slhi} - \hat{R}_{sh} M'_{hi})$$

$$\hat{R}'_{sh} = \frac{\sum_{i=1}^{v_h} M_{slhi} \bar{y}_{shi}}{\sum_{i=1}^{v_h} M'_{hi}}$$

3.1.4.4 Pooling of the estimates and the estimates of their variances over different seasons

Let \hat{M} , \bar{y} and \hat{P} be the estimates of number of layers, average egg production per layer per day and total egg production per day in the season, then

$$\hat{M} = \sum_{s=1}^3 Q_s \hat{M}_s$$

where Q_s is the relative period of the season, viz $\frac{d_s}{12}$ and

$$\sum_{s=1}^3 Q_s = 1, \quad \bar{y} = \frac{\sum_{s=1}^3 \hat{M}_s \bar{y}_s}{\hat{M}}, \quad \hat{P} = \sum_{s=1}^3 Q_s \hat{P}_s,$$

$$\bar{y} = \frac{\hat{P}}{\hat{M}} \text{ approx.} \quad \text{Est. V}(\hat{P}) = \sum_{s=1}^3 Q_s^2 \text{Est. V}(\hat{P}_s)$$

$$\text{Est. V}(\hat{M}) = \sum_{s=1}^3 Q_s^2 \text{Est. V}(\hat{M}_s)$$

Est.V(\bar{y}) may be taken approximately equal to

$$\frac{1}{\hat{M}_s^2} \left[\text{Est. V}(\hat{P}) + \bar{y}^2 \text{Est. V}(\hat{M}) - 2\bar{y} \text{Est. Cov.}(\hat{P}, \hat{M}) \right]$$

where $\text{Est. Cov.}(\hat{P}, \hat{M}) = \sum_{s=1}^3 Q_s^2 \text{Est. Cov.}(\hat{P}_s, \hat{M}_s)$

3.1.4.5 Tabulation of estimation of number of layers, average egg production per layer per day, total egg production and estimation of their variances

Table 1: Estimation of number of layers and estimation of its variances

Season	Stratum	Total no of village	No of villages for complete enumeration	No of enumerated layers M_{shi}	Census no of layers M'_{hi}	M'_h	\hat{R}_{sh}	\hat{M}_{sh}	$\hat{R}_{sh} * M'_{hi}$	$M_{shi} - \hat{R}_{sh} * M'_{hi}$	$(col.11)^2$	$\hat{V}(\hat{M}_{sh})$	%SE
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	I		1										
			2										
			.										
			10										
	Total	V_h	n_h	Σ	Σ	$M'_h = \sum_{i=1}^{V_h} M'_{hi}$	col.5/ col.6	col.8*col.7	col.8*col.6	col.5-col.10	Σ	$(col.3)^2 * col.12 / col.4 (col.4-1)$	$\sqrt{col.13 * 100 / col.9}$
	Pooling of the stratum in the season												
	I	V_h	n_h	Σ	Σ	$M'_h = \sum_{i=1}^{V_h} M'_{hi}$	col.5/ col.6	col.8*col.7	col.8*col.6	col.5-col.10	Σ	$(col.3)^2 * col.12 / col.4 (col.4-1)$	$\sqrt{col.13 * 100 / col.9}$
	II												
	III												
	Overall							$\Sigma = \hat{M}_s$				$\Sigma = \hat{V}(\hat{M}_s)$	$\sqrt{col.13 * 100 / col.9}$

Table 2: Estimation of average egg production per layer per day

Season	Stratum	Village V_h	Round	House hold u_{srhi}	No of layer M_{srhij}	total eggs \bar{Y}_{srhij}	\bar{Y}_{srhi}	\bar{Y}_{shi}	No of enumerated layers M_{shi}	M_{shi} * \bar{Y}_{shi}	$\hat{\bar{Y}}_{sh}$	$M^2_{shi} * (\bar{Y}_{shi} - \bar{Y}_{sh})^2$	$\hat{V}(\bar{Y}_{sh})$	%SE	Census no of layers M'_{hi}	\hat{R}''_{sh}
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1	1	1	1												
				-												
				4												
					Σ	Σ	col.7/col.6									
			2	1												
				-												
				8												
					Σ	Σ	col.7/col.6									
			3	1												
				-												
				8												
					Σ	Σ	col.7/col.6									
			4	1												
				-												
				8												
					Σ	Σ	col.7/col.6									
		Overall	4				Σ	col.8/ col.4	M_{shi}	col.10* col.9		$[col.10(col.11 - col.12)]^2$				
1	1	1	4				Σ	col.8/ col.4	M_{shi}	col.10* col.9		$[col.10(col.11 - col.12)]^2$				
		2	4				Σ	col.8/ col.4	M_{shi}	col.10* col.9		$[col.10(col.11 - col.12)]^2$				
		3	4				Σ	col.8/ col.4	M_{shi}	col.10* col.9		$[col.10(col.11 - col.12)]^2$				
		4	4				Σ	col.8/ col.4	M_{shi}	col.10* col.9		$[col.10(col.11 - col.12)]^2$				
		5	4				Σ	col.8/ col.4	M_{shi}	col.10* col.9		$[col.10(col.11 - col.12)]^2$				
	Overall	5							Σ $\hat{M}_{sh} = \frac{\Sigma}{col.3}$	Σ	col.11/ col.10	Σ	col.13/ $(col.10)^2 * col.3(col.3-1)$	$\sqrt{col.14 * 100 / col.12}$	Σ	col.11/ col.16

Table 3: Estimation of total egg production per day

Season	Stratum	$\hat{\bar{Y}}_{sh}$	$\hat{V}(\bar{Y}_{sh})$	\hat{M}_{sh}	\hat{P}_{sh}	$\hat{V}(\hat{M}_{sh})$	$\hat{V}(\hat{P}_{sh})$	\bar{Y}_s	\hat{R}_{sh}	M'_{hi}	$\hat{R}_{sh} * M'_{hi}$	$M_{srhi} - \hat{R}_{sh} * M'_{hi}$	$M_{shi} * \bar{Y}_{shi}$
1	2	3	4	5	6	7	8	9	10	11	12	13	14
I	I				col.3*col.5		$(col.5)^2 * col.4 + (col.3)^2 * col.7$		from col.17 of table2	from col.6 of table1	col.10*col.11	from col.11 of table1	from col.11 of table2
	II				col.3*col.5		$(col.5)^2 * col.4 + (col.3)^2 * col.7$				col.10*col.11		
	III				col.3*col.5		$(col.5)^2 * col.4 + (col.3)^2 * col.7$				col.10*col.11		
	Overall			$\Sigma = \hat{M}_s$	$\Sigma = \hat{P}_s$	$\Sigma = \hat{V}(\hat{M}_s)$	$\Sigma = \hat{V}(\hat{P}_s)$	col.6/col.5					

$M_{shi} * \bar{Y}_{shi} - \hat{R}_{sh} * M'_{hi}$	$(M_{sh} * \bar{Y}_{sh} - \hat{R}_{sh} * M'_{hi}) * (M_{srhi} - \hat{R}_{sh} * M'_{hi})$	$V^2_h / v_h (v_h - 1)$	$EstCov(\hat{P}_{sh}, \hat{M}_{sh})$	$\hat{V}(\bar{Y}_s)$	%SE
15	16	17	18	19	20
col.14-col.12	col.15*col.13	$(from\ col.3\ of\ table1)^2$	col.17*col.16		
col.14-col.12	col.15*col.13	/from col.3 (col.3-1) of table2	col.17*col.16		
col.14-col.12	col.15*col.13		col.17*col.16		
	Σ		$\Sigma = EstCov(\hat{P}_s, \hat{M}_s)$	$[col.8 + (col.9)^2 * col.7 - 2 * col.9 * col.18] / (col.5)^2$	$\sqrt{col.19 * 100 / col.9}$

Table 4: Pooling of the estimates and estimates of their Variances over the different Seasons

Season	\bar{Y}_s	\hat{M}_s	Q_s	$Q_s * \hat{M}_s$	\hat{P}_s	$Q_s * \hat{P}_s$	\bar{Y}	$\hat{V}(\hat{M}_s)$	$Q_s^2 * \hat{V}(\hat{M}_s)$	$\hat{V}(\hat{P}_s)$	$Q_s^2 * \hat{V}(\hat{P}_s)$	$EstCov(\hat{P}_s, \hat{M}_s)$	$Q_s^2 * EstCov(\hat{P}_s, \hat{M}_s)$	$\hat{V}(\bar{Y})$	%SE
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
I	from col.9 of table3	from col.5 of table3	1/3	col.3*col.4	from col.6 of table3	col.4*col.6		from col.7 of table3	$(col.4)^2 * col.9$	from col.8 of table3	$(col.4)^2 * col.11$	from col.18 of table3	$(col.4)^2 * col.13$		
II			1/3	col.3*col.4		col.4*col.6			$(col.4)^2 * col.9$		$(col.4)^2 * col.11$		$(col.4)^2 * col.13$		
III			1/3	col.3*col.4		col.4*col.6			$(col.4)^2 * col.9$		$(col.4)^2 * col.11$		$(col.4)^2 * col.13$		
Overall				$\Sigma = \hat{M}$		$\Sigma = \hat{P}$	col.7/col.5	$\Sigma = \hat{V}(\hat{M})$	Σ	$\Sigma = \hat{V}(\hat{P})$		$\Sigma = EstCov(\hat{P}, \hat{M})$	$[col.12 + (col.8)^2 * col.10 - 2 * col.8 * col.14] / (col.5)^2$	$\sqrt{col.15 * 100 / col.8}$	

3.1.5 Estimation of wool production

The procedure for estimating sheep numbers, average wool yield per sheep and total wool production and also the estimates for their variances are given below. The procedure is discussed for one category of sheep say (ewes) only. For others the procedure is identical.

3.1.5.1 Notation

Let N = number of villages in the district

n' = total number of villages selected during the year which is 15 per cent of the total number of villages in the district i.e. $n' = 0.15 \times N$.

n = number of villages selected in a season i.e. $n = \frac{n'}{3}$

T = number of strata formed in the district

V_h = total number of villages in the h -th stratum

n_h = number of villages allotted to the h -th stratum for complete enumeration of households for sheep numbers in a season

$$\text{Thus } n = \sum_h^T n_h$$

v_h = sub-sample of villages selected from the n_h villages in the h -th stratum for yield estimation

X_{shi} = enumerated number of sheep in the s -th season, h -th stratum and i -th village.

y_{shijk} = wool yield in the s -th season, h -th stratum, i -th village, j -th flock and k -th sheep.

Let X'_{hi} , X'_h and X' be the number of sheep in the i -th village, h -th stratum and in the entire district as per the latest livestock census respectively i.e.

$$W_h = \frac{X'_h}{X'}$$

3.1.5.2 Estimation of sheep population

(i) Estimation for a season

The estimate of sheep population in the s -th season is given by:

$$\hat{X}_s = \sum_{h=1}^T \hat{X}_{sh}$$

Where \hat{X}_{sh} is the estimate for the h -th stratum in the s -season and is given by

$$\hat{X}_{sh} = \frac{\sum_{i=1}^{n_h} \hat{X}_{shi}}{\sum_{i=1}^{n_h} X'_{hi}} X'_h \quad \text{Or} \quad \hat{X}_{sh} = \hat{R}_{sh} x \hat{X}_h$$

Estimate of variance of \hat{X}_{sh} is given by

$$\hat{V}(\hat{X}_{sh}) = \frac{V_h^2 \sum_{i=1}^{n_h} (X_{shi} - \hat{R}_{sh} X'_{hi})^2}{n_h(n_h - 1)}$$

Estimate of variance of \hat{X}_s is given by

$$\hat{V}(\hat{X}_s) = \sum_{h=1}^T \hat{V}(\hat{X}_{sh})$$

(ii) Estimate of average sheep population in the district

The estimate of average sheep population in the h-th stratum is given by

$$\hat{X}_h = \frac{1}{3} \sum_{s=1}^3 \hat{X}_{sh}$$

and the estimate of sheep population in the district is given by

$$\hat{X} = \sum_{h=1}^T \hat{X}_h$$

Estimate of variance of \hat{X}_h is given by

$$\hat{V}(\hat{X}_h) = \frac{1}{9} \sum_{s=1}^3 \hat{V}(\hat{X}_{sh}) = \frac{1}{9} [\hat{V}(\hat{X}_{1h}) + \hat{V}(\hat{X}_{2h}) + \hat{V}(\hat{X}_{3h})]$$

and

$$\hat{V}(\hat{X}) = \sum_{h=1}^T \hat{V}(\hat{X}_h)$$

3.1.5.3 Estimation of average wool yield per sheep

(i) Estimation of average wool yield per sheep in a season

During each shearing season, v_h villages would be covered and from each flock in a sample of selected flocks within a village, 2 rams or 2 wethers or 1 ram and 1 wether, 2 ewes and 2 lambs were selected for recording individual fleece weights. The following estimates are for a sheep wether or ram, ewe or lamb.

Let $\bar{y}_{shi} = \frac{\sum_{j=1}^{f_{shi}} \sum_{k=1}^{x_{shij}} y_{shijk}}{\sum_{j=1}^{f_{shi}} x_{shij}}$ the average wool yield per sheep in the i-th village.

x_{shij} be the number of sheep selected in the s-th season, h-th stratum, i-th village, j- th flock, f_{shi} be the number of flocks selected in the i-th village.

The estimate of wool production in the i-th village is given by:

$$P_{shi} = X''_{shi} \bar{y}_{shi}$$

$$X''_{shi} = (\% \text{ Sheep shorn}) \times X_{shi}$$

where X''_{shi} is the number of sheep sheared in the i-th village. This is obtained by multiplying X_{shi} with percentage of sheep shorn in the i-th village.

The estimate of average wool yield per sheep is given by:

$$\bar{y}_{sh} = \frac{\sum_{i=1}^{v_h} P_{shi}}{\sum_{i=1}^{v_h} X''_{shi}} \text{ for h-th stratum.}$$

Estimate of variance of \bar{y}_{sh} is approximately given by

$$\hat{V}(\bar{y}_{sh}) = \frac{1}{v_h(v_h - 1)} - \frac{1}{\bar{X}''^2_{sh}} \sum_{i=1}^{v_h} (P_{shi} - \bar{y}_{sh} X''_{shi})^2$$

where

$$\bar{X}''_{sh} = \frac{1}{v_h} \sum_{i=1}^{v_h} X''_{shi}$$

Estimate of average wool yield per sheep during the s-th season in the district is given by:

$$\bar{y}_s = \sum_{h=1}^T W_h \bar{y}_{sh}$$

Estimate of variance is given by

$$\hat{V}(\bar{y}_s) = \sum_{h=1}^T W_h^2 \hat{V}(\bar{y}_{sh})$$

(ii) Estimate of annual wool yield per sheep

The estimate of annual wool yield per sheep in the h-th stratum is given by

$$\bar{y}_h = \sum_{s=1}^3 \bar{y}_{sh}$$

Estimate of variance of \bar{y}_h is given by:

$$\hat{V}(\bar{y}_h) = \hat{V}(\bar{y}_{1h}) + \hat{V}(\bar{y}_{2h}) + \hat{V}(\bar{y}_{3h})$$

$\hat{V}(\bar{y}_{1h}), \hat{V}(\bar{y}_{2h}), \hat{V}(\bar{y}_{3h})$ are as given earlier.

An estimate of annual wool yield per sheep for the district is given by:

$$\bar{y} = \sum_{h=1}^T W_h \bar{y}_h$$

Estimate of variance of \bar{y} is given by:

$$\hat{V}(\bar{y}) = \sum_{h=1}^T W_h^2 \hat{V}(\bar{y}_h)$$

Similarly estimate of annual wool yield per ram, ewe and lamb can be obtained.

3.1.5.4 Estimate of annual wool production

(i) Estimate of total wool production of the district in a season

The estimate of wool production

$$\hat{P}_{sh} = \hat{X}_{sh}'' \bar{y}_{sh}$$

where \hat{X}_{sh}'' be the estimated number of sheep shorn in the h-th stratum during the s-th season and is obtained by multiplying \hat{X}_{sh} with percentage of sheep shorn in the h-stratum.

Estimate of variance of \hat{P}_{sh} is given by:

$$\hat{V}(\hat{P}_{sh}) = \hat{X}_{sh}''^2 \hat{V}(\bar{y}_{sh}) + \bar{y}_{sh}^2 \hat{V}(\hat{X}_{sh}''), \text{ where } \hat{V}(\hat{X}_{sh}'') = (\% \text{ sheep shorn})^2 \times \hat{V}(\hat{X}_{sh})$$

where $\hat{V}(\bar{y}_{sh})$ has already been defined earlier. Let \hat{P}_{sh} be the estimated total wool production in the h-th stratum during the s-th season obtained by adding the estimated wool production for rams, ewes and lambs. The estimate of variance of \hat{P}_{sh} is obtained by adding the estimated variances of rams-wethers, ewes and lambs.

The estimated total wool production during the s-th season is given by

$$P_s^* = \sum_{h=1}^T P_{sh}^* .$$

The estimate of variance of P_s^* is given by

$$\hat{V}(P_s^*) = \sum_{h=1}^T \hat{V}(P_{sh}^*) .$$

Estimate of annual wool production for the district is given by:

$$P^* = \sum_{s=1}^3 P_s^*$$

Estimate of variance of P^* is given by

$$\hat{V}(P^*) = \sum_{s=1}^3 \hat{V}(P_s^*) .$$

3.1.5.5 Tabulation of estimation of sheep population, average wool yield per sheep, annual wool production and estimation of their variances

Table 1: Estimation of sheep (ewe) population

Season	Stratum	Total no. of village V_h	No. of villages for complete enumeration	No. of enumerated sheep X_{shi}	Census no. of sheep X'_{hi}	X'_h	\hat{R}_{sh}	\hat{X}_{sh}	$\hat{R}_{sh} * X'_{hi}$	$X_{shi} - \hat{R}_{sh} * M'_{hi}$	$(col.11)^2$	$\hat{V}(\hat{X}_{sh})$	%SE
1	2	3	4	5	6	7	8	9	10	11	12	13	14
I	I		1										
			2										
			.										
			10										
	Total	V_h	n_h	Σ	Σ	$X'_h = \sum_{i=1}^{V_h} X'_{hi}$	col.5/col.6	col.8*col.7	col.8*col.6	col.5-col.10	Σ	$(col.3)^2 * col.12 / col.4(col.4 - 1)$	$\sqrt{col.13 * 100 / col.9}$
	Pooling of the stratum in the season												
	I	V_h	n_h	Σ	Σ	$X'_h = \sum_{i=1}^{V_h} X'_{hi}$	col.5/col.6	col.8*col.7	col.8*col.6	col.5-col.10	Σ	$(col.3)^2 * col.12 / col.4(col.4 - 1)$	$\sqrt{col.13 * 100 / col.9}$
	II												
	III												
	Overall							$\Sigma = \hat{X}_s$				$\Sigma = \hat{V}(\hat{X}_s)$	$\sqrt{col.13 * 100 / col.9}$

Table 2: Estimation of average wool yield per sheep

Season	Stratum	Village v_h	No of flock selected f_{shi}	Total no of ewe in flocks	No of ewe selected X_{shij}	Yield of selected animal y_{shijk}		Total yield	\bar{Y}_{shi}	Enumerated of sheep in village X_{shi}	% sheep shorn	X''_{shi}	P_{shi}	\bar{Y}_{sh}	$\bar{Y}_{sh}^* X''_{shi}$	$(P_{shi} - \bar{Y}_{sh} X''_{shi})^2$	X''_{sh}	$\hat{V}(\bar{Y}_{sh})$	%SE	$W_h = \frac{X'_h}{X'}$	W_h^* \bar{Y}_{sh}	w_h^2 $\hat{V}(\bar{Y}_{sh})$
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	1	1	1																	Livestock census of stratum/ livestock census entire district		
			-																			
			5																			
				Σ	Σ			Σ	col.9/ col.6		col.6* 100/col.5	col.11* col.12	col.13* col.10		col.15* col.13	$(\text{col.14}-\text{col.16})^2$						
		2	1																			
			-																			
			5																			
				Σ	Σ			Σ	col.9/ col.6		col.6* 100/col.5	col.11* col.12	col.13* col.10		col.15* col.13	$(\text{col.14}-\text{col.16})^2$						
		3	1																			
			-																			
			5																			
				Σ	Σ			Σ	col.9/ col.6		col.6* 100/col.5	col.11* col.12	col.13* col.10		col.15* col.13	$(\text{col.14}-\text{col.16})^2$						
		4	1																			
			-																			
			5																			
				Σ	Σ			Σ	col.9/ col.6		col.6* 100/col.5	col.11* col.12	col.13* col.10		col.15* col.13	$(\text{col.14}-\text{col.16})^2$						
		5	1																			
			-																			
			5																			
				Σ	Σ			Σ	col.9/ col.6		col.6* 100/col.5	col.11* col.12	col.13* col.10		col.15* col.13	$(\text{col.14}-\text{col.16})^2$						
	overall	5							Σ			Σ	Σ	col.14/ col.13		Σ	col.13/ col.3	col.17/ [(col.18) ² col.3(col.3-1)]	$\sqrt{\text{col.19} \times 100 / \text{col.15}}$		col.21* col.15	$(\text{col.21})^2 \times \text{col.19}$
I	I	5							Σ			Σ	Σ	col.14/ col.13		Σ	col.13/ col.3	col.17/ [(col.18) ² col.3(col.3-1)]	$\sqrt{\text{col.19} \times 100 / \text{col.15}}$		col.21* col.15	$(\text{col.21})^2 \times \text{col.19}$
I	II	5							Σ			Σ	Σ	col.14/ col.13		Σ	col.13/ col.3	col.17/ [(col.18) ² col.3(col.3-1)]	$\sqrt{\text{col.19} \times 100 / \text{col.15}}$		col.21* col.15	$(\text{col.21})^2 \times \text{col.19}$
I	III	5							Σ			Σ	Σ	col.14/ col.13		Σ	col.13/ col.3	col.17/ [(col.18) ² col.3(col.3-1)]	$\sqrt{\text{col.19} \times 100 / \text{col.15}}$		col.21* col.15	$(\text{col.21})^2 \times \text{col.19}$
	Overall																				$\Sigma = \bar{y}_s$	$\Sigma = \hat{V}(\bar{y}_s)$

Table 3: Estimation of annual wool yield per sheep for the district

Stratum	Season			\overline{Y}_h	Season			$\hat{V}(\overline{Y}_h)$	W_h	$W_h * \overline{Y}_h$	$w_h^2 * \hat{v}(\overline{y}_h)$	%SE
	\overline{Y}_{sh}				$\hat{V}(\overline{Y}_{sh})$ from col.19 of table 2							
	I	II	III		I	II	III					
1	2	3	4	5	6	7	8	9	10	11	12	13
I				col.2+col.3+col.4				col.6+col.7+col.8	From col. 21 of table 2	col.10*col.5	$(col.10)^2*col.9$	
II				col.2+col.3+col.4				col.6+col.7+col.8		col.10*col.5	$(col.10)^2*col.9$	
III				col.2+col.3+col.4				col.6+col.7+col.8		col.10*col.5	$(col.10)^2*col.9$	
Overall										$\Sigma = Y$	$\Sigma = \hat{V}(\overline{Y})$	$\sqrt{col.12*100/col.11}$

Table 4: Estimation of wool production of the district

Season	Stratum	\bar{Y}_{sh}	\hat{X}_{sh}	\hat{X}_{sh}''	\hat{P}_{sh}	$\hat{V}(\hat{X}_{sh})$	$\hat{V}(\hat{X}_{sh}'')$	$\hat{V}(\bar{Y}_{sh})$	$\hat{V}(\hat{P}_{sh})$	% SE
1	2	3	4	5	6	7	8	9	10	11
I	I		From col.9 of table1	From col.18 of table 2	col.3 * col.5	From col.13 of table 1	$(col.5)^2 * col.7$	From col.19 of table 2	$(col.5)^2 * col.9 + (col.3)^2 * col.8$	$\sqrt{col.10 * 100 / col.6}$
	II									

3.1.6 Estimation of meat production

The procedure of estimating:

- (a) the total number of animals slaughtered;
- (b) the average meat production per animal; and
- (c) the total meat production,

are discussed in the following paragraphs:

The information on the number of animals slaughtered is obtained from two sources namely, (i) from the sample of households reporting slaughter of animals and from all the butchers and other agencies in the villages selected in the sample, and (ii) from records maintained at all the slaughter houses in state.

3.1.6.1 Notation:

Let V be the number of villages in the state. n' be the total number of villages selected during the year which is 15 percent of total number of villages in the State i.e.

$$n' = 0.15 \times V$$

n = number of villages selected in a season i.e. $n = n'/3$

T = number of strata in the state.

V_h = total number of villages in the h -th stratum.

n_h = number of villages allocated to the h -th stratum for complete enumeration of livestock.

$$\text{Thus, } n = \sum_{h=1}^T n_h$$

v_h = sub-sample of villages selected out of n_h villages in the h -th stratum for yield estimation.

U_h = number of registered slaughter houses in the h -th stratum.

U = number of registered slaughter houses selected out of U_h in the s -th season.

x'_{shi} = number of animals slaughtered by butchers and other agencies in the i -th village during s -th season in the h -th stratum.

x''_{shi} = number of animals slaughtered by the household in the i -th village during s -th season in the h -th stratum.

y_{smhik} = meat production from the k -th animal of i -th slaughter house of h -th stratum during m -th month of the s -th season.

3.1.6.2 Number of animals slaughtered

(i) Estimated number of animals slaughtered in households of butchers and chamars privately in a season is given by

$$\hat{X}_{sp} = \sum_{h=1}^T \frac{V_h}{n_h} \sum_{i=1}^{n_h} x_{shi}$$

where x_{shi} is the total number of animals slaughtered in the i -th village and is given by

$$x_{shi} = x''_{shi} + x'_{shi}$$

Estimate of variance of \hat{X}_{sp} is approximately given by

$$\hat{V}(\hat{X}_{sp}) = \sum_{h=1}^T \left(\frac{1}{n_h} - \frac{1}{V_h} \right) V_h^2 S_{sh}^2 \quad \text{where} \quad S_{sh}^2 = \frac{1}{(n_h - 1)} \sum_{i=1}^{n_h} (x_{shi} - \bar{x}_{sh})^2 \text{ and}$$

$$\bar{x}_{sh} = \frac{1}{n_h} \sum_{i=1}^{n_h} x_{shi}$$

(ii) Number of animals slaughtered in register slaughter houses

Let X_{sr} be the total number of animals slaughtered in all the registered slaughter houses of the state during the s -th season.

(iii) Estimate of total number of animals slaughtered in the state during the s -th season is given by

$$\hat{X}_s = \hat{X}_{sp} + X_{sr}$$

Estimate of variance of \hat{X}_s is given by

$$\hat{V}(\hat{X}_s) = \hat{V}(\hat{X}_{sp})$$

(iv) Estimate of total number of animals slaughtered in the state during the year is given by

$$\hat{X} = \sum_{s=1}^3 \hat{X}_s$$

Estimate of variance of \hat{X} is given by $\hat{V}(\hat{X}) = \sum_{s=1}^3 \hat{V}(\hat{X}_s)$

3.1.6.3 Estimate of average meat production per animal

The average meat production per animal in the l -th slaughter house of the h -th stratum during the m -th month of the s -th season is

$$\bar{y}_{smhl} = \frac{1}{3} \sum_{k=1}^3 y_{smhlk} \quad (\text{as 3 animals selected in each month})$$

Let X_{smhl} be the number of animals slaughtered in the l -th slaughter house of the h -th stratum during m -th month of s -th season. The estimate of meat production in a month in the l -th slaughter house of the h -th stratum is

$$P_{smhl} = \bar{y}_{smhl} \times x_{smhl}$$

(i) The estimate of average meat production from an animal in the s -th season in the state is given by

$$\bar{y}_s = \frac{\sum_{h=1}^T \sum_{m=1}^{d_s} \sum_{l=1}^u P_{smhl}}{\sum_{h=1}^T \sum_{m=1}^{d_s} \sum_{l=1}^u x_{smhl}}$$

d_s is the number of months in the s -th season, which is equal to 4 for all s

Estimate of variance of the \bar{y}_s is approximately given by

$$\hat{V}(\bar{y}_s) = \frac{1}{\hat{\bar{x}}_s^2} \sum_{h=1}^T \sum_{m=1}^{d_s} \left(\frac{1}{u} - \frac{1}{u_h} \right) \frac{1}{(u-1)} \sum_{l=1}^u (P_{smhl} - \bar{y}_s x_{smhl})^2$$

$$\text{where } \hat{\bar{x}}_s = \frac{1}{d_s u T} \sum_{h=1}^T \sum_{m=1}^{d_s} \sum_{l=1}^u x_{smhl}$$

and d_s is the number of months in the s -th season.

(ii) The estimate of average meat production from an animal in the state is given by

$$\hat{\bar{y}} = \frac{\sum_{s=1}^3 \hat{X}_s \bar{y}_s}{\sum_{s=1}^3 \hat{X}_s} = \frac{\hat{P}}{\hat{X}} \quad \text{where } X_s \text{ is already defined.}$$

Estimate of variance y is approximately given by

$$\hat{V}(\hat{\bar{y}}) = \frac{1}{\hat{X}^2} \left[\hat{V}(\hat{P}) + \bar{y}^2 \hat{V}(\hat{X}) - 2 \bar{y} \text{Cov.}(\hat{P}, \hat{X}) \right]$$

$$\text{Cov.}(\hat{P}, \hat{X}) = \sum_{s=1}^3 \text{Cov.}(\hat{P}_s, \hat{X}_s)$$

where

$$= \sum_{s=1}^3 \bar{y}_s \hat{V}(\hat{X}_s)$$

3.1.6.4 Estimate of total meat production

Estimate of total meat production in a state is obtained by multiplying the estimated number of animals slaughtered in the s-th season in a State with the average meat production per animal in the s-th season and added over the different seasons and is given by

$$\hat{P} = \sum_{s=1}^3 \hat{X}_s \bar{y}_s \quad \text{and estimate of variance of } \hat{P} \text{ is given by}$$

$$\hat{V}(\hat{P}) = \sum_{s=1}^3 \left[\bar{y}_s^2 \hat{V}(\hat{X}_s) + \hat{X}_s^2 \hat{V}(\bar{y}_s) \right]$$

3.1.6.5 Tabulation of estimation of number of animals slaughtered, average meat production per animal, total meat production and estimation of their variances

Table 1: Number of animal slaughtered

Season	Stratum	Village	No of animal slaughtered by butcher X'_{shi}	No of animal slaughtered by HH X''_{shi}	$X_{shi} = X'_{shi} + X''_{shi}$	\bar{X}_{sh}	$(x_{shi} - \bar{X}_{sh})^2$	S_{sh}^2	Total no of village in stratum	$(1/n_h - 1/v_h) * V_h^2 * S_{sh}^2$	$\frac{V_h}{n_h} * \sum_{i=1}^{n_h} X_{shi}$	%SE	Total no. of animal slaughtered in registered slaughter houses in a season	$\hat{X}_s = \hat{X}_{sp} + X_{sr}$	$\hat{v}(\hat{X}_s) = \hat{v}(\hat{X}_{sp})$	%SE
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
I	I	1			col.4+ col.5		(col.6- col.7) ²									
		.														
		10			col.4+ col.5		(col.6- col.7) ²									
Total		$n_h = 10$	Σ	Σ	Σ	col.6 / col.3	Σ	col.8 / (col.3-1)	V_h	(col.10- col.9)*col.10/ col.3	col.10/ col.3* col.6	$\sqrt{\text{col.11*100}/\text{col.12}}$				
	II	1			col.4+ col.5		(col.6- col.7) ²									
		.														
		10			col.4+ col.5		(col.6- col.7) ²									
Total		$n_h = 10$	Σ	Σ	Σ	col.6 / col.3	Σ	col.8 / (col.3-1)	V_h	(col.10- col.9)*col.10/ col.3	col.10/ col.3* col.6	$\sqrt{\text{col.11*100}/\text{col.12}}$				
	III	1			col.4+ col.5											
		.														
		10			col.4+ col.5											
Total		$n_h = 10$	Σ	Σ	Σ	col.6 / col.3	Σ	col.8 / (col.3-1)	V_h	(col.10- col.9)*col.10/ col.3	col.10/ col.3* col.6					
Overall										$\Sigma = \hat{v}(\hat{X}_{sp})$	$\Sigma = \hat{X}_{sp}$	$\sqrt{\text{col.11*100}/\text{col.12}}$	X_{sr}	col.12+ col.14	col.11	
I										$\Sigma = \hat{v}(\hat{X}_{sp})$	$\Sigma = \hat{X}_{sp}$	$\sqrt{\text{col.11*100}/\text{col.12}}$	X_{sr}	col.12+ col.14	col.11	
II										$\Sigma = \hat{v}(\hat{X}_{sp})$	$\Sigma = \hat{X}_{sp}$	$\sqrt{\text{col.11*100}/\text{col.12}}$	X_{sr}	col.12+ col.14	col.11	
III										$\Sigma = \hat{v}(\hat{X}_{sp})$	$\Sigma = \hat{X}_{sp}$	$\sqrt{\text{col.11*100}/\text{col.12}}$	X_{sr}	col.12+ col.14	col.11	
Overall										Σ	Σ		Σ	$\Sigma = \hat{X}$	$\Sigma = \hat{v}(\hat{X})$	$\sqrt{\text{col.16*100}/\text{col.15}}$

Table 2: Estimate of average meat production per animal

Season	Stratum	Month d _s	No of Slaughtered houses in stratum	Selected Slaughtered houses	No of animal slaughtered in slaughter houses (X_{smhl})	Y_{smhlk}			Total	\bar{y}_{smhl}	P_{smhl}	\bar{y}_s	$(p_{smhl} - \bar{y}_s * X_{smhl})^2$	$(1/u - 1/u_h) * \text{col. 14}/(u-1)$	$\hat{\bar{x}}_s$	$\hat{v}(\bar{y}_s)$	%SE
						1	2	3									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I	I	1		1					col.7+col.8+ col.9	col.10/3	col.11* col.6		(col.12- col.13*col.6) ²				
				2					col.7+col.8+ col.9	col.10/3	col.11* col.6		(col.12- col.13*col.6) ²				
				u									\sum	(1/col.5- 1/col.4)*col.14 / (col.5-1)			
	2			1					col.7+col.8+ col.9	col.10/3	col.11* col.6		(col.12- col.13*col.6) ²				
				2					col.7+col.8+ col.9	col.10/3	col.11* col.6		(col.12- col.13*col.6) ²				
				u									\sum	(1/col.5- 1/col.4)*col.14 / (col.5-1)			
	3			1					col.7+col.8+ col.9	col.10/3	col.11* col.6		(col.12- col.13*col.6) ²				
				2					col.7+col.8+ col.9	col.10/3	col.11* col.6		(col.12- col.13*col.6) ²				
				u									\sum	(1/col.5- 1/col.4)*col.14 / (col.5-1)			
	4			1					col.7+col.8+ col.9	col.10/3	col.11* col.6		(col.12- col.13*col.6) ²				
				2					col.7+col.8+ col.9	col.10/3	col.11* col.6		(col.12- col.13*col.6) ²				
				u									\sum	(1/col.5- 1/col.4)*col.14 / (col.5-1)			
T=3 Overall	4		u _h		\sum						\sum		\sum	=sum of all 4 month			
Pooling of the stratum in the season																	
I	4		u _h		\sum						\sum		\sum				
II	4		u _h		\sum						\sum		\sum				
III	4		u _h		\sum						\sum		\sum				
T=3 Overall					\sum =all three stratum						\sum =all three stratum	col.12/ col.6		\sum =all three stratum	col.6/ d _s uT	col.15/ (col.16) ²	$\sqrt{\text{col.17} * 100 / \text{col.13}}$

Table 3: Estimate of average meat production from an animal and total meat production in the State

Season	\hat{x}_s	\bar{y}_s	$\hat{p}_s = \hat{x}_s * \bar{y}_s$	$\hat{\bar{y}}$	$\hat{v}(\hat{x}_s)$	$\text{Cov.}(\hat{p}_s, \hat{x}_s) = \bar{y}_s * \hat{v}(\hat{x}_s)$	$\hat{v}(\bar{y}_s)$	$\bar{y}_s^2 * \hat{v}(\hat{x}_s) + \hat{x}_s^2 * \hat{v}(\bar{y}_s)$	%SE	$\hat{v}(\hat{\bar{y}})$	%SE
1	2	3	4	5	6	7	8	9	10	11	12
I	col.15 from table1	col.13 from table 2	col. 2*col. 3		col.16 from table1	col.3 * col. 6	col.17 from table 2	$(\text{col.3})^2 * \text{col.6} + (\text{col.2})^2 * \text{col.8}$			
II	-Do-	-Do-	col. 2*col.3		-Do-	col.3 * col.6	-Do-	-Do-			
III	-Do-	-Do-	col .2*col.3		-D0-	col.3 * col.6	-Do-	-Do-			
Total	$\hat{X} = \sum$		$\hat{p} = \sum$	col.4/ col.2	$\sum = \hat{v}(\hat{X})$	$\sum = \text{Cov.}(\hat{p}, \hat{x})$		$\sum = \hat{v}(\hat{p})$	$\sqrt{\text{col.9}} * 100 / \text{col.4}$	$[(\text{col.9} + (\text{col.5})^2 * \text{col.6} - 2 * \text{col.5} * \text{col.7})] / (\text{col.2})^2$	$\sqrt{\text{col.11} * 100 / \text{col.5}}$

3.2 Precision of the estimates for estimation of livestock numbers and products

The methodological studies undertaken by IASRI for estimation of major livestock products viz. milk, eggs, wool and meat under the concept of integrated approach for simultaneous estimation of all these products in a single survey revealed that the estimates of livestock numbers and production of different products can be obtained with a reasonable precision i.e. with standard errors ranging between 7 to 15 per cent. The estimates of average milk yield per cattle or buffalo in milk, the standard errors ranged between 9 to 14 per cent. In case of average egg production per layer and average wool yield per sheep the estimates were obtained with standard errors of 4 to 7 per cent only.

As regards the production of hides and skins, the standard errors of the estimates varied from 24 to 26 per cent for hides and 50 to 66 per cent for skins with the observed sample size. If it is desired to estimate the production of hides with a standard error of 8 per cent and skins with a standard error of 20 percent which is quite reasonable for the estimates at district level, a large sample of 130 clusters of 3 villages is required to be observed. Such a large sample to be observed is on account of very rare slaughtering in the households as a result of which variation within cluster is almost negligible.

CHAPTER IV

SAMPLING METHODOLOGY AND ESTIMATION PROCEDURE FOR ESTIMATION OF COST OF PRODUCTION OF MILK AND EGG

4.1 Estimation Cost of Production of Milk and Egg

4.1.1 Introduction

Besides conducting surveys on estimation of production of major livestock products viz. milk, eggs, wool and meat, IASRI also conducted a series of pilot sample surveys for estimation of cost of production of milk and egg. The methodologies developed by the Institute were passed on to the Department of Animal Husbandry and Dairying, Ministry of Agriculture, Government of India for adoption by Animal Husbandry Departments of different states in order to estimate the cost of production of milk and egg besides the estimation of production of major livestock products viz. milk, eggs, wool and meat.

It is evident that there is basic difference in the methodological approaches for estimation of production of major livestock products and cost of production of these products. In estimation of production of livestock products same p.s.u.'s (villages) are observed and s.s.u's (households) vary from round to round in a particular season and information on number and yields are collected whereas in cost of production surveys same p.s.u.'s and s.s.u.'s are observed throughout the period of study and information on cost aspects are collected. Since the sampling units and information to be collected under these studies are entirely different so the states could not undertake the study along with the study on estimation of production of major livestock products under integrated sample surveys. Since the collection of such data is very much essential for framing the pricing policy of different commodities by the Government, the Department of Animal Husbandry and Dairying discuss this issue with the Directorates of Animal Husbandry of different states in the meetings of Technical Committee of Directions (TCD) for inclusion of the data collection on this aspect along with the data on different livestock products. Now, some of the states have started collecting data and are estimating the cost of production of milk and egg. The sampling design which is being adopted, components of cost and estimation procedure are being discussed in the following sections.

4.1.2 Sampling design

The surveys on cost of production of milk is being taken up as a part of the large scale sample surveys on estimation of production of major livestock products to provide State

level estimates and also district level estimates. From districts which are selected for preparation of district level estimates of production of milk and egg, two villages (not already selected for production estimates) are selected randomly in each district for conducting the cost of production studies. Each of these villages along with two neighbouring villages comprise as one group. Thus, there are two such groups which are kept under constant study throughout the period of survey (cost), extending over a period of 30 months.

From each of the groups of villages thus selected two clusters of two households/stalls are selected for milk and two clusters of five households/farms are selected for egg. Information is collected for all the animals (cow, buffalo and goat) and birds in the selected households once every fortnight, which constitutes a round. Whenever during the period of cost survey, selected households/farms ceases to have at least one breeding animal in case of milk and at least 5 female birds in case of egg and also the head of the household has no intention of obtaining the same, then in that case the household may be replaced by another, preferably of the same category and from the same village.

4.1.3 Field-work

Milk

One Enumerator is assigned two groups of three villages each, in which complete enumeration of households is to be done in the beginning and the particulars recorded in village schedules I and II (already prescribed for the Large Scale Surveys on Estimation of Production). The Enumerator collects data for 24 stalls/households located in two groups of villages at an interval of fortnight. He collects detailed data from two stalls in a village per day visiting both in the morning and evening, thus covering the 12 stalls in a group of villages in 6 days. Thereafter he proceeds to be second group and records similar data. He then reports back to the first group, for another round of collection.

Egg

One enumerator is assigned two groups of three villages each in which the complete enumeration of households was done in the beginning of the study alongwith the Enumerator for milk costing, in village schedules I and II of the main Survey. The Enumerator collects data for 60 farms/households located in two groups of villages at an interval of fortnight. He collects data from 5 farms/households in a village per day, thus covering 30 farms/households in a group of villages in 6 days. After completing the work in the 30 selected farms/households in the first group of villages in a period of 6 days, he

proceeds to the second group and records similar data. He then comes back to the first group again, for another round of collection.

4.2 Estimation of cost of Milk production

4.2.1 Components of cost

The overall cost of milk production is an aggregate of expenditure incurred on feeds, paid labour, family labour, depreciation on animals, interest on fixed and working capital, depreciation on assets and equipment and miscellaneous recurring expenses. From this the income on account of the dung produced, hides and skins etc. is subtracted. Evaluation of components of cost is given below:

- (i) **Feed cost:** It is the value of feed and fodders fed to milch stock and is obtained as the sum of the products of quantities and their corresponding rates. For feeds purchased from the market the cost should be worked out on the basis of actual market rates at which these are purchased. In the case of home grown feeds, the cost of the quantities fed to different animals need to be worked out using the nearest market rates. Normally the quantities of feeds fed are available for different categories of animals in a household, separately. However, in the households where collective feeding is practiced, the apportionment of feed should be done on the basis of ratios of feeds fed which can be worked out on the basis of information received from households reporting separate feeding.
- (ii) **Cost on labour:** It includes paid as well as unpaid (family) labour cost on stall operations. The actual amount paid to the different types of hired labour is taken as paid labour. For family labour and the cost is to be worked out on the basis of prevailing local wage rates. When hired labour is paid in kind either wholly or partly, its money equivalent needs to be worked out. As the labour utilized in a stall is generally for all categories of animals maintained therein, apportionment of cost of labour needs to be done in ratio of the average quantities of feeds fed. The cost of grazing the animals can be evaluated as the charges of the grazier which are generally available separately for cows and buffaloes. From these a ratio is worked out for apportioning the cost on grazing in case of mixed stalls.
- (iii) **Depreciation on animals:** It is calculated by subtracting the sale proceeds and the market value of the milch animals present in the household at the end of the enquiry, from the purchase price, if purchased during the survey period and the market value of the animals at the beginning of the enquiry over all the sample households. From

this depreciation component per year/season on milch stock can be obtained by simple arithmetic.

- (iv) **Depreciation on assets and equipment:** It includes the depreciation on items like investment on housing of animals, and equipment such as feeding troughs, chaff cutter, Milking cans, etc. This component is calculated on the basis of the average price of the article and its average life. It is calculated for the whole year and then apportioned for different seasons in proportion to the duration of seasons. Value of animals forms the basis for apportioning this component.
- (v) **Miscellaneous expenditure:** It includes recurring expenditure like cost on repairs, service and veterinary charges, purchase of ropes, lighting charges for the stall, etc. The average value of the animals is taken as the basis for splitting this cost.
- (vi) **Interest on capital:** It is generally worked out at the prevailing bank rates of interest per annum for fixed and working capital. The price of the animals forms the fixed capital and the monetary value of one month's ration for milch stock as the working capital.
- (vii) **Income from dung:** Income from dung is generally the main source of income, other than the sale of milk and is worked out on the basis of dung produced in the stall by the milch stock.

4.2.2 Estimation procedure (milk)

4.2.2.1 Notations:

- i : p.s.u (clusters of villages), $i=1,2$
- j : s.s.u. (milk producer household), $j = 1, 2, 3, 4 \dots 12$
- y_{ij} : Value of the Cost Component for milch animals in the j -th household of i -th p.s.u.
- x_{ij} : The corresponding milk yield in the j -th s.s.u. of i -th p.s.u.
- H_i : Total number of s.s.u. in the i -th p.s.u.
- h_i : Number of selected s.s.u.'s in the i -th p.s.u.
- N : Total number of p.s.u.'s in the population
- n : Total number of p.s.u.'s in the sample

4.2.2.2 Estimate of cost of per kg of milk

$$\hat{C} = \frac{\hat{Y}}{\hat{X}}$$

where, $\hat{Y} = \frac{N}{n} \sum_{i=1}^n \frac{H_i}{h_i} \sum_{j=1}^{h_i} y_{ij}$ and $\hat{X} = \frac{N}{n} \sum_{i=1}^n \frac{H_i}{h_i} \sum_{j=1}^{h_i} x_{ij}$

The estimate of variance \hat{C} is given by

$$\hat{V}(\hat{C}) = \frac{1}{(\hat{X})^2} \left[\hat{V}(\hat{Y}) + \left(\frac{\hat{Y}}{\hat{X}} \right)^2 \hat{V}(\hat{X}) - 2 \left(\frac{\hat{Y}}{\hat{X}} \right) \hat{Cov}(\hat{Y}, \hat{X}) \right]$$

$$\hat{V}(\hat{Y}) = N^2 \left[\frac{1}{n} - \frac{1}{N} \right] s_{by}^2 + \frac{N}{n} \sum_{i=1}^n H_i^2 \left(\frac{1}{h_i} - \frac{1}{H_i} \right) s_{iy}^2$$

$$\hat{V}(\hat{X}) = N^2 \left[\frac{1}{n} - \frac{1}{N} \right] s_{bx}^2 + \frac{N}{n} \sum_{i=1}^n H_i^2 \left(\frac{1}{h_i} - \frac{1}{H_i} \right) s_{ix}^2$$

$$\hat{Cov}(\hat{Y}, \hat{X}) = N^2 \left[\frac{1}{n} - \frac{1}{N} \right] s_{byx} + \frac{N}{n} \sum_{i=1}^n H_i^2 \left(\frac{1}{h_i} - \frac{1}{H_i} \right) s_{iyx}$$

where

$$s_{by}^2 = \frac{1}{(n-1)} \sum_{i=1}^n (H_i \bar{Y}_i - \hat{Y})^2$$

$$s_{iy}^2 = \frac{1}{(h_i-1)} \sum_{j=1}^{h_i} (y_{ij} - \bar{y}_i)^2$$

$$s_{bx}^2 = \frac{1}{(n-1)} \sum_{i=1}^n (H_i \bar{X}_i - \hat{X})^2$$

$$s_{ix}^2 = \frac{1}{(h_i-1)} \sum_{j=1}^{h_i} (x_{ij} - \bar{x}_i)^2$$

$$s_{byx} = \frac{1}{(n-1)} \sum_{i=1}^n (H_i \bar{y}_i - \hat{Y})(H_i \bar{x}_i - \hat{X})$$

$$s_{iyx} = \frac{1}{(h_i-1)} \sum_{j=1}^{h_i} (y_{ij} - \bar{y}_i)(x_{ij} - \bar{x}_i)$$

$$\bar{y}_i = \frac{1}{h_i} \sum_{j=1}^{h_i} y_{ij}$$

$$\bar{Y} = \frac{1}{n} \sum_{i=1}^n H_i \bar{y}_i$$

$$\bar{x}_i = \frac{1}{h_i} \sum_{j=1}^{h_i} x_{ij}$$

$$\hat{\bar{X}} = \frac{1}{n} \sum_{i=1}^n H_i \bar{x}_i$$

The above procedure leads to the cost per kg of milk in one district. If there is D number of districts then the overall cost for all the districts together will be

$$\text{Cost} = \sum_{d=1}^D W_d \hat{C}_d$$

\hat{C}_d = Cost estimated in the d-th district

and $W_d = \frac{M_d}{M}$; M_d are the milch animals in the d-th district and $M = \sum_{d=1}^D M_d$

The estimate of V (cost) is given by

$$\hat{V}(\text{Cost}) = \sum_{d=1}^D W_d^2 \hat{V}(\hat{C}_d)$$

4.2.2.3 Tabulation of estimation of cost of per kg. of milk and estimation of its variance

No. of cluster of villages (p.s.u) in population N	No. of p.s.u in the sample n	Sl.no. of p.s.u.	Total no. of H.H.'s in the selected p.s.u H_i	No. of selected s.s.u. in the selected p.s.u. h_i	Value of cost component for milch animals in selected h.h.'s of ith p.s.u. y_{ij}		Milk yield in j th h.h. of i th selected p.s.u x_{ij}		$\bar{y}_i = \sum \text{col.6} / \text{col.5}$	$\bar{x}_i = \sum \text{col.7} / \text{col.5}$	$\text{col.8} \times \text{col.4}$	$\text{col.9} \times \text{col.4}$	\bar{Y}	\bar{X}	$\sum y_{ij}^2$ =Sum squares of each value of col. 6
					1 2.....12	Total Σ	1 2.....12	Total Σ							
1	2	3	4	5	6		7		8	9	10	11	12	13	14
		1 2 3 4 . . . n													
	n										Σ	Σ	$\sum \text{col.10} / \text{col.2}$	$\sum \text{col.11} / \text{col.2}$	

$(\sum y_{ij})^2 / h_i$ =(square of $\sum \text{col.6} / \text{col.5}$)	S_{iy}^2 =(col.14 – col.15) / (col.5-1)	$\sum x_{ij}^2$ =Sum of sqs. Of each value of col.7	$(\sum x_{ij})^2 / h_i$ =square of $\sum \text{col.7} / \text{col.5}$	S_{ix}^2 =(col.16 – col.17) / (col.5-1)	$\sum y_{ij} \cdot x_{ij}$ =sum of product of each corresponding value of col.6 & col.7	$\sum y_{ij} \cdot x_{ij} / h_i$ =($\sum \text{col.6} \times \sum \text{col.7} / \text{col.5}$)	S_{iyx} =(col.20-col.21) / (col.5-1)	$H_i \bar{Y}_i - \hat{\bar{y}}$ =(col.4 \times col.8 - col.12)	$(\text{col. 23})^2$
15	16	17	18	19	20	21	22	23	24
									Σ

S_{by}^2	$H_i \bar{x} - \bar{X}$ =(col. 4 * col. 9 - col. 13)	(col. 26) ²	S_{bx}^2	$(H_i \bar{Y}_i - \hat{\bar{y}}) \cdot (H_i \bar{x} - \bar{X})$ = col. 23 × col. 26	S_{bxy} =(\sum col. 29) / (col. 2-1)	$\frac{N}{n}$	$\frac{N(N-n)}{n}$ =(col. 1 (col. 1 - col. 2)) / col. 2	$\frac{H_i(H_i - h_i)}{h_i}$ =(col. 4 (col. 4 - col. 5)) / col. 5	$\frac{N(N-n)}{n} s_{by}^2$ = col. 32 × col. 25	$\frac{H_i(H_i - h_i)}{h_i} s_{iy}^2$ = col. 33 × col. 16
25	26	27	28	29	30	31	32	33	34	35
\sum col. 24 / (col. 2-1)		\sum	\sum col. 27 / (col. 2-1)	\sum					col. 25 × col. 32	\sum

	$\hat{V}(\hat{y})$ = col. 34 + col. 36	$\frac{N(N-n)}{n} s_{bx}^2$ = col. 32 × col. 28	$\frac{H_i(H_i - h_i)}{h_i} s_{ix}^2$ = col. 33 × col. 19		$\hat{V}(\hat{x})$ = col. 38 + col. 40	$\frac{N(N-n)}{n} s_{bxy}$	$\frac{H_i(H_i - h_i)}{h_i} s_{iyx}$ = col. 33 × col. 22		$\text{cov}(\hat{y}, \hat{x})$ = col. 42 + col. 44
36	37	38	39	40	41	42	43	44	45
$\text{col. 31} \times \sum \text{col. 35}$	$\hat{V}(\hat{y})$	col. 32 × col. 28	\sum	$\text{col. 31} \times \sum \text{col. 39}$	$\hat{V}(\hat{x})$	col. 30 × col. 32	\sum	$\text{col. 31} \times \sum \text{col. 43}$	$\text{cov}(\hat{y}, \hat{x})$

$$\text{Estimate of cost of per kg. of milk} = \hat{c} = \frac{\hat{y}}{\hat{x}} = \frac{\sum \text{col. 12}}{\sum \text{col. 13}}$$

Estimate of variance of \hat{c}

$$\begin{aligned} \hat{v}(\hat{c}) &= \frac{1}{(\hat{x}^2)} \left[\hat{v}(\hat{y}) + \left(\frac{\hat{y}}{\hat{x}} \right)^2 \hat{v}(\hat{x}) - 2 \left(\frac{\hat{y}}{\hat{x}} \right) \text{cov}(\hat{y}, \hat{x}) \right] \\ &= \hat{x}^2 \hat{v}(\hat{y}) + \hat{y}^2 \hat{v}(\hat{x}) - 2 \hat{y} \hat{x} \text{cov}(\hat{y}, \hat{x}) \\ &= (\sum \text{col. 13})^2 * \text{col. 37} + (\sum \text{col. 12})^2 * \text{col. 41} - 2 (\sum \text{col. 12}) (\sum \text{col. 13}) * \text{col. 45} \end{aligned}$$

4.3 Estimation of cost of Egg production

4.3.1 Components of cost

With regard to the study on cost of production of egg, basic information collected pertains to number of adult birds of both sexes, eggs produced, number of day old chicks, unsexed chicks upto 8 weeks of age, young birds between 8-12 weeks, 12-16 weeks, 16-20 weeks and 20-24 weeks. The study of information helps in arriving at the cost of maintenance of an adult bird, cost of production of a day old chick and cost of rearing of young birds respectively. The maintenance cost of birds comprises components of feed, paid labour, family labour, depreciation on adult birds and miscellaneous expenditure, interest on fixed and working capitals and income from sale of miscellaneous items which includes sale of obsolete equipment, poultry manure etc.

(i) Feed cost: Cost of Feed consumed by a bird belonging to a category in a day. In case there is joint feeding the cost of feed is to be apportioned in the ratio of body weights or any other suitable measure such as the bird valuation. Feeds may be purchased or home grown. The value of the home grown feed is to be evaluated.

(ii) Labour cost: Cost on attendance of labour for issue of feed, procuring feed, watering and cleaning of sheds, egg collection, setting eggs for hatching etc. The relevant portion of labour cost required for any category of birds should be obtained by adding the cost on attendance for the particular category to the cost obtained by apportioning the common cost proportionally to the average number of hours of work put in for that category of birds.

(iii) Management: This is generally expected to be incurred in very large commercial farms to maintain accounts, control of operations etc.

(iv) Depreciation of fixed assets: It is defined as the difference between the final and initial valuation over a stipulated period. While some appreciation of the assets which may be there and is not considered for costing. Depreciation on used up equipments is calculated. The total depreciation on common items of assets and equipments is to be apportioned between various categories of birds according to the average stock value of birds during the year.

(v) Depreciation of birds: Stock of birds changes over a period due to sale, purchase, culling, death, gift, consumption etc. as also due to new hatching and growth. The difference of final and initial stock values gives the depreciation of birds at a farm on an average.

(vi) Miscellaneous expenditure: It is incurred on heating arrangement, lighting, postage, feeding hoppers, brooders, maintenance of the farm conveniences and equipment etc. It includes items like fencing, warming up protections for the sheds etc. which wear out in shorter duration and need replenishment. This expenditure is also to be apportioned according to the stock value in each case.

(vii) Interest on fixed assets: It is a hidden component connected with investments, calculated at a suitable rate of interest. Generally the current bank rate is taken as standard.

(viii) Interest on working capital: Working capital is necessary for running of the farm. In case of poultry, the bird stocks change rapidly in value and composition within a very short interval of time and to be able to manage such changes, working capital should include the cost on birds. Apart from these stocks of feed, medicines are to be maintained at the farm for at least for some intervals of time initially. Arrangement for veterinary aid is another very important aspect.

(ix) Miscellaneous income: It is the income obtained from sale of obsolete equipment, poultry manure, disposal of gunny bags etc. This excludes the sale of birds and eggs.

4.3.2 Estimation procedure (egg)

(For estimating unit cost)

4.3.2.1 Method of calculation for average of different costs incurred for maintaining a bird

- (1) For a household/farm we in the first instance calculate total standard bird days (D) over a period. Let d_1 be the standard layer days in respect of young male birds,
- (2) Cost (C_1) for a group of birds say young male birds is worked out as under

$$C_1 = \frac{\text{Total feed cost} \times d_1}{D}$$

After getting the total feed cost for young male birds we divide the same by total number of bird days of the young male birds to get the per bird per day feed cost of a young male bird. In a similar manner we work out for each category of birds and for each of the component costs.

- (3) The total maintenance cost of an adult layer bird is equivalent to, feed cost per bird + labour cost per bird + interest on working and fixed capital + depreciation on fixed assets and birds + miscellaneous expenses per bird – income (apportioned for this category).

- (4) So far as the feed cost per layer per day is concerned, this is equal to total feed cost for layers divided by number of layer days.
- (5) Labour cost per layer per day is equivalent to the total labour cost divided by standard number of layer days (expenditure on labour for performing common items of poultry work are apportioned to layers on the basis of the valuation of birds and this labour cost is then divided again by the number of standard number of layer days to obtain cost per layer per day).
- (6) Interest on working capital is equivalent to the total investment on working capital for layers divided by the standard number of layer days.
- (7) For one year (365 days) the total maintenance cost of a layer is equal to maintenance cost of a layer per day x 365.
- (8) Cost of production per egg
This is calculated as follows:
 - (i) Productivity of a layer = Total egg production of household/farm to be divided by a total number of layer days.
 - (ii) Total egg production of a layer in a year is equal to productivity x 365.
 - (iii) Cost of production per egg (excluding labour cost on collection of egg) is equal to total maintenance of cost of a layer in a year divided by egg production of the layer in a year (table + hatching).
 - (iv) Cost of production per egg including labour accounted for egg collection is equal total cost per egg excluding labour cost + labour cost per egg incurred on egg collection.
 - (v) Cost of production of hatching type egg is obtained as follows:
For hatching, the ratio of hens and cocks say for example (8:1), we then take 1/9 cost of maintenance of a cock towards costs of production of hatching eggs (maintenance of a cock is obtained similarly as in the case of the maintenance of the layer).
- (9) Components towards maintenance of cock for hatching eggs = $\frac{1}{9}$ of the cost of maintenance for cock during a year \div total number of hatching eggs produced per layer in a year.
- (10) The total cost of production of hatching egg is, therefore = cost of production of an egg + components towards maintenance of a cock for hatching eggs.
- (11) Let C_p denote cost of maintenance of p^{th} category bird.
r = particular round in the survey.

p = category

q = particular component of the cost

$$\text{Therefore } C_p = \sum_q \sum_r C'_{pqr} \div \sum_q \sum_r b_{pqr}$$

C'_{pqr} denotes the q^{th} component of cost of the p^{th} category in the r^{th} round and b_{pqr} denotes the number of birds, accordingly.

The Variance of C_p is given as under:

$$V(C_p) = \frac{1}{b_p^2} [V(C'_p) + C_p^2 V(b_p) - 2 C_p \text{Cov}(C'_p, b_p)]$$

This is so far as the variance of a particular component over time observation is concerned, we need now to have a look at the analysis variance and different degrees of freedom as arrived from the survey design.

Source of variation	Degree of freedom
Between group of villages	1
Within groups between villages	4
Within villages between cluster of households	6
Within clusters and between households	48
Total	59

Let x_{ijkm} = Cost of a particular component in m^{th} household of the k^{th} cluster in the j^{th} village of i^{th} group

As per our sampling design:

- (a) Number of households/farms ($m = 5$)
- (b) Number of clusters in a village ($k = 2$)
- (c) Number of villages ($j = 3$) in each group
- (d) Number of groups of villages in each district ($i = 2$)

$$\bar{x}_{ijk} = \frac{1}{5} \sum_{m=1}^5 x_{ijkm}$$

$$\bar{\bar{x}}_{ij} = \frac{1}{2} \sum_{k=1}^2 \bar{x}_{ijk}$$

$$\bar{\bar{\bar{x}}}_i = \frac{1}{3} \sum_{j=1}^3 \bar{\bar{x}}_{ij}$$

$$\bar{\bar{x}} = \frac{1}{2} \sum_{i=1}^2 \bar{x}_i$$

Let in the i^{th} village there are S_i possible clusters of households. Out of which s are selected. At the i^{th} village level, the variance will have the expression

$$G_{w_i}^2 = \left[\frac{(s-1)\sigma_b^2 + s(m-1)\sigma_w^2}{sm-1} \right] \left[\frac{S_i - s}{S_i \times s} \right]$$

$$G_{w_i}^2 = \left[\sum (\bar{x}_{ijk} - \bar{x}_{ij})^2 + \frac{\sum_s \sum_m x_{ijkm} - \bar{x}_{ijk})^2}{sm-1} \right] \left(\frac{S_i - s}{S_i \cdot s} \right)$$

$i = 1, 2, 3, 4, 5, 6$

Where $\sigma_w^2 = \frac{1}{s(m-1)} \sum_s \sum_m (x_{ijkm} - \bar{x}_{ijk})^2$

$$\sigma_b^2 = \frac{1}{s-1} \sum_s (\bar{x}_{ijk.} - \bar{x}_{ij..})^2$$

Let σ_v^2 be the between village variance and $G_{w_i}^2$ gives the within village variance.

N groups of villages are possible and we select n (in our case there are 2) with z units (in our case they are 3) within each n .

Formula for variance is given by

$$\hat{V}(\bar{x}) = \left(\frac{N-n}{N} \right) \left[\frac{(n-1)\sigma_v^2 + n(z-1)G_w^2}{(nz-1)} \right]$$

Where $G_w^2 = \frac{1}{nz} \sum_{i=1}^n G_{wi}^2$

As σ_v^2 is between villages

Which have S_i sub-units each in the i^{th} σ_v^2 , has to be estimated basing on both between village and within village components as in the case of a sub-sampling set up. If S_{bv}^2 is the survey estimate for this variance:

$$\hat{\sigma}_v^2 = \frac{S_{bv}^2}{n} + \frac{1}{ns} G_w^2$$

Where $s_{bv}^2 = \frac{1}{n-1} \sum (\bar{x}_i - \bar{x})^2$

We shall get seasonal estimates of variance for the components when we want for a year or for pooled over two similar seasons, the variance will be obtained as in the normal case of obtaining pooled variance.

4.3.2.2 Cost of Maintenance of a bird

Table 1: Tabulation for Maintenance of a bird

House hold No.	Net cost incurred during different rounds		No. of birds days during different rounds		$C_{pi} = \frac{\sum \sum c'_{pqr}}{\sum \sum b_{pqr}}$	c'^2_{pi}	b^2_{pi}	$c'_{pi} b_{pi}$
	1 2 3 . . .	Total = $\sum \sum c_{ipqr} = c'_{pi}$	1 2 3 . . .	Total $\sum \sum b_{ipqr} = b_{pi}$				
1	2		3		4	5	6	7
1								
2								
3								
.								
.								
.								
h								
		$\sum c'_{pi} = c'_p$		$\sum b_{pi} = b_p$		$\sum c'^2_{pi}$	$\sum b^2_{pi}$	$\sum c'_{pi} b_{pi}$

Where $V(c'_p) = \frac{1}{h-1} \left[\sum c'^2_{pi} - \frac{(\sum c'_{pi})^2}{h} \right]$

$$V(b_p) = \frac{1}{h-1} \left[\sum b^2_{pi} - \frac{(\sum b_{pi})^2}{h} \right]$$

$$Cov(c'_p, b_p) = \frac{1}{h-1} \left[\sum c'_{pi} b_{pi} - \frac{\sum c'_{pi} \sum b_{pi}}{h} \right]$$

Hence $c'_p = \frac{\sum c'_{pi}}{\sum b_{pi}} = \frac{c'_p}{b_p}$; $V(c_p) = \frac{1}{b^2_p} [v(c'_p) + c'^2_p v(b_p) - 2c_p cov(c'_p, b_p)]$

Table 2: Tabulation for Cost of Particular Component for Maintenance of a bird

Season	Round	Clusters of villages in the population N	Clusters of villages selected n	No. of villages in each Clusters z	Cluster No.	Village No.	Cluster of 5 h.h. in each village S _i	No. of cluster of households selected s	Cluster No.	No. of H.H. in each cluster M	Cost of particular component in a household (X _{ijkm})						Averages over H.H. & villages & clusters	$\sum (x_{ijkm} - \bar{x}_{ijk})^2 = \sum x_{ijkm}^2 - (\sum x_{ijkm})^2 / m$	$\sum (\bar{x}_{ijk} - \bar{x}_i)^2 = \sum \bar{x}_{ijk}^2 - (\sum \bar{x}_{ijk})^2 / s$
											1	2	3	4	5	Total Σ			
1	2	3	4	5	6	7	8	9	10	11	12						13	14	15
1	1		2	3	1	1		2	1	5							\bar{x}_{ijk} = $\frac{\sum col.12}{col.11}$	Σ Square of each value of col.12 - (Σ col.12) ² / col.11	Σ square of each value of \bar{x}_{ijk} from col.13 - (square of sum of \bar{x}_{ijk}) / col.9
									2	5							same	same	same
									overall							\bar{x}_{ij} = $\sum / col.9$	Σ = s(m-1) σ_w^2	=(s-1) σ_b^2	
						2		2	1 2 overall	5 5							\bar{x}_{ijk} \bar{x}_{ijk} \bar{x}_{ij}	Repeat	Repeat
						3		2	1 2 overall	5 5							\bar{x}_{ijk} \bar{x}_{ijk} \bar{x}_{ij}	Repeat	Repeat
						over-all											\bar{x}_i = Σ \bar{x}_{ij} / col.5		
					2	1 2 3 over-all											\bar{x}_i	Repeat Repeat Repeat	Repeat Repeat Repeat
					overall												\bar{x} = Σ \bar{x}_i / col.4		

Overall of col.14 + col.15	$\left(\frac{col.8 - col.9}{col.8.col.9} \right)$	(col. 9* col.11) -1	G_{wi}^2 =(col.16*col.12)/col.18	$S_{bv}^2 = \frac{1}{n-1} [\sum \bar{X}_i - \bar{X}]^2$ $= \frac{1}{n-1} [\sum \bar{X}_i^2 - (\sum \bar{X}_i)^2 / n]$	$\hat{\sigma}_v^2 = \frac{S_{bv}^2}{n} + \frac{G_w^2}{nS}$ =[col.20/col.4 + col.19/(col.4* col.9)]
16	17	18	19	20	21
			Use above formula	Use the values of \bar{X}_i calculated in col.13 for n use col.4	
			Repeat		
			Repeat		
			Repeat Repeat Repeat		
			$G_w^2 =$ $\sum / col.14 col.5$		

\bar{X} =overall of col.13 &

$$\hat{v}(\bar{X}) = \frac{N - n}{Nn} \left[\frac{(n - 1) \sigma_v^2 + n (z - 1) G_w}{nz - 1} \right] = \left(\frac{col .3 - col .4}{col .3 * col .4} \right) \left[\frac{(col .4 - 1) col .20 + col .4 (col .5 - 1) col .19}{col .4 * col .5 - 1} \right]$$

CHAPTER V

Sampling Methodology and Estimation Procedure for Estimation of Production of hides and skins

5.1 Estimation of production of hides and skins

5.1.1 Introduction

Hides and skins, the byproducts of meat and wool industry are obtained by flaying the dead or slaughtered animals. The leather goods prepared by these byproducts are important earner of foreign exchange but no reliable data on their production, prices etc. are available in providing a scientific data base for the formation of development programmes for increasing their production. The data collected on the basis of market surveys conducted by Directorate of Marketing and Inspection (DMI) are not scientifically based and thus the estimates of production could not be considered reliable and of limited utility. Keeping in view the importance, Indian Agricultural Statistics Research Institute (IASRI) conducted a series of pilot surveys for estimation of their production. The sampling plan, type of data collected and the estimation procedure etc. are discussed in the following paragraphs.

5.1.2 Sampling plan

The sampling design adopted for the survey was stratified two stage random sampling. Each district was divided into four strata, group of taluks formed on the basis of geographical contiguity were taken as strata. A cluster of three adjoining villages was the primary sampling unit (p.s.u.). The clusters of villages were formed by first selecting villages with equal probability and without replacement and then clubbing with each of them two nearest villages. In case a village was found nearer to some selected villages it was clubbed with one selected village, for the other selected village other two nearest villages were clubbed to form a cluster in order to avoid overlapping. Households having livestock within the cluster of villages were the second stage sampling units (s.s.u's) which were selected with equal probability and without replacement.

From each stratum, a sample of four p.s.u's was selected and from each p.s.u's a sample of 60 households having livestock were observed for detailed enquiry. In respect of selected p.s.u's all the butchers were covered under the survey. For collecting data in respect of fallen or dead animals all the chamars in the selected p.s.u's were also covered. A fresh sample was selected in each season. In addition, a sample of two registered slaughter houses in each district was selected randomly every month and

information on the number of animals slaughtered on the day of visit and those during the last one month was collected along with the data on various practices relating to the slaughter of animals and production of hide and skins.

5.1.3 Type of data collected

From each of the households in the sample, information of number of animals slaughtered during the previous month was collected. From the butcher's establishment and chamar's households, information on practices of flaying animals and curing of hides and skins was collected. From such households additional information on disposal of hides and skins and their prices etc. was also collected. The schedules used for collection of primary data under the survey are as follows:

Schedule I: Household-wise particulars of livestock.

Schedule II: Information on fallen and slaughtered animals flayed and cured in previous month by chamars / butchers.

Schedule III: Changes in the number of livestock in selected households.

Schedule IV: Number of hides and skins handled by the butchers in the registered slaughter houses on the day of visit and number of animals slaughtered in the slaughter houses during last calendar month.

Schedule V: Disposal, use and prices of the byproducts (other than hides and skins) of the dead and slaughtered animals.

Schedule VI: Socio-economic status of householders handling hides/skins.

5.1.4 Estimation procedure

The information on the quantum of hides and skin is obtained from (i) clusters of villages as recorded from the sample of households keeping livestock (ii) all the butchers reporting slaughter of animals and (iii) all the chamars handling dead and slaughtered animals and (iv) the registered slaughter houses in the region on the basis of records maintained therein.

The estimation procedure is given for hides obtained from cattle/buffaloes. The procedure for estimation of skins from sheep/goats is identical.

5.1.4.1 Notation

L = number of strata,

V_i = total number of clusters of villages in the i th stratum

v_i = number of clusters of villages selected out of V_i in the i th stratum,

H_{ij} = total number of households keeping livestock in the jth cluster of villages of ith stratum.

h = number of households selected out of H_{ij}

x''_{sijk} = quantum of hides obtained from the animals slaughtered in the kth household of the jth cluster of villages in the ith stratum during the sth season, and

x'_{sij} = quantum of hides obtained from animals slaughtered by the butchers and fallen/dead animals received by the chamars in the jth clusters of villages of the ith stratum during the sth season.

5.1.4.2 Estimate of quantum of hides/ skins

(i) From private slaughter and dead animals

The estimate of the quantum of hides obtained from animals slaughtered in households by butchers and the dead animals received by chamars during the sth season is given by

$$\hat{x}_{sp} = \sum_{i=1}^L \frac{V_i}{v_i} \sum_{j=1}^{v_i} x_{sij}$$

where x_{sij} is the estimate of hides obtained in the jth cluster of villages of ith stratum during the sth season and is given by

$$x_{sij} = x'_{sij} + x''_{sij}$$

where x''_{sij} is the estimate of quantum of hides from the animals slaughtered in the households and is given by

$$x''_{sij} = \frac{H_{ij}}{h} \sum_{k=1}^h x''_{sijk}$$

The estimate of hides during the year is given by

$$\hat{x}_p = \sum_{s=1}^3 \hat{x}_{ps}$$

The estimate of variance of \hat{x}_{ps} is given by

$$\hat{V}(\hat{x}_{ps}) = \sum_{i=1}^L V_i^2 \left(\frac{1}{v_i} - \frac{1}{V_i} \right) s_i^2 + \sum_{i=1}^L \frac{V_i}{v_i} \sum_{j=1}^{v_i} H_{ij}^2 \left(\frac{1}{h} - \frac{1}{H_{ij}} \right) s_{ij}^2$$

where $s_i^2 = \frac{1}{v_i - 1} \sum_{j=1}^{v_i} (x_{sij} - \bar{x}_{si})^2$, $\bar{x}_{si} = \frac{1}{v_i} \sum_{j=1}^{v_i} x_{sij}$ and $s_{ij}^2 = \frac{1}{h - 1} \sum_{k=1}^h (x''_{sijk} - \bar{x}''_{sij})^2$,

$$\bar{x}''_{sij} = \frac{1}{h} \sum_{k=1}^h x''_{sijk}$$

Estimate of variance of X_p is given by

$$\hat{V}(\hat{X}_p) = \sum_{s=1}^3 \hat{V}(\hat{X}_{sp})$$

(ii) From registered slaughter houses

Let X_R be the quantum of hides obtained from animals slaughtered in all the registered slaughtered houses in the area during the year which is based on complete records maintained by the state Directorate of Animal Husbandry.

(iii) Estimate of quantum of hides and the estimate of its variance

The estimate of the quantum of hides is given by

$$\hat{X} = \hat{X}_p + X_R$$

Estimate of variance of X is given by

$$\hat{V}(\hat{X}) = \hat{V}(\hat{X}_p)$$

5.1.4.3 Tabulation of estimation of quantum of hides/ skins and estimation of its variances.

Season	Stratum	Clusters of villages in stratum V_i	No. of Clusters of villages selected in stratum v_i	Sl. of Clusters of villages	No. of h.h having livestock in selected clusters H_{ij}	No. of households selected h	No. of animals slaughtered in the selected h.h x''_{sijk}		$\frac{H_{ij}}{h}$ = col. 6/ col. 7	$H_{ij} - h =$ col.6 – col. 7	$\frac{H_{ij}}{h} \times (H_{ij} - h)$ = col. 9 \times col.10	$x''_{sij} = \frac{H_{ij}}{h} \times \sum x''_{sijk}$ = col. 9 $\times \sum col. 8$	Animals slaughtered by butcher & dead animals by chamars x'_{sij}
							1 2 3 h	Total $\sum x''_{sijk}$					
1	2	3	4	5	6	7	8		9	10	11	12	13
I	I			1 2 . . . v_i									
	II												
	III												
	IV												

Continued

$x_{sij} = x''_{sij} + x'_{sij}$	Sum of square of each value of col.8 = $\sum (x''_{sijk})^2$	square of sum of x''_{sijk} $= (\sum x''_{sijk})^2$ $= \sum (col.8)^2$	$(\sum x''_{sijk})^2 / h$ = col.16 / col.7	$sij^2 = (\sum (x''_{sijk})^2 - (\sum x''_{sijk})^2 / h) / (h-1)$ = (col.15 - col.17) / (col.7 - 1)	$\frac{H_{ij}}{h} \times (H_{ij} - h) \times sij^2$ = col.11 \times col.18	$(x_{sij})^2$ = (col.14) ²	$(\sum x_{sij})^2 / v_i$ = $(\sum col.14)^2 / col. 4$	s_i^2 = $\sum col.20 - col.21 / (col. 4 - 1)$
14	15	16	17	18	19	20	21	22
$\sum x_{sij}$					Σ	Σ		

Pooling of estimates of Hides/Skins & their variances over seasons & strata

Season	Stratum	$\sum x_{sij}$ = $\sum col.14$	$\frac{V_i}{v_i}$ = col. 3/ col. 4	$V_i - v_i =$ (col. 3 – col. 4)	$\frac{V_i}{v_i} (V_i - v_i)$ = col. 24 × col. 25	$\frac{V_i}{v_i} \sum x_{sij}$ = col. 24 × col. 23	$s_i^2 =$ col. 22	col. 26 × col.28	$\sum col.19 \times col.24$	$\hat{V}(\hat{x}_{ps})$
1	2	23	24	25	26	27	28	29	30	31
1	1 2 3 4									
						$\Sigma = \hat{x}_{sp}$		Σ	Σ	$\hat{V}(\hat{x}_{ps}) =$ $\Sigma col.29 +$ $\Sigma col.30$
II										
III										
Overall						$\hat{x}_p = \sum_s \hat{x}_{sp}$				$\hat{V}(\hat{x}_p) =$ $\sum_s \hat{v}(\hat{x}_{ps})$

No. of hides/ skins estimated in the district/state

$$\hat{x} = \hat{x}_p + x_R$$

where, x_R = No. of animals slaughtered in registered slaughter houses.

$$\hat{V}(\hat{x}) = \hat{V}(\hat{x}_p)$$

CHAPTER VI

PROBLEMS IN DATA COLLECTION, THE GAPS THEREIN AND SUGGESTIONS FOR IMPROVEMENT IN ANIMAL HUSBANDRY STATISTICS

In the country the information on Animal Husbandry Statistics is being collected regularly by the State Departments of Animal Husbandry under the Centrally sponsored scheme, coordinated by Ministry of Agriculture, Government of India. In order to streamline the statistical activities, and identify important data gaps and to suggest suitable methodologies from time to time, the Department of Agriculture and Co-operation constituted a **Technical Committee of Directions for improvement of Animal Husbandry and Dairying Statistics** during 1976 under the Chairmanship of Director, IASRI with the following broad functions:

- i) Identify the essential data gaps on indicators of Animal Husbandry and Dairying economy and recommend suitable measures.
- ii) Deliberate and recommend the statistical methodology to be adopted by Centre/States/UT's in the field of Animal Husbandry and Dairying.
- iii) Guide the Department of Agriculture and Co-operation in the conduct of sample surveys relating to Animal Husbandry and Dairying.
- iv) Approve the results / estimates (except for livestock census) for release.

Since then this committee meet on regular intervals with the representatives of State Animal Husbandry Departments. In this Committee problems/difficulties experienced in data collection, analysis of data and gaps therein under the changing scenario are discussed.

6.1 Problems in data collection

6.1.1 Measurement problems: For estimation of average yield of milk, wool and meat, the actual weighment of the produce is recommended but experience has shown that the farmers hesitate to allow the enumerators to weigh the milk. Under such circumstances the choice left with the enumerator is either to record the yield as told by the farmer or by his own judgement. Similarly in case of wool, the wool sheared contains dust particles, dry grass / thorns, grease, etc. which is also included in the weight of the wool sheared and thus estimates of production are on higher side. Also in case of meat

production there is no provision to weigh big animals and thus the quality of production estimates is affected.

6.1.2 Problems in estimation of wool: Unlike milk which is recorded every day in the selected households, wool yield is to be collected at the time of shearing. In the villages the wool is not sheared by the individual flock owner but given to contractors who shear the wool either in the village or at the nearest shearing centre and thus the enumerators are unable to record the data of the individual selected sheep as per the recommended plan. Frequent migration of flocks also creates problems in the collection of data on wool yield.

6.1.3 Problems of estimation of meat: In case of meat production, the problems faced are enormous viz. basic concept /definition of slaughter house, species-wise actual number of animals slaughtered in the slaughter houses etc. In addition to this there is a great deal of non-response from the butchers.

6.2 Data gaps in Animal Husbandry Statistics

Some of the data gaps in the methodology adopted under integrated sample surveys and also in livestock statistics are listed below.

6.2.1 Data gaps in the methodology under integrated sample surveys

- i) Breed -wise milk yield of different species viz cattle, buffaloes and goats.
- ii) Information on egg production from commercial poultry farms.
- iii) Breed-wise wool yield from various sources like sheep breeding farms, wool shearing and extension centres, etc.
- iv) Information on poultry meat be including to get the total meat production.

6.2.2 Data gaps in livestock statistics

A large number of surveys are being conducted regularly for the estimation of major livestock products and also for the cost of production studies, but there are gaps both in coverage as well as to the less important products and by-products. However, these data are needed for the estimation of value of output from this sector. Some of the gaps in basic studies, which need immediate attention, are:

- i) Estimation of yield rates of livestock products like other meat products, hair, pig bristles and bones, etc.

- ii) Estimate of value of inputs e.g. cattle feed including salt, etc.
- iii) Production estimates of dung especially of small animals and droppings of birds, etc.
- iv) Estimation of losses of various livestock products.
- v) Estimation of animal draught power.
- vi) Production estimates of poultry meat.
- vii) Price of livestock and livestock products.
- viii) Conversion ratio of milk into ghee, butter, etc. and the cost of conversion.
- ix) Deaths of different categories of animals due to natural calamities and other reasons.
- x) Consumption of roughages and concentrates by different categories of livestock.
- xi) Utilization of milk, eggs and dung, etc.

6.3 Suggestions for the improvement of Animal Husbandry and livestock statistics

Integrated Sample Survey which are being taken up by the State Animal Husbandry Departments on regular basis, there is no problem in collecting information on milk and egg production but in case of wool and meat, the estimates are not being prepared due to the problems being faced by the field staff in the collection of production data. Some suggestions are made to tackle the problems up to some extent.

6.3.1 Wool production: Due to non-existence of sheep in the selected villages of certain tracts and also the areas which have sheep population, the field staff fails to record the wool yield data in their presence even after regular follow up. In order to overcome this problem, it is suggested

- (i) To identify some pockets in the state having the sheep population before the start of the survey and efforts should be concentrated in those areas only.
- (ii) Since the sheep are sheared in shearing seasons only, the efforts should be concentrated in the collection of wool yield data during that period by taking the help of the staff engaged with sheep breeding association which is always in touch with the shepherds. In case such associations do not exist in the selected areas, additional staff may be deployed to have a regular follow up of the selected shepherds for collecting the information.

- (iii) To have the better estimates of total wool production, the information on wool yield should be collected separately for indigenous and crossbred sheep as there is wide different in the yields of two types of sheep.
- (iv) The information on wool yield may also be collected from sheep breeding farms existing in the area and wool production should be supplemented for estimating the total wool production in the area.

6.3.2 Meat production: Major portion of meat is produced in the slaughter houses and since slaughter houses come under the preview of local self-government and there is no check by the officials of animal husbandry departments, so it is difficult to collect information on meat production and also the reliability of number of animals slaughtered as reported in their records is not ensured. Secondly, there is no clear cut concept and definition of slaughter houses and they vary from state to state. It is therefore suggested that the following measures should be taken to overcome this problem.

- (i) A fresh list of slaughter houses should be prepared on the basis of some uniform concept and definition for each state.
- (ii) A sample checking of the data provided by the slaughter houses should be done on regular basis in order to work out the correction factor.
- (iii) The provision of the weighing equipments should be made for weighing the animals in the slaughter houses.
- (iv) The information on meat production should be collected not only from slaughter houses but also from other sources viz. unregistered houses (butcher houses) and households to have reliable estimates of production.
- (v) Poultry and broiler meat production should be included to work out the total meat production in the state.

6.3.3 Hides and skins production:

The studies undertaken by IASRI revealed that slaughtering of animals at household level was almost negligible and because of this reason the standard errors of the estimates were quite high. It was also observed that the households which keep cattle and buffaloes (source of hides) generally do not keep sheep and goats (source of skins) and vice-versa. Thus the slaughtering at household level is a very rare event, hence it has little recall lapse error. Since, this type of information is not very sensitive, so it is

usually known to wider group. It is therefore suggested that the information on number of animal slaughtered may be collected for the entire village by a careful enquiry from a few knowledgeable persons residing in the same village and for accuracy of the data, the concerned households which are likely to be smaller in number may be personally visited. This will help in reducing the cost of the collection of the data.

The information on production of hides and skins is obtained (i) from cluster of villages as recorded in the sample of households reporting slaughter of animals (ii) all the butchers reporting slaughter of animals (iii) all the chamars handling dead and slaughtered animals and (iv) the registered slaughter houses in the region on the basis of records maintained whereas estimate of total meat production in the region is obtained by multiplying estimated number of animals slaughtered with the average meat production per animal. The information on the number of animals slaughtered is obtained from the above sources viz. (i), (ii) and (iv) and meat production per animal is also obtained from (iv). It is, therefore, suggested that instead of conducting two separate surveys for estimating the numbers of hides and skins and meat production, the two can be combined in a single survey and the two estimates i.e. on number of hides/skins and meat production obtained with the desired precision. Thus in the survey for estimating meat production only one more schedule on chamars may be included (for collection of data in respect of fallen or dead animals) with the schedules for collecting data on animals slaughtered after adding some columns for getting information on hides/skins in them. The expenditure involved will be considerable reduced if the two separate surveys are combined in a single survey.

6.4 General suggestions for improvement of livestock statistics

As discussed, the different methodologies available for estimation of major livestock products viz. milk, eggs, wool and meat under different sampling schemes and thus the availability of livestock statistics on production of these products. But there are still a number of data gaps, which are required to be filled in to have a strong database in livestock sector. Some of the data gaps can be filled in by making use of other information collected in these surveys but not processed and analyzed. For example, under Integrated sample surveys on estimation of production of major livestock products and cost of production of these products, the information on utilization of milk and eggs, and dung, roughages and concentrates fed to the animals, causes of deaths of animals and details of veterinary aid given to animals, prices of livestock and livestock products,

etc. are also collected besides the yields of these major products. Therefore, there is a need for providing / updating infrastructural support for better utilization of data being collected under different surveys relating to livestock. There is also a need for improvement in the quality of livestock statistics. There should be regular upgrade in the knowledge of statistical as well as field staff through frequent training, workshops, etc.

Professional competence of the statistical staff under the State Directorates is another bottleneck. They do not understand or comprehend theoretical aspects of sampling and statistical methods and thus fail to submit the desired results properly and in time. This problem can be overcome by deploying qualified staff and be given intensive training in statistical methods and periodical refresher training to update their knowledge in latest developments in statistical techniques for conduct of sample surveys and analysis of the data.

CHAPTER VII

SUMMARY

Both direct and indirect contribution of livestock in human food chain is highly significant. Direct contributions are the production of high quality foods rich in protective proteins like milk, meat, eggs and poultry. Indirect contributions are the supply of draught power for various agricultural operations and supply of good quality manure (dung and urine) for the nutritional enrichment and conditioning of arable land. Thus, it is essential to maintain updated data on livestock, livestock products, growth pattern, national requirement, status of demand and supply for determining the scope and extent of export items. Although attempts are made by different institutions of States and Union Government, but variations in procedures of data collection by different agencies often present different picture for the same item which causes confusion in users. Therefore, there is need of developing a common system for uniform collection of data on various aspects of animal husbandry. Significance of various livestock and other enterprises contributing for the welfare of human being has been mentioned in the introduction.

The concepts and definitions pertaining to statistics collection on animal husbandry and allied enterprises have been identified and described in Chapter II. This information will be useful for uniform data collection and it may also be useful for reducing the ambiguity and detection of inadvertent error if caused during the process of data collection and/or processing statistically before final presentation. Attempt has been made to select relevant terminologies commonly used for livestock production, husbandry activities of household, stocks and flows, cost of production and income, requirement of manpower, consumer units, animal units and measurement of cost of production.

Details of sampling methodology and estimation procedures for the estimation of different livestock products and byproducts have been described in Chapter III. In chapter IV problems in data collection, gaps therein and suggestions for improvement in livestock statistics have been discussed. In the end of this manual copies of various proformae used for the collection of statistics pertaining to animal husbandry, dairying and poultry husbandry are appended.

REFERENCES

1. Report of 'Technical Committee of Direction' for improvement of animal husbandry and dairying statistics, 1989, Department of Animal Husbandry & Dairying Ministry of Agriculture, Govt. of India, New Delhi.
2. FAO Production Year Book – 2001 & 2003, Volume 55 & 57.
3. Annual Reports on livestock numbers and production of different livestock products published by Animal Husbandry Departments of States/UTs.
4. Report on the working group on Animal Husbandry & Dairying for the Tenth Five Year Plan (2002-2007) -2002, Government of India, Planning Commission, New Delhi.
5. Singh D., Garg J.N., Goel B.B.P.S., Rajagopalan M. and Singh K.B. 1977. *Sampling methodology for estimation of milk production, Northern region, (1969-72)*. Research report-IASRI, New Delhi-12.
6. Singh D., Goel B.B.P.S., Garg J.N. and Singh K.B. 1979. *Sampling methodology for estimation of milk production, Southern region, (1971-74)*. Research report-IASRI, New Delhi-12
7. Singh D., Goel B.B.P.S., Garg J.N., Singh K.B. and Rajagopalan M. 1978. *Sampling methodology for estimation of egg production and study of poultry keeping practices in Northern region (1969-72) and Southern region (1971-74)* Research report-IASRI, New Delhi-12.
8. Singh D., Goel B.B.P.S., Maini J.S. and Goyal J.P. 1979. *Sampling methodology for estimation of wool production in Northern region (1969-72) and Southern region (1971-74)* Research report - IASRI, New Delhi-12,
9. Singh D., Maini J.S. Goel B.B.P.S., and Bassi G.S. 1978. *Sampling methodology for estimation of meat production in Northern region (1969-72) and Southern region (1971-74)*. Research report-IASRI., New Delhi-12.
10. Singh D., Murty V.V.R. and Goel B.B.P.S. 1970. *Monograph on estimation of milk production*. Research series- IASRI, New Delhi-12.
11. Singh D., Goel B.B.P.S., Garg J.N. and Rao D.V.S. 1975. *Monograph on Sample Survey Techniques for Estimation of Egg Production*. Research Series-IASRI, New Delhi-12.
12. Singh D., Rajagopalan M., Maini J.S. 1972. *Monograph on estimation of wool production*. Research Series-IASRI, New Delhi-12.

13. Singh D., Rajagopalan M., Maini J.S. and Singh K.B. 1978. *Monograph on sample survey techniques for estimation of meat production*. Research series- IASRI, New Delhi-12.
14. Raut K.C., Singh D. & Singh Shivtar 1975. *Estimation of availability and cost of production of milk*. Research report - IASRI, New Delhi-12.
15. Nadkarni U.G., Somayazulu L.B.S. & Jain T.B. 1981. *Monograph on estimation of cost of production of poultry and eggs*. Research series - IASRI, New Delhi-12.
16. Maini J.S., Goel B.B.P.S., and Dahiya D.C. 1978. *Sample survey for estimation of production of hides and skins in Punjab, 1974-76*. Project report. Indian Agril. Statist. Res. Instt. New Delhi
17. Maini, J.S., Singh, K.B. and Khatri, R.S. 1988 *Pilot sample survey for estimation of production of hides and skins, in U.P.* Project report. Indian Agril. Statist. Res. Instt. New Delhi
18. Goyal, J.P., Maini, J.S., Singh, K.B. and Khatri, R.S. 1991 *Pilot sample survey for estimation of production of hides and skins, Tamil Nadu*. Research report. Indian Agril. Statist. Res. Instt. New Delhi.
19. Khatri R.S., Goyal J.P. and Singh K.B. 1998. *Pilot sample survey for estimation of post production losses of milk in rural areas*. Research report - IASRI, New Delhi-12.
20. Khatri R.S., Goyal J.P., Jayasankar J. and Geethalakshmi V. 2005. *Estimation of wool production—emerging data needs and a methodological reappraisal* (AP-Cess Fund Project)
21. Bathla H.V.L., Khatri R.S., Kalra K.K. and Singh Rajvir. *Pilot study on assessment of harvest and post harvest losses*.

APPENDIX I

MINISTRY OF AGRICULTURE
Department of Agriculture and Cooperation
Animal Husbandry Division
Sample Survey for estimation of production of milk, eggs, wool and meat
and study of A. H. Practices
Village Schedule I

General information about village/town selected for complete enumeration

Period of Study.....

i) District

ii) Tehsil

iii) Block

iv) Name of the selected village/town

Serial No in Census Record.....

v) Season

I Particulars of the selected village (large Sample)

i) Total number of house holds as per the latest population census

ii) Total human population

iii) Total population of:

(a) S.F. / M.F. and A.L.....

(b) S.C./S.T.

iv) Net geographical area of the village (hect.)

v) Total cultivated area (hect.)

Current year

Last year

(a) Irrigated

(b) Unirrigated

vi) Area under fodder crops

vii) Area under permanent Pasture and other grazing land

viii) Location and distance to the nearest

Location Distance village (km)

(a) A.I. Centre /Semen Collection centre

(b) Veterinary Hospital / Dispensary

(c) Markets for:

(i) Purchase of Cattle / Poultry feed

(ii) Sale and purchase of Livestock products

ix) Is the village covered under any of the following development programme:

Sl. No. Name of the Development Programme

Yes/No

(1)

(2)

(3)

1 Intensive Cattle Development Project

2 Key Village Scheme

3 Intensive Poultry Development Project

4 Intensive Poultry Development Project

5 Sheep and Wool Extension Centre

6 Milk Collection Centre

7 Any other development program (specify)

x) Any out break of disease of Livestock / poultry during the last season

Name of the disease	Particulars	Cattle, Buffaloes, Sheep, Goat Poultry
1	2	3
a. Number of animals affected		
b. Number of prophylactic vaccinations made		
c. Number of animals died		

II. Livestock and Poultry population according to latest livestock census in the selected village

Classification	No.	Classification	No.
CATTLE A Crossbred cattle i) Total males over 2 ½ years ii) Total females over 2 ½ years a) In milk b) Dry c) Not calved even once iii) Young stock below 2 ½ years iv) Total crossbred (Males+ females+ young stock) B Indigenous i) Total males over 3 years ii) Total females over 3 years a) In milk b) Dry c) Not calved even once iii) Total indigenous cattle (male + females+ young stock) BUFFALOES i) Total males over 3 years ii) Total females over 3 years a) In milk b) Dry c) Not calved even once iii) Total Buffaloes (Males+ females + young stock) SHEEP A Crossbred i) Total males over 1 year ii) Total females over 1 year iii) Total cross bred sheep (Adult+ young stock) Recognized B Indigenous i) Total males over 1 year ii) Total females over 1 year iii) Total indigenous sheep (adult+ young stock)		GOATS i) Total males over 1 year ii) Total females over 1 year iii) Total Goats. (Adult + young) PIGS A Crossbred B Indigenous Total Pigs HORSES DONKEYS CAMELS Other Livestock (specify) POULTRY A Fowls i) Cocks a) Desi b) Improved ii) Hens a) Desi b) Improved iii) Chickens a) Desi b) Improved iv) Total fowls i) Desi ii) Improved B Ducks i) Ducks a) Desi b) Improved ii) Drakes a) Desi b) Improved iii) Ducklings(Below five months) a) Desi b) Improved iv) Total Ducks(Adults & young stock) a) Desi b) Improved	

Enumerator
Date

Supervisor
Date

Field Officer
Date

Complete Enumeration....Listing of households for enumeration of livestock and poultry possessed in villages / wards selected for complete enumeration

1	Census number of H.H.
2	Name of the H.H. and his father's name
3	Serial number of H.H.
4	Serial number of H.H. having milch bovines
5	Males over 2 ½ Years
6	In Milk
7	Dry
8	Not calved even once
9	Others
10	Young stock below 2 ½ years
11	Total Crossbred
12	Males over 3 years
13	In Milk
14	Dry
15	Not calved even once
16	Others
17	Young stock below 3 years
18	Total indigenous

Buffaloes							Sheep								Female goats				
								Crossbred				Indigenous					Over one year		
Males over 3 years	Females over 3 years		Others	Young stock below 3 years	Total buffaloes	Sl. No. of H.H. having sheep		Males over 1 year	Females over 1 year	Young stock below 1 year	Total crossbred	Males over 1 year	Females over 1 year	Young stock below 1 year	Total indigenous		Sl. No. of H.H. having goat	Dry	In Milk
19	20	21					22	23	24	25	26	27	28	29	30	31		32	33

Pigs			Poultry										Ducks							
Crossbred	Indigenous	Total	Sl. No. of H.H. having layers	Cocks		Hens			Chickens		Total		Ducks		Drakes		Ducklings		Total	
				Desi	Improved	Desi	Improved	Total Hens	Desi	Improved	Desi	Improved	Desi	Improved	Desi	Improved	Desi	Improved	Desi	Improved
39	40	41	42	43	44	45	46	46(A)	47	48	49	50	51	52	53	54	55	56	57	58

No. of Animals Slaughtered during last season								Area covered under green fodder (ha)	Remarks
Cattle	Buffalo	Sheep	Goat	Pig	Poultry	Others			
59	60	61	62	63	64	65	66	67	

Enumerator

Supervisor

Date

Date

MINISTRY OF AGRICULTURE
Department of Agriculture and Cooperation
Animal Husbandry Division
Sample survey for estimation of production of milk, eggs, wool and meat
and study of A. H. Practices
Schedule L.P.S.1.1
Selection of clusters of households for detailed study

- (i) District.....
- (ii) Tehsil.....
- (iii) Block.....
- (iv) Name of the selected Village/Town and Ward.....
- (v) Seasons: Summer/Rainy/Winter
- (vi) Round 1/2/3/4

For Milk Production (Cows and Buffaloes)		Highest Sl. No. of H.H having bovines (Col.4 of village Schedule II)				
Cluster No.	Allotted random No. as in the chart	Reminder (key No.)	Selected cluster of H.H.	Sl. No. of substitute H.H.	Date of recording	Remarks
1	2	3	4	5	6	7

For Milk production(goat)	Highest Sl.No.of H.H. having goats in milk (col.35 of village Schedule II)
1. . .	

For Egg production	Highest Sl.No.of H.H. having Poultry for eggs (col.42 of village Schedule II)
1. . .	

For Wool production	Highest Sl.No.of H.H. having sheep (col.26 of village Schedule II)
1. . ..	

Enumerator
Date

Supervisor
Date

Field Officer
Date

MINISTRY OF AGRICULTURE
Department of Agriculture and Cooperation
Animal Husbandry Division
Sample survey for estimation of production of milk, eggs, wool and meat
and study of A. H. Practices
Schedule L.P.S. 1.2

Details of milk yield and attendant practices in selected households

Period of survey_____

i) District ii) Tehsil iii) Block iv) Name of selected village/town in the sub-sample
(v) Season Summer/ Rainy / winter

I. Identification of selected HH in the sub-sample of villages

Serial No. of H.H.	Name of the householder	Father's name of householder	Size of the family			Cultivators			Sells both
			Adult	Children	Total	Private	Commercial		
							Sells milk	Sells milk products	
1	2	3	4	5	6	7	8	9	10

Non-Cultivator				No. of animals in milk				
Private	Sells milk	Sells milk products	Sells both	Cattle		Buffalo	Goats	Remarks
				Cross breed	Indigenous			
11	12	13	14	15	16	17	18	19

Changes in stock
Birth and death of animals at the household in the last one year period

Births			Deaths	
Year of Birth	No. of Animals	Year of Death	No. of Animals	Remarks
20	21	22	23	24

II. Details of feed consumption on the day of visit

Sl. No.	Name of the Animal	Category Cow/ Buffalo	Classification	Breed	Grazed / stall fed / or both	Green fodder	
						Separate or Joint feeding	Name of the green fodder
1	2	3	4	5	6	7	8

Weight (Kg.)			Dry fodder Weight (kg.)				
Evening	Morning	Total	Separate or joint feeding	Name of dry fodder	Evening	Morning	Total
9	10	11	12	13	14	15	16

Concentrates Weight (kg.)					Hours of grazing
Separate of joint feeding	Name of the concentrate	Evening	Morning	Total	
17	18	19	20	21	22

III. Milk yield of individual animal on the day of visit

Sl. No.	Name of the animal	Category C/B	Breed	No. of lactation completed	Calendar month of calving
1	2	3	4	5	6

Present stage of lactation	Milk yield			Remarks
	Evening (kg./gm)	Morning (kg./gm)	Day's total (kg./gm)	
7	8	9	10	11

Details of utilization of milk (total produced) on the previous day (kg.)						
	Cow milk	Buffalo milk	Goat milk	Total	Rate of sale (kg.)	Purchase (kg.)
	1	2	3	4	5	6
1. Produced 2. Purchased a) Quantity b) Rate / kg. 3. Sold as liquid milk a) Quantity b) Rate/ kg. 4. Kept for conversion into milk products 5. Consumed (in the household)						

IV. Utilization of dung collected on the previous day

Total No. of animals		Total No. of Baskets/Buckets	Wt. per Basket/ Bucket	Total wt. of dung produced	Utilization (Kg.)		
Adult	Young stock				For dung cakes	For manure	Other ways
1	2	3	4	5	6	7	8

V. Whether animals in the household have been vaccinated against diseases during the past season If yes, indicate the

Disease against which they were vaccinated

Enumerator
Date

Supervisor
Date

Field Officer
Date

MINISTRY OF AGRICULTURE
Department of Agriculture and Cooperation
Animal Husbandry Division
Sample survey for estimation of production of milk, eggs, wool and meat
and study of A. H. Practices
Schedule L.P.S. 2.1

Details of egg production and attendant practices in selected households

District_____Taluk_____Block_____Name of selected village/town (sub-sample)
Season: Summer/Rainy/Winter

1. Identification of selected H.H. in the sub sample of villages

Sl. No. of the H.H.	Name of the Householder	Father's name of the householder	Main occupation	Size of the family			Remarks
				Adult	Children	Total	
1	2	3	4	5	6	7	8

2. Production, Purchase and Disposal of eggs during the last 24 hours

Sl. No. of HH	Fowls/ducks	Breed	Total Number of layers	Number of eggs laid	Number of eggs purchased	Number consumed at home	Number of eggs set kept for hatching
1	2	3	4	5	6	7	8
Sold	Number damaged	Balance	Price of eggs sold per dozen	Number of layers used for meat purpose		Remarks	
9	10	11	12	13		14	

3. Feed Supply

Species	Breed	Classification	Feed supplied per flock per day	
			Name of the feed	Quantity (kg.)
1	2	3	4	5

4. Any prophylactic vaccination made during the last season
Indicate the disease against which vaccination carried out.

Enumerator Officer

Date

Supervisor

Date

Field

Date

MINISTRY OF AGRICULTURE
Department of Agriculture and Cooperation
Animal Husbandry Division
Sample survey for estimation of production of milk, eggs, wool and meat
and study of A. H. Practices
Schedule L.P.S.2.2

Details of Egg production and attendant practices in the commercial poultry farms

Period of Survey.....
(i) District.....
(ii) Tehsil.....
(iii) Block.....
(iv) Village/town.....
(v) Name of the farm.....
(vi) Name of the owner.....
(vii) Father's name.....
(viii) Season: Summer/Rainy/Winter

Name of layers maintained	Average yield per layer per person	Total no. of eggs produced at the farm during last season /four months
1	2	3
Fowls		
(a) Improved		
(b) Desi		

1	2	3
Ducks		
(a) Improved		
(b) Desi		

Owner of the Farm
Date

Enumerator
Date

Supervisor
Date

Field Officer
Date

MINISTRY OF AGRICULTURE
Department of Agriculture and Cooperation
Animal Husbandry Division
Sample survey for estimation of production of milk, eggs, wool and meat
and study of A. H. Practices
Schedule LPS 3.1
Details of wool production in sample households and attendant practices

Period of survey
(i) District.....
(iii) Block.....
(v) Season: Summer / Rainy / Winter

(ii) Tehsil.....
(iv) Village / Town and ward.....
(vi) Shearing season.....

1. Particulars of selected household in the village / town and ward

Sl. no. of household	Name of the householder	Father's name	Size of the family			Main Occupation
			Adult	Children	Total	
1	2	3	4	5	6	7

Details of Sheep								
Flock Stationary/ Migratory	Breed	Adult				Young stock		
		Ram	Wethers	Ewes	Total	Male	Female	Total
8	9	10	11	12	13	14	15	16

II. Wool yield of selected sheep (Grams)

Sl. No.	Breed	Wool yield				Total sheep sheared in the flock			
		Ram	Wethers	Ewes	Lambs	Total sheep in the flock	Total No. of sheep sheared	Total wool production	Remarks
1	2	3	4	5	6	7	8	9	10

III. Disposal of sheep during the Last Season

Breed	Ram/Wether/Ewe/Lamb	No. at the beginning of the season	Died		Sold (No.)	Purchased (No.)	No. slaughtered for consumption	Other disposal		Remarks
			No.	Cause				Mode	No.	
1	2	3	4	5	6	7	8	9	10	11

IV. Feeding and grazing practices and protection and treatment against diseases

Feed supplied		Grazing hrs.	Protection against diseases				Any other treatment for safety	Remarks
Name of feed	Qty.		Name of the disease	No. affected	No. of sheep vaccinated	No. of sheep died		
1	2	3	4	5	6	7	8	9

Enumerator
Date

Supervisor
Date

Field Officer
Date

MINISTRY OF AGRICULTURE
Department of Agriculture and Cooperation
Animal Husbandry Division
Sample survey for estimation of production of milk, eggs, wool and meat
and study of A. H. Practices
Schedule LPS 4.1
Information on yield of meat from unrecognized slaughter houses meat shop
(On the day of visit)
UNREGISTERED SLAUGHTER HOUSES
(In selected seven villages)
(For first round only)

Period of survey_____

(i) District_____(ii) Tehsil_____(iii) Block_____ (iv) Village / town_____
(v) Name and Address of Slaughter / Butcher house_____
(vi) Season: Summer / Rainy/ winter (vii) Date of visit_____

Table 1

Category of animals	No. of animals					
	Brought for slaughter on the day of visit			Slaughtered during the previous season (S / M / W)		
	Adults	Young	Total	Adult	Young (Four months)	Total
1	2	3	4	5	6	7
Cattle Sheep Goats Pigs Buffaloes Other (Specify species)						

Table 2: Details of animal slaughtered

Species	Adult or Young (A or Y)	Breed	Sex	Weight before slaughter (kg.)	Qty of dressed meat obtained	Aprox. price of meat / kg. (in Rs.)
1	2	3	4	5	6	7
I	Cattle					
II	Sheep					
III	Goat					
IV	Pigs					
V	Buffaloes					
VI	Others					

Enumerator
Date

Supervisor
Date

Field Officer
Date

Instructions for filling in the schedules under Integrated Sample Survey (ISS) Scheme

Village schedule – I

This schedule is meant for recording general information for the allotted village for complete enumeration.

On the top of the schedule, in items (i) to (v), name of the district, tehsil, block, village/ town selected and the season viz. summer, rainy, winter in which the data is collected along with the period of the study will be entered.

(I) Particulars of the selected village are to be entered as follows:

In items (i) and (ii) total number of households and total population as per the latest population census will be recorded. Net geographical area (in hectare) of the village, the total cultivated area (in hectare) irrigated and unirrigated of the current year and last year will be mentioned after ascertaining from the Patwari records in items (iv) and (v). Similarly information area under fodder crops and area under permanent pasture and other grazing land will be entered in items (vi) and (vii). Location and distance from the village to the centres viz. A.I. Centre, Semen collection centre, Veterinary hospital dispensary, markets for purchase of cattle poultry feed and sale and purchase of livestock products will be recorded in item (viii). The village covered under any development programmes, viz. intensive cattle development programme, key village scheme, intensive poultry development, sheep and wool extension centre milk collection centre, any other development programmes will be entered in item (ix) as YES against development programmes otherwise NO. In item (x) any out break of disease of livestock/poultry during the last season is to be recorded. In column (1), name of the disease will be mentioned. In column (2) the particulars of the disease will be given. In column (3), type of animals viz. cattle, buffaloes, sheep, goat, poultry etc. affected due to disease will be mentioned. Indicate the number of animals affected, number of prophylactic vaccination given to the animals and number of animals died due to different diseases in 1(a), (b), and (c) respectively.

(II) Livestock population according to the latest livestock census in the selected village will be entered as species-wise and classification-wise in the space provided in II of page 2. After filling all the information required in the schedule the enumerator will put his signature and date which must be countersigned by Supervisor and Field Officer with date after verification at the space provided on the bottom of the schedule

Village schedule – II

The schedule is meant for preparing a complete list of households in the entire village/Town

In items (i) to (iv), name of the district, Taluk, block and name of selected village / town will be entered. In item (v), the season viz. summer, rainy, winter will be entered. At the top right corner, period of the survey i.e. the date of start and date of completion of enumeration work will be written. The enumerator will visit all the households in the village / town one by one starting from one end. Proper care should be taken by the enumerator to ensure that all the households in the village / town are enumerated.

In column (1) of the schedule the house number of the household as given by the Panchayat will be recorded. In case there is no house number for a particular household, this column will be left blank. In column (2), name of the householder and his father's

name will be recorded. In column (3) a serial list of all the households will be prepared irrespective of the fact whether a household has any livestock or not. In column (5) to (25), information on the number of cattle and buffaloes separately of each classification will be recorded in the respective columns. Consulting columns (5) to (25), a serial list of households having at least one bovine will be prepared in column (4). In case a particular household does not have at least one bovine (cattle or buffaloes), no serial number will be given to that household in column (4). In columns (27) to (34), information on number of sheep will be recorded. Number of males & females sheep over one year, and young below 1 year and total number of crossbred sheep will be entered in columns (27) to (30) whereas in column (31) to (34), the similar information of indigenous breed will be entered. In column (26), the serial list of households having at least one sheep is to be prepared.

In columns (36) to (38), number of dry and in milk goat over 1 year and the total will be recorded. Column (35) will be used to prepare the serial list of households having at least one goat. Columns (39) to (41) will be used to record the number of crossbred and indigenous pigs and their totals. Columns (42) to (50) are meant to record the information on poultry possessed by the householders. In columns (43) and (44), the number of desi and improved cocks will be recorded. Similar information will be recorded for hens and chickens in columns (45) to (48). In columns (49) to (50), the total of cocks, hens and chickens separately for desi improved varieties are to be recorded. Column (42) will be used to prepare the serial list of households having at least one layer i.e. female bird laying eggs. Similarly, in columns (51) to (58), number of desi and improved ducks, drakes, ducklings and their totals will be recorded. In columns (59) to (65), the number of cattle, buffaloes, sheep, Goats, pigs, poultry and other species slaughtered during the last season will be recorded. In column (66), the area of the field under green fodder in hectare possessed by the householder will be recorded. Remarks, if any, will be given in column (67).

Schedule L.P.S. 1.1

This schedule is meant for selection of clusters of households (or flocks) for study of production of milk, eggs, wool. In items (i) to (iv), name of the district, taluk, block, and the selected village / town respectively will be entered. In item (v) and (VI), the season as summer, rainy, winter and round as 1,2,3,4 respectively will be entered. At the top of the schedule, period of the survey i.e. DMY of start and end of the survey will be mentioned. Before filling in the schedule, the highest serial number of household having bovines, poultry, and sheep in the selected village from village schedule II (complete enumeration schedule) will be indicated in the space provided.

Suppose in a particular round, four cluster of two households each are to be observed for milk recording, then write cluster no. 1,2,3,4 in column (1) and against each cluster write the allotted random number in column (2) after dividing the random number by the total number of households having bovines, the remainder obtained will be written in column (3). Suppose the remainder comes out to be 91, then the selected households will be 91 and 92 which are to be written in column (4). Suppose household number 91 is not having milch animal then replace this number by the household number 93 which will be the substitute household. Then the selected cluster will have household number 92 and 93. The date of recording the milk yield of the selected household is to be given in column (6). Remarks if any, will be given in column (7). Similar procedure is to be adopted for the selection of households having poultry and sheep.

Schedule LPS 1.2

On the top of the schedule, the items (i) to (v) and the period of the survey may be filled in the same manner as explained in the schedule LPS 1.1.

The identification particulars of the selected household in a particular sub-sample of village are to be entered in columns (1) to (19).

In columns (1) to (6), serial number of household, name of the householder, his/her father's name and size of family i.e. adult, children and total will be mentioned.

The type of household is in regard to utilization of milk and cultivation of land. In case, the milk produced in the household is kept only for its own use and not sold, then the household will be called Private household. If this household is also a cultivator it will be treated as private cultivator otherwise private non-cultivator. The household which usually sells milk or milk products will be called as a commercial household. If this household is a cultivator, the household will be commercial cultivator otherwise commercial non-cultivator. The commercial cultivator/non-cultivator households are further classified according as they sell milk, milk products or both. This information is to be recorded in the columns (7) to (14). The number of crossbred and indigenous cattle in milk possessed by the householder are to be recorded in columns (15) & (16) whereas the number of buffaloes and goats in columns (17) & (18). The remarks, if any, will be entered in columns (19).

The changes in the livestock possessed by the householder during the last one year period are to be recorded in columns (20) & (23). The number of animals born and year of birth are to be given in columns (21) & (20) respectively. Similar information on number of animals died during this period may be recorded in columns (22) & (23). Remarks, if any, will be recorded in columns (24).

II Details of the feed consumption on the day of the visit

In column (1), the serial number of each animal (cattle & Buffalo) in the selected household will be recorded. In column (2), the name of the animal will be recorded. In column (3) indicate whether the animal is cattle (C) or buffalo (B). In column (4), classification of the each animal will be recorded. The breed of the animal will be entered in column (5). It is very important to note here that the breed should be recorded after a very careful observation.

Column (6) indicates whether the animal is only grazed or is only stall-fed or both grazed and stall fed on the date of visit. Such information may be recorded as G or S or B. In columns (7) to (21) have been provided for recording data on feeds supplied to the animals on the date of visit. In columns (7) to (11) the information on green fodder will be recorded while in columns (12) to (16) information on dry fodder supplied on the day of visit will be recorded. Similarly columns (17) to (21) are meant for recording information on concentrates. The name of green fodder, dry fodder and concentrates are to be given in columns (8), (13) and (18), while in columns (9) to (11), (14) to (16) and (19) to (21), the quantity of feed supplied to the animal will be given. In columns (7), (12) and (17), indicate whether the animal was fed separately or along with some other animals in a common trough (Jointly fed). It may be noted here that when two or more animals of same classification say two cows in milk were fed in a common trough the total fed may be distributed equally among the animals. However, if two or more animals of different categories or classification are jointly fed, it will be difficult to estimate the quantity of feed supplied separately to each animal and in this case the total quantity of

feed supplied to these animals will be given in appropriate columns and the approximate proportion of quantity of feed supplied to each animal will also be given. Suppose two cows in milk were fed 20 kg. of barseem (green fodder) in a common trough in the morning period. Then the total quantity may be apportioned equally between the two cows in milk as 10 kg. for one cow and 10 kg. for the second cow and these data will be given column (9). However, if the two animals fed in the same trough are of different classifications or categories, say, cow in milk and bullock or cow in milk and buffalo in milk, the total quantity and approximate proportion of feed supplied to each animal will be given in column (9).

It should be noted here that the information on the feed to be recorded in columns (7) to 21 related only to the day of visit of enumerator to the household. Such data should be recorded only after careful weighment of the feed supplied to the animals separately in the morning and evening periods. In recording data on the quantity of green fodder, the 100 kg. balances supplied to the enumerator will be used and the quantity will be given to the nearest integer. Similarly, for recording information on concentrates supplied to an animal, the 10 kg. balances will be used and the weight of concentrates will be recorded in Kg. and grams.

In column (22), indicate the number of hours, the animal was grazed on the day of visit; and such information may be recorded in the evening time when the animals return from grazing.

III Milk yield of individual animals on the day of visit

In this table, information on the milk yield of each selected animal in milk in the household on the day of the visit will be recorded. The procedure of selecting animals in milk from households which have more than two animals in milk has already been explained. However, if there are only one or two animals in milk in households no selection of animals will be done but the one or two animals will be observed for milk recording. In column (1) the serial number of each animal (cattle & Buffalo) in the selected household will be recorded. In column (2), the name of the animal will be recorded. In column (3) indicate whether the animal is cattle (C) or buffalo (B). In column (4), breed of the each animal will be recorded. In column (5), indicate the number of lactations completed by the animals. In column (6) indicate the calendar month like May, June, etc. during which the animals has calved. In column (7) indicate the stage of lactation or month after calving. In columns (8) to (9), the milk yield of the animal is to be recorded after careful weighment with the help of the 10 Kg. balances both in the evening and morning after getting the animal milk fed in his presence. It should be noted here that in case all the milk was fed to the calf viz. no milk was drawn in the pail, the information on milk yield will be recorded as zero. Remarks, if any, will be mentioned in column (11)

Details of utilization of milk (Total produced) on the previous day (kg)

This table gives his details of utilization of the total milk produced in the household on the previous day. Thus, if there are more than two animals in milk in the household, this table gives results of utilization of the total milk produced on the previous day for all the animals in milk in the household and the information will be recorded by enquiry alone.

The information on utilization of milk will be given as (1) total milk produced, (2) total milk purchased, (3) quantity sold as milk (4) quantity kept for conversion into milk products and (5) quantity consumed in fluid form. It is important to verify that the quantity produced plus quantity purchased should be equal to the sum of the quantity sold,

quantity kept for conversion into products and quantity consumed. The milk used for tea etc. should be treated as consumed in fluid form. The rate of sale or purchase of milk will be recorded in the relevant columns.

IV Utilization of dung collected on the previous day

The details of utilization of dung collected on the previous day in the household will be recorded. It should be noted here that this information relates only to the quantity of dung collected in the household on the previous day and not the dung excreted on the fields, roadside etc. The quantity of dung collected in the household may be estimated as follows. Weigh one bucket or basket of dung and multiply this figure by the number of baskets or buckets of dung collected in the household on the previous day. This estimate will give the total weight of dung collected in the household. Information on the production in a basket or bucket should be recorded by utilizing the 100 kg. balance and the total production should be given correct to a kg. The utilization of dung should be indicated as proportion converted into dung cakes and proportion thrown into the manure pits or fields and the proportion utilized in other ways like flooring etc.

V Animals vaccinated against diseases during the past season

The information whether animals have been vaccinated against diseases during the past season are to be recorded by enquiry from the householder. If yes, indicate the disease against each animal for which they were vaccinated.

Schedule L.P.S. 2.1

This schedule is meant for recording the details of egg production and attendant practices in selected households. On the top of the schedule, the items (i) to (v) and the period of the survey may be filled in the same manner as explained in the schedule LPS 1.1.

In table 1 the family particulars of each of the selected households is to be recorded.

In column 1 to 3 and 5 to 7 may be filled in the same manner as explained in schedule LPS 1.2. In column 4 main occupation of the householder viz. livestock rearing, agriculture etc. will be recorded. Remarks, if any, will be recorded in column 8.

In table 2, production, purchase and disposal of eggs during the last 24 hours on the day of the visit. Such information will be recorded separately for fowls and other species of poultry such as Ducks, Turkeys etc. if any. The data will be recorded for one cluster of five households on each day of the visit.

In column 1, serial number of household as shown in Schedule LPS 1.1 will be recorded. In column 2 & 3, the species and breed of the bird respectively will be recorded. In column 4 total numbers of layers will be recorded. It may also be noted that if a layer has not laid any eggs on the day of visit such bird should also be counted in the figure recorded in column. It may be noted that a layer is an adult female bird which has started laying eggs. In column 5, number of eggs laid by all birds of the particular species and breed in the household during the last 24 hours will be entered. In column 6, the number of eggs purchased on the previous day will be recorded. Column 7 is meant for recording information on the number of eggs consumed in the household on the previous day. Similarly, column 8 indicates the number of eggs set kept for hatching. Column 9 indicates the number of eggs sold. Column 10 indicates the number of eggs damaged. Remaining number of eggs after consuming, sold and damaged will be entered in column 11. In column 12, price of eggs sold per dozen will be mentioned.

Column 13 indicates the number of layers used for meat purposes. Remarks, if any, will be mentioned in column 14.

In table 3, the information on feeding practices of poultry birds on the day of visit is to be recorded. In column (1), species viz. fowls, ducks, turkeys, etc. will be recorded. Breed of the species will be recorded in column (2). The classification namely adult female bird, adult male bird, young bird etc. will be recorded in column (3). Name of the feed supplied to the species namely mash grain, green and others are to be recorded in column (4). Quantity given per flock (in kg) per day will be recorded in column (5).

Prophylactic vaccination made during the last season

Whether any prophylactic vaccination made during the last season, if yes indicate the disease separately against vaccination carried out.

Schedule LPS 2.2

The information for the Commercial Poultry Farms, i.e., a Farm having 1000 layers and more, should be recorded in this schedule. This has to be obtained from all Commercial Poultry Farms. A copy of this Schedule be sent to all registered commercial Poultry Farms along with a letter from Managing Director of Poultry Corporation/Animal Husbandry Director, requesting the farm owner to send the desired information on monthly basis. In case of continuous non-response, enumerator should personally be deputed to collect the required information.

Schedule LPS 3.1

1. The programme of work may be classified as the work to be done in the shearing season and the work to be done during the off season:
 - (a) During the off season, the field work consists of contacting of the flocks in the selected villages and noting down the information in Blocks I, III and IV of the Schedule.
 - (b) During the shearing season, information on wool yield and other related items will be made in Block-II. Wool yield of the selected ram/ whether/ewe lamb etc. be recorded by actual weighment at the time of the shearing.
2. Selection of sheep for recording wool yield: From each selected flock in a village, two rams, two ewes, two wethers and two lambs will be selected for recording wool yield in the shearing season. For making such selection of sheep the sheep are serially numbered and random numbers of one or two or three digits as the case may be (depending on the number of sheep in the flock, i.e., if below 10 then one digit, if sheep are between 10 and 99 then two digits, 100 and more but less than 1000 then 3 digit number table are to be used) are selected and that number is divided by the highest number of sheep in the flock to get the sheep selected for the sample.
3. In addition to selected sheep, total wool production from the flock and number of sheep sheared may be recorded in columns 7-10 of Block II of the schedule.
4. Sheep and wool development staff may be associated for recording wool yield of selected sheep.

Schedule L.P.S. 4.1

This schedule is meant for recording information on yield of meat from un-recognized slaughter houses (meat shop located in the selected villages) on the day of visit. On the top of the schedule, the items (i) to (v) and the period of the survey may be filled in the same manner as explained in the schedule LPS 1.1.

In table 1, in columns 2, 3 & 4 the number of adult, young and their total respectively brought for slaughter on the day of the visit is to be recorded for each category mentioned in column 1. Similarly, information is to be given in columns 5, 6 & 7 for the previous season.

In table 2, the details of meat production of the three selected animals from each category is to be recorded.

In column (1) name of the species will be mentioned. Whether the animal young or adult is to be recorded in column (2). Breed and sex of species will be mentioned in columns 3 and 4. Weight of the animals before slaughtering (in kg) will be mentioned in column (5). Quantity of meat obtained after dressing will be indicated in column (6). Approximate price of meat/kg (in Rs.) will be mentioned in column (7).

SCHEDULE----- C. P. M.
GOVERNMENT OF.....
Directorate of Animal Husbandry and veterinary services
STUDY OF COST OF PRODUCTION OF MILK

Block I - General

1. Period of survey.....
2. Season: Winter/Summer/Rainy
3. Round / Fortnight No.....
4. Location: (a) District.....(b) Taluk.....
(c) Town / Village.....(d) Ward / Mohalla.....
5. (a) Date of visit:..... (b) Time of visit.....AM.....PM
6. Time of milking.....A M.....PM
(If different from time of visit)

Block II Identification

1. (a) Name / No. of the stall / household.....
(b) Name of the owner of the stall/Head of Household
(c) Occupation of the owner of the Farm/Head of Household: Cultivator/Agricultural labourer
/Businessmen/others (.....) (specify)
2. Whether a member of a milk co-operative society : Yes / No

Block III: Information of individual animal

Sl.No.	Name of	Category (cow/buffalo/ goat)	Breed	Age (years)	No. of lactations completed	Mode of acquiring		Current market value (Rs.)	If disposed, mode of disposal		
						Home born/ purchased/gift/ otherwise	Date of acquiring		Sale/death/gift/otherwise	Date of disposal	Market value at the time of disposal
1	2	3	4	5	6	7	8	9	10	11	12

Note: (a) * Name of the animal, as popularly referred to in the household, may be written for easy identification of the animal by the investigator. If the same is not possible, numbers may be given to each of the animals and the same may be indicated under this column.
(b) Use extra sheets, if necessary.
(c) This block needs only updating from round to round.

Block IV: Information on milk yield of lactating animals on the day of visit

Sl. No.	Name of animal*	Category (Cow/ Buffalo /goat)	Breed @	Milk yield (in kg. up to two decimals)				Milk fed to calf (approx.) (in kg. up to two decimals)			Remarks
				Morning	Evening	Third milking†	Total for the day	Morning	Evening	Total	
1	2	3	4	5	6	7	8	9	10	11	12

Note: (a) * Use the same description, as used in Block II, for describing a particular animal.
 (b) @ Breed indicated here, should be the same as in Block II
 (c) Use extra sheets, if necessary.
 (d) †Third milking of any.

Block V: Production and disposal of milk and milk products on the day previous to the day of visit

(Qty in kg. up to two decimals)

Item	Quantity produced	Purchased		Otherwise procured		Quantity consumed	Qty. converted into milk products	Qty. sold to		Qty. sold to		Remarks
		Qty	Rate/ (kg)	Qty.	Source			Consumer	Rate/ (kg.)	Others*	Rate/ (kg.)	
1	2	3	4	5	6	7	8	9	10	11	12	13

Fluid milk

1. Cow milk
2. Buffalo milk
3. Goat milk

Milk products

1. Dahi (curd)
2. Cream
3. Butter
4. Ghee
- 5.
- 6.

Note: (a) Information furnished under Col.2 against items 1, 2, 3 may be checked for consistency with the information furnished in Col. 8 of Block IV.
 (b) * Includes quantity of milk sold to organized dairies /middlemen etc.

Block VI: Income from sales during the fortnight ending the day of visit

Item of sale	Amount (in Rs) received	Item of sale	Amount (in Rs) received
1	2	3	4
Milk products		Other products	
(a) Cow milk	-----	(a) Dung/Cakes/Manure	-----
(b) Buffalo milk	-----	(b) Discarded equipment	-----
(c) Goat Milk	-----	(c) Hides and skins	-----
(d) Dahi (Curd)	-----	Fodder Crops	
(e) Cream	-----	(a) Grasses	-----
(f) Butter	-----	(b) Paddy straw	-----
Livestock		(c) Wheat straw	-----
(a) Cattle	-----	(d) Berseem	-----
(b) Buffalo	-----	(e) Lucerne	-----
(c) Goats	-----	(f) Jowar	-----
(d) Others	-----	(g) Maize	-----
		(h) Cherri	-----
		(i) Others (specify)	-----

Block VII: Procurement and disposal of feed during the fortnight ending the day to visit

Name of fodder concentrate	Procurement				Overload Cost @ including Transportation (Rs.)	Qty. fed to animals (in kg. upto two decimals)	Disposal of the remaining feed				Remarks
	Source	Qty. (kg. Upto two Decimals)	Rate Per Kg. (Rs.)	Amount Paid (Rs.)			Mode	Qty. (kg. Upto two Decimals)	Rate Per kg. if sold (Rs.)	Amount Received (Rs.)	
1	2	3	4	5	6	7	8	9	10	11	12
Green Fodder 1. Barseem 2. Lucerne 3. Jowar 4. - - Dry fodder 1. Paddy Straw 2. Wheat Straw - - Concentrates 1. 2. .											

Note: (1) use extra sheets, if necessary.

(2) @ If the overhead charges incurred are combined for different feeds purchased, the same may be indicated in the remarks column.

Block VIII: Feed consumption by animal on the day visit (give name and weight both)
(in kg up to two decimals)

Name of animal	Category (Cow /Buffalo/ Goat)		Green Fodder			Dry Fodder			Concentrates			Grazing hours for the days	Separate /Joint Feeding	Remarks
			Name	Name	Name	Name	Name	Name	Name	Name	Name			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.			Morning											
			Evening											
			Total											
.														
.														

Note: (a) Total above information may be given separately for each animal. The name of the animal should be the same as indicated under Col.(2) in Block III

(b) Use extra sheets, if necessary.

Block IX: Production and utilization of dung etc.

(Quantity should be given in kg up to one decimal place)

1. Dung* (on previous day)
 - (a) Production: kg.
 - (b) Utilized for:
 - (i) Cakes: kg.
 - (ii) Household use: kg.
 - (iii) Gobar gas plants: kg.
 - (iv) Manure pit: kg.
 - (v) Directly in field: kg.
 - (c) Sold
 - (i) Quantity: kg.
 - (ii) Rate/100 kg..... Rs
2. Cakes (during the fortnight ending the day of visit)
 - (a) Production: kg.
 - (b) Used in household : kg.
 - (c) Sold
 - (i) Quantity: kg.
 - (ii) Rate/kg. :..... Rs..
3. Manure (during the fortnight ending the day of visit)
 - (a) Production: kg.
 - (b) Used in field : kg.
 - (c) Sold
 - (i) Quantity: kg.
 - (ii) Rate/100 kg. : Rs.

Note: * Information on production of dung may be furnished by actual weighment, wherever possible.

Block X: Labour employed during the fortnight ending the day of visit

	Name	Man (m)/ Woman (w)/ Child (C)	Age (in years)	Relationship with stall owner, if any	Paid/ unpaid	Casual/ Regular	Wages* per day, if paid (Rs)
	1	2	3	4	5	6	7
1							
2							

	No. of days worked	Average No. of hours worked			Remarks
		On the stall	Otherwise	Total	
	8	9	10	11	12
1					
2					

Note: (a) Use extra sheets, if necessary.

(b) *In case, wages are paid partly or wholly in kind, the same may be indicated in remarks column.

Block XI: Investment on assets and equipment

	Item	No./Area*	Date of purchase/ discarding	Price per Unit †	Total Value† (Rs.)	Approx. life @(yrs & months)	Remarks
	1	2	3	4	5	6	7
A. At the beginning of fortnight							
1.	Value of land, if the stall is owned						
2.	Cost of construction.. Pucca excluding repair)						
3.	Cost of construction.... Kuchcha (excluding repair)						
4.	Watering pumps/wells.wranches						
5.	Tubs (metal/wooden)						
6.	Feeding troughs						
7.	Milk cans						
8.	Buckets						
9.	Vessels						
10.	Measuring sets						
11.	Chaff cutter						
12.	Iron chains						
13.	Cart						
14.	Others						
15.	Furniture						
B. Additions during the fortnight ending the day of visit							
1.							
C. Equipment discarded/disposed during the fortnight ending the date of visit							
1.							

Note: (a) * Area may be given in Sq. meters up to two decimals.

(b) † Price and value may be furnished as those of new articles, wherever applicable, except in case of discarded equipment. In the case of latter, price and value may be given, if sold. Otherwise, only estimated value may be given.

(c) @ Life may be given in terms of estimated life of a new article or construction. In case of discarded equipment, article's life may be given.

Block XII: Recurring expenditure during the fortnight ending the date of visit

	Item	Date of expenditure	Amount (Rs.)	Remarks
	1	2	3	4
1.	Rent (if not owned) (from ...to ...)			
	Repairs			
2.	Roof			
3.	Flooring			
4.	Shed			
5.	Feeding Troughs			
6.	Water Troughs			
7.	White Washing			
8.	Chaff Cutter			
9.	Cart			
10.	Cans/Utensils			
11.	Interest on loan taken for animal/stall (From to)			
	Service charge			
12.	Natural service			
13.	Artificial Insemination			
Veterinary Charges				
14.	Vaccination			
15.	Medicine			
16.	Castration of calves			
17.	Dehorning			
18.	Doctor's fee			
19.	Veterinary Attendance fee			
Purchase of consumable items				
20.	Baskets			
21.	Ropes			
22.	Brooms			
23.				
24.				
Miscellaneous				
25.	Water tax			
26.	Lighting charges			
27.	Municipal taxes (Stall/animals)			
28.	Stationery			
29.	Disposal of dead animals			
30.	Other expenditure			

Instructions for Filling in the Schedule Cost of Production of Milk

- Block I: Item 5(a) – In each, village, the enumerator would be spending two days in a round, covering two stalls each day. The day of visit of the particular stall/household may be mentioned.
Item 5(b) – Time of visiting the stall/household both in the morning and evening has to be separately indicated.
Item 6- Time of milking may be given for both morning and evening separately in case the milking has already been done by the time the enumerator reached the household.
- Block II: Item I: Name or number of the stall / household may be clearly indicated against sub-item (a) and name of the owner or head of the household may be given against sub-item (b). Occupation of the owner may be indicated against (c).
- Block III: Under column 4, Breed- the following classification may be followed:
(a) Locally popular breed.....
(b) Cross-bred
(c) Non-descript
In column 5, age may be given in completed years.
- Block IV: Milk yield under columns 5 to 7 has to be filled in by actual weighment and columns 9 and 10 may be filled in approximately.
- Block V: Quantity of milk products produced (column 2) should be consistent with the information on relevant items under column 8.
- Block VI: Information in this block should be filled, keeping in view the information already filled in against the relevant items under cols. 9 to 12 of Block V, as check.
- Block VII: Under Col. 6 if different types of fodder are transported together, the total cost of transport only needs to be indicated.
- Block VIII: Under cols. 4 to 12, Feed consumption may be given for each of the green fodders (berseem, Lucerne, jowar, bajra, oats, maize, cherri etc.) and dry fodders (paddy straw, wheat straw, ragi, kadvi, bhusa etc.) and concentrates separately.
- Block IX: The information on dung may be furnished by actual weighment wherever possible.
- Block X: Under col. 3 – Age may be given in completed years.
col. 8 – No. of days worked during the fortnight under reference only, may be furnished.
Col.9 to col.11: Average number of hours worked per day may be worked out in relation to the number of days worked during the fortnight only.
- Block XI: Under Col 2 : Area may be given in sq. meters (up to two decimals.)

Col. 4 & 5 – Price and value may be those of new articles and construction, except in case of discarded equipment. In case of discarded equipment, price and value may be given, if sold. Otherwise, only estimated value may be furnished under Co; 5.

Col. 6 – Expected life (years and months) of new items may be given, except in case of discarded equipment. In case of latter, actual life may be given.

Block XII: Recurring expenditure on all repairs, services and veterinary charges, taxes including the purchase of consumable items such as baskets, ropes gunny bags brooms etc. may be furnished in this block.

Schedule ----- C. P. E.
GOVERNMENT OF.....
Directorate of Animal Husbandry and veterinary services

STUDY OF COST OF PRODUCTION OF EGGS

Block I: General

1. Period of survey:
2. Season: Winter/Summer/Rainy
3. Round/Fortnight No.....
4. Location:(a) District :
 (b) Taluk:
 (c) Town/Village:
 (d) Ward/Mohalla
5. Date of Visit:

Block II: Identification

1. (a) Name/No. of the Farm/Household:
 (b) Name of the owner of the Farm/Head of Household:
 (c) Occupation of the owner of Farm/Head of Household:
 Cultivator/Agriculture Labourer/Businessman/Service/Others
 (Specify)
2. Whether a member of Cooperative Society: Yes/No

Block III: Record of egg production and utilization for the day of visit

	Breed*	Eggs available on previous day after last collection		Eggs disposed of after last collection on previous day		Fresh eggs laid during the day		Eggs Purchased			
		H-Type		T-Type		H-Type		H-Type		T-Type	
		No.	Value (Rs)	No.	Value (Rs)	No.	Value (Rs)	No.	Value (Rs)	No.	Value (Rs)
	1	2	3	4	5	6	7	8	9	10	11
1.											

	Eggs sold				Eggs consumed	Eggs spoiled		Eggs put in incubator	Eggs given as gift or lost		Closing balance		Remarks	
	H-Type		H-Type			H-Type	T-Type		H-Type	H-Type	T-Type	T-Type		H-Type
	No.	Value (Rs)	No.	Value (Rs)										
	12	13	14	15	16	17	18	19	20	21	22	23	24	
1.														

- Note: (a) * Information in this block may be given, breed-wise
 (b) H-Type = Hatching Type: T-Type = Table Type
 (c) Under Cols. 22 and 23, the number of hatching type and table type eggs lying in balance at the end of the day, respectively may be furnished.

Block IV: Record of day-old chicks for the fortnight ending the day of visit

	Breed	No. of eggs for hatching	No. of chicks born	Purchased		Sold	
				No.	Value (Rs.)	No.	Value (Rs.)
	1	2	3	4	5	6	7
1.							

	Died			Given as gift or lost		Balance of chicks	
	No.	Value (Rs.)	Cause of death	No.	Value (Rs.)	No.	Value (Rs.)
	8	9	10	11	12	13	14
1.							

Note: Information on the number of hatchings during the fortnight etc. may be furnished in this block.

Block V: Record of unsexed chicks eggs up to 8 weeks, for the fortnight ending the day of visit

	Breed	No. transferred from day old chicks (aged upto 8 weeks)	Purchased		Sold		Consumed		Died		
			No.	Value (Rs.)	No.	Value (Rs.)	No.	Value (Rs.)	No.	Value (Rs.)	Cause of death
	1	2	3	4	5	6	7	8	9	10	11
1.											

	Given as gift or lost		No. transferred to higher age groups	Balance No. of chicks aged up to 8 weeks
	No.	Value (Rs.)	No.	Value (Rs.)
	12	13	14	15
1.				

Block VI: Report of sexed birds, aged from 8 to 24 weeks, for the fortnight ending the day of visit

Breed	Sex	No. transferred after sexing from the age group of upto 8 weeks	Purchase		Sold		Consumed		Died			Given as gift or lost		Transferred to higher age group	Balance of sexed chick (8-24 weeks)
			No.	value (Rs.)	No.	Value (Rs.)	No.	Value (Rs.)	No.	Value (Rs.)	Cause of death	No.	Value (Rs.)		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Male														
	Female														
	Total														
2.	Male														
	Female														
	Total														
3.	Male														
	Female														
	Total														
4.	Male														
	Female														
	Total														
5.	Male														
	Female														
	Total														

Block VII: Report of adult birds, aged from 24 weeks, for the fortnight ending the day of visit

Breed	Sex	transferred after sexing from the age group of 8 to 24 weeks	Purchased		Sold		Consumed		Died			Given as gift or lost		Closing Balance of	Remarks
			No.	Value (Rs.)	No.	Value (Rs.)	No.	Value (Rs.)	No.	Value (Rs.)	Cause of death	No.	Value (Rs.)		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Male														
	Female														
	Total														
2.	Male														
	Female														
	Total														
3.	Male														
	Female														
	Total														
4.	Male														
	Female														
	Total														
5.	Male														
	Female														
	Total														

Block VIII: Procurement and disposal of feed during the fortnight ending the day of visit

Feed Description	Balance of feed carried over from last fortnight	Procurement					Quantity fed to birds (in kg. upto two decimals)	Disposal of remaining feed				Balance left for use for next fortnight
		Source (recognized agency or not, please specify)	Quantity (in kg. upto two decimals)	Rate per kg. (Rs.)	Amount paid (Rs.)	Over head @ charges including transport (Rs.)		Mode	Quantity (in kg. upto two decimals)	Rate per kg. (Rs.)	Amount Received (Rs.)	
1	2	3	4	5	6	7	8	9	10	11	12	13
1.Mash												
2.Grain												
3.Green												
4.Marble chips												

Note: @ If the overhead charges incurred are combined for different feeds purchased, the same may be indicated in the remarks column. However, such charges may be given only at the one place.

Block IX: Feed fed on the day of visit

Breed	Age group	Number of birds fed	Mash		Grain		Greens		Marble Chips		Other specify		Remarks
			Quantity (kg.)	Rate per (kg.)	Quantity (kg.)	Rate per (kg.)	Quantity (kg.)	Rate per (kg.)	Quantity (kg.)	Rate per (kg.)	Quantity (kg.)	Rate per (kg.)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	Upto 8 Weeks												
	8 to 24 Weeks												
	Above 24 Weeks												

Block X: Particulars of labour employed during the fortnight ending the day of visit

1.	Name	Man(M) Woman (W) child (C)	Age in (Years)	Relationship with farm owner ,if any	Paid/ unpaid	Casual / Regular	Wages per day If any* (Rs.)	Local wage rates (Rs.)	No. of days worked	Average no. of hours worked per day on the farm @							Other purpose	Total	Remarks
	10	11	12	13	14	15	16	17											
										a	b	c	d	e	f				
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18			

Note: (a) Use extra sheets, if necessary. (b) * In case wages are paid partly or wholly in kind, the same may be indicated in the remarks column. (c) @ Utilization of time for different group of birds:- a: 'day old' chicks b: upto 8 weeks' chicks c: '8 to 24' weeks chicks d: 'above 24 weeks' chicks e: general work on the farm f: Sub-Total.

Block XI: Investment on assets and equipments

Item	Number/ Area*	Date of Purchase/ Discarding	Price per Unit(Rs.)	Total value † (Rs.)	Approximate Life @ (Yrs & month)	Remarks
1	2	3	4	5	6	7
A. At the Beginning of Fortnight 1.Land area of the Farm Total Office Store Sheds Vacant land 2.Building and Fixtures Office Store Sheds 3.Fencing material Temporary Permanent 4.Watering Wells Pumps Others 5.Furniture Table Chairs Others 6.Housing Pens Sheds 7.Equipment Watering trough Baskets Lamps Buckets Other articles (Specify) B. Addition during the Fortnight ending the day of visit 8. . C. Discarded disposed equipment excluding feed during the Fortnight ending the day of visit 13. .						

Note (a) *Area may be given in square metres upto two decimals.

(b)† Price and value may be furnished as those of most articles, wherever applicable, except in case of discarded equipment. In the case of later, price and value may be given, if sold otherwise estimated value may be given.

(c)@ Life may be given terms of estimated life of a new article or construction. In case of discarded equipment, actual life may be given.

Block XII: Recurring expenses during the fortnight ending the day of enquiry

Item	Date of expenditure	Amount spent (Rs.)	Remarks	Item	Date of expenditure	Amount spent (Rs.)	Remarks
1	2	3	4	1	2	3	4
1. Rent (If not owned) (from--to----) 2. Interest on loan taken for the Farm (from--to----) 3. Repairs Roof Flooring Shed Stores Fencing White Washing Wells/Pumps Pans Equipment repair				4. Veterinary Charges 5. Purchase of consumable stores other than feed 6. Miscellaneous			

Block XIII: Miscellaneous Income during the fortnight ending the day of visit

Serial No.	Item	Date when sold	Quantity / Number	Total Value (Rs.)	Remarks
1	2	3	4	5	6
1. .					

Instructions for Filling in the Schedule Cost of production of Egg

- Block I: Item 5 – In each village the enumerator would be spending two days covering five farms/households each day. The data of visit of the particular farm/household may be mentioned.
- Block II: Item I – Name or number of the farm/household may be clearly indicated against sub-item (a) and name of the owner of the farm or head of household may be given against sub-item (b). The primary occupation of the Farm owner/Head of the household, if different from the poultry activity, the same may be furnished against item (c).
- Block III: Col. 1 – The information in the block may be furnished for each of the breeds viz. 'purebred' (such as white leg horn), 'crossbred' and Desi 'nondescript' separately.
Cols. 9, 11, 13 and 15 – Total value of the corresponding number of eggs shown in the previous column may be given.
- Block IV: Information on number of hatching during the fortnight, number of day old chicks purchased, sold etc. during the same period may be furnished in this block, breed-wise.
- Block V: Information on chicks which are more than one day old, but less than 8 weeks may be furnished in this block.
- Block VI: Information of birds, after sexing in this age-group from 8 weeks to 24 weeks, may be filled in this block.
- Block VII: Information of birds, in the age-group of above 24 weeks, may be filled in this block.
- Block VIII: Under col. 7 – If the overhead charges are combined for more than one feed, the charge may be given at one place, indicating the same in the remarks column
- Block IX: Information on feed fed to the birds may be given in this block, separately for each age-group of different breeds.
- Block X: Cols. 10 to 17: Information under these columns viz. the average number of hours worked per day may be based on the average during the fortnight ending the day of visit.
- Block XI: Col.2 – Relevant information regarding the numbers or area (in sq. metres up to two decimals) may be furnished.
Col. 6 – Information on life may be given in terms of estimated life of a new article. In case of discarded equipment/article only, actual life may be given.
- Block XII: Information on the recurring expenses, including the purchase of consumable stores may be furnished in this block.
- Block XIII: Information on miscellaneous income may please be furnished in this block.

**INDIAN AGRICULTURAL STATISTICS RESEARCH INSTITUTE
(ICAR)**

LIBRARY AVENUE, NEW DELHI-110012

PILOT SAMPLE SURVEY FOR ESTIMATION OF PRODUCTION OF HIDES AND SKINS

Schedule 1: Household wise particulars of livestock

Code		Code		Code		Code	
State		District		Year		Season	
stratum		Village/ward		Round		Month	

House number or identification	Name of the householder & his father's name	Serial Number of households	Is the householder Keeping Livestock?	If yes, Number of livestock in the household											
				Cattle				Buffaloes				Sheep			
			Adult		Young		Adult		Young		Adult				
			Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Young
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

If yes ,Number of livestock in the household						Other (specify)				Does the householder Slaughter Animals for Meat/Consumption/sale?		Practices of disposing the hides/ skins of the slaughtered /dead animals	Remarks
Goats			Pigs			Name	Adult		Young	Yes/No	Number Slaughtered Last year		
Adult		young	Adult		Young		Male	Female					
Male	Female		Male	Female									
16	17	18	19	20	21	22	23	24	25	26	27	28	29

Signature of enumerator-----
Name of enumerator -----
Date -----

Signature of Supervising Officer-----
Name of Supervising Officer-----
Date -----

**INDIAN AGRICULTURAL STATISTICS RESEARCH INSTITUTE
(ICAR)
LIBRARY AVENUE, NEW DELHI-110012
PILOT SAMPLE SURVEY FOR ESTIMATION OF PRODUCTION OF HIDES AND SKINS**

Schedule II: Information on fallen and slaughtered animals, flayed and cured

Code		Code		Code		Code	
State		District		Year		Season	
stratum		Village/town & ward		Round		Month	

Serial number	Name of the chamar /butcher With Father's name	Species	Fallen animals received /collected				Source	Number flayed	Method of flaying
			Number						
			Adult		Young				
			Male	Female	Male	Female			
1	2	3	4	5	6	7	8	9	10

In the previous month by chamars/butchers

Animal Slaughtered							Disposal of uncured hides & skins & their prices				
Number				Source	Number flayed	Method of flaying	Sold				
Adult		Young					Number kept for personal use	Number	Hides/ Skins weight (kg.)	Prices per kg. per piece	To whom sold
Male	Female	Male	Female								
11	12	13	14	15	16	17	18	19	20	21	22

Number cured	Method of curing	Disposal of cured hides & skins & their prices				
		Number kept for personal use	Sold			
			Number	Hides/Skins weight (kg.)	Prices per kg./per piece	To whom sold
23	24	25	26	27	28	29

Rs. P.

Disposal of offals and their prices							Average time lag between flaying and curing (in minute)	If disposal of uncured time lag between flaying and disposal (in minutes)	REMARKS
Head		Hoofs		Other parts (specify)					
Number	Price per head	Number	Price per hoofs	Name	Number/ Quantity (kg.)	Price per piece/ per kg.			
30	31	32	33	34	35	36	37	38	39

Signature of enumerator-----
Name of enumerator -----
Date -----

Signature of Supervising Officer-----
Name of Supervising Officer-----
Date -----

**INDIAN AGRICULTURAL STATISTICS RESEARCH INSTITUTE
(ICAR)
LIBRARY AVENUE, NEW DELHI-110012
PILOT SAMPLE SURVEY FOR ESTIMATION OF PRODUCTION OF HIDES AND SKINS**

Schedule III: Changes in the number of livestock in the selected households

Code		Code		Code		Code	
State		District		Year		Season	
stratum		Village/Town & ward		Round		Month	

Serial No.	Name of the householder with father's name	Serial number of the household as in schedule	Species	Number of livestock at the last visit						Number of livestock on the day of visit					
				Adult		Young		Total		Adult		Young		Total	
				Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Reasons for changes if any, since last visit														
Number acquired					Number disposal of					Number died				
Adult		Young		Mode	Adult		Young		Mode	Adult		Young		Cause of death
Male	Female	Male	Female		Male	Female	Male	Female		Male	Female	Male	Female	
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Disposal of dead animal										Remarks				
Within the village					Outside the village									
32					33					34				

Signature of enumerator-----
Name of enumerator -----
Date -----

Signature of Supervising Officer-----
Name of Supervising Officer-----
Date -----

**INDIAN AGRICULTURAL STATISTICS RESEARCH INSTITUTE
(ICAR)**

LIBRARY AVENUE, NEW DELHI-110012

PILOT SAMPLE SURVEY FOR ESTIMATION OF PRODUCTION OF HIDES AND SKINS

Schedule IV: Number of hides and skins handled by the butchers in the slaughter houses on day of visit and number of animals slaughtered in the slaughter house during last calendar month

Code		Code		Code		Code	
State		District		Year		Season	
stratum		Village/Town & ward		Round		Month	

1. Number of hides and skins handled by the butcher in the slaughter house on the day of visit

Serial number	Name of the butcher with his Father's name	Species	Animal slaughtered						Disposal of hides/skins and their prices					
			Adult		Young		Number flayed	Method of flaying	Number uncured	Number cured	Hides weight (kg)	Price per kg per piece	To whom sold	Method of curing
			Male	Female	Male	Female								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Disposal of offals and their prices							Average Time leg between flaying & curing (in minutes)	If disposed of uncured, time lag between flaying & disposal (in minutes)	Remarks
Head		Hoofs		Other parts(specify)					
Number	Price per head	Number	Price per hoof	Name	Number	Price per piece per kg.			
16	17	18	19	20	21	22	23	24	25

2. Number of animals slaughtered in the last calendar month (mention the month with year)

Species	Adult	Young	Total
1.Sheep			
2.Goats			
3.Buffaloes			
4.Others(specify)			

Name of Supervising Officer

Signature of Supervising Officer

Date

**INDIAN AGRICULTURAL STATISTICS RESEARCH INSTITUTE
(ICAR)
LIBRARY AVENUE, NEW DELHI-110012
PILOT SAMPLE SURVEY FOR ESTIMATION OF PRODUCTION OF HIDES AND SKINS**

Schedule V: Disposal, use and price of the byproducts (other than hides and skins) of the dead and slaughtered animal

District Season..... Round..... Village/Town.....
Slaughter house / Butcher house / Chamar

Number of animals slaughtered on the day of visit/died during last one month and detailed information on their byproducts									
Serial no.	Species	Number of animals slaughtered/died	Name of the byproduct	Number/ Quantity (kg.) of the byproduct	Mode of disposal	If sold			REMARKS
						Place of sale	To whom sold	Price per piece/ per kg. Rs. P	
1	2	3	4	5	6	7	8	9	10

Signature of Enumerator

Date

Signature of Supervisor

Date

Schedule VI: Socio - economic status of householders handling hides / skins

6. Size of holding

	Irrigated (hectare)	Unirrigated (hectare)	Total (hectare)
Owned			
Leased			
Total			

7. Place of living Kachcha / Semi Pacca / Pacca

8. Location of the household: In the village / out side the village

Table: Socio-economic status oh household

Sl. No.	Name of family members	Relationship with householder	Age (Yrs & Mth)	Educated/Uneducated	If educated, qualification	Occupation	Earning/not earning	If earning (in Rs.) during previous month	*No. of days devoted in handling hides/skins during the previous month
1	2	3	4	5	6	7	8	9	10

Note: * More than 4 hours work per day will be treated as one day.

Signature of Enumerator

Name of Enumerator
Date

Signature of Supervising Officer

Name of Supervising Officer _____
Date _____

Instructions for filling in schedules for production of Hides and Skins

1. Schedule 1

This schedule is meant for preparing a complete list of households and livestock thereof in the entire cluster of villages/ward and will be filled in only once during first round of the survey. The enumerator will visit all the households in the cluster of villages/ward one by one starting from one end. Proper care should be taken by the enumerator to ensure that all the households in the cluster of villages or ward were enumerated.

The name of the state viz. Tamil Nadu will be given. The name of the district will be given as Chingleput or North Arcot as the case may be. The year of the survey will be entered as 1985-86 and the seasons will be given as summer or rainy or winter. Stratum number and the name of the cluster of villages/ward will be entered as supplied to the enumerator. A similar procedure will be followed for filling in these columns in other schedules also.

In column 1 of the schedule the house number of the household or some identification will be recorded. In column 2 the name of the householder and his father's name will be recorded. In column 3 of the schedule a serial list of all the households will be prepared. In column 4 indicate by 'yes', if the householder keeps animals, otherwise 'No'. If column 4 indicates 'yes' then in columns 5 to 25 information on the number of cattle, buffaloes, sheep, goats and other species, if any, will be recorded. In column 26 indicate by 'yes' if the householder slaughters animals for meat consumption or sale, otherwise 'No'. In column 27 record the number of animals if slaughtered during last year. In column 28 the practice of disposing hides and skins of slaughtered/dead animals will be given. Remarks column 29 has been provided for recording any information by the enumerator not covered in the earlier columns.

2. Schedule II

This schedule is meant for recording information on fallen and slaughtered animals flayed and cured by the chamars/butchers in the selected clusters of villages in the previous month. The information on the chamars/butchers in the clusters of villages will be recorded on the same schedule. The items in columns 1, 2, 4, 5, 6, 7, 9, 11, 12, 13, 14, 16, 18, 19, 23, 25, 26, 30, 32, 37 and 38 are self explanatory. In column 3 indicate whether the householder has cattle, buffaloes, sheep, goats or any other species. In column 8 mention the source from where the fallen animals were received/collected viz. whether received/collected from the same village or some other village, cattle fair etc. In columns 10 and 17 indicate the method of flaying the carcass viz. (i) whether flayed on the ground or (ii) flayed by hanging on the beam etc. In column 15 indicate whether the animals slaughtered are home born or purchased. If purchased, mention whether purchased from same village or some other village. In columns 20 and 27 give the total weight in kilograms of the number of hides sold. In columns 21 and 28, in case of hides price in Rs. and paise per kg. may be given while in case of skins, price in Rs. and paise per piece will be mentioned. In columns 22 and 29 indicate the disposal of uncured/cured hides and skins i.e. whether they were sold to (i) tannery, (ii) raw hides and skins, collector (iii) whole sale dealer and (iv) others (specify). In column 24 give the method of curing

of hides and skins if cured, such as drying in the sun, dry salting and wet salting. For disposal of parts, the enumerator should enquire from the butcher/chamar as to how he has disposed of the heads, hoofs and other parts viz., tail, intestines etc. of the slaughtered animals. If they are sold the price per head and price per hoof in Rs. and paise may be given in columns 31 and 33 respectively. In case of other parts, name of the part sold, its number/quantity (kg.) and the price fetched per piece/per kg. in Rs. and paise will be given in columns 34, 35 and 36 respectively. Column 39 is meant for recording remarks, if any.

3. Schedule III

This schedule is meant for recording the changes in the number of livestock in the selected households. In this schedule information on 60 selected households will be recorded. The procedure of selection of these households has already been explained in part B of the instructions.

The items in columns 1 to 4 are self explanatory. In columns 5 to 10 the details of the livestock as recorded by the enumerator in his previous visit i.e. the number of animals which are adult, young and their total will be entered while in columns 11 to 16 the details of the livestock on the day of visit may be given. In columns 17 to 33 the changes that have occurred in the number of livestock since last visit of the enumerator viz. the number acquired and its mode i.e. by purchase, exchange or gift the number of disposed of i.e. the number slaughtered, number sold within or outside the village and the mode of disposal such as slaughtered, sold for breeding purpose, gift or given on exchange basis etc. number died and the cause of death i.e. due to disease, natural death, accident, killed by wild animals etc. and disposal of dead animals within or outside the village will be recorded. Indicate the number of dead animals buried in the ground in the remarks column.

4. Schedule IV

This schedule is meant for recording information on the number of hides and skins handled by the butcher in the slaughter house on the day of visit and the number of animals slaughtered in the slaughter houses during last calendar month. In table I i.e. on number of animals slaughtered and their hides and skins disposed of by the butcher on the day of visit, the items in columns 1 to 24 are self explanatory. When the supervisor has understood the instructions for filling in the schedule II, there is no difficulty for filling in the columns 1 to 24.

In table 2, i.e. on the number of animals slaughtered in the last calendar month, mention the month with year and record the number of animals slaughtered species-wise with number of adults, young and their total in the columns provided.

Note : This schedule will be filled in by the supervisors only.

5. Schedule V

(This will be filled in only in second round of each season)

This schedule is meant for recording information on disposal, use and price of by-products other than hides and skins of the dead and slaughtered animals in

slaughter houses, butcher houses and by chamars in the village.

In column 2 of the schedule, species such as cattle, buffaloes, sheep, goats, etc. are to be recorded. Number of animals slaughtered or died during last one month is to be recorded in column 3. Column 4 is meant for recording the name of the by-product viz. head, hoofs, stomach, lungs, blood, hairs, tail, bones and intestines. In column 5 number or quantity (kg.) of the by-product as the case may be recorded. Mode of disposal such as consumed at home, gift or given on exchange basis etc. is to be recorded in column 6. If the by-product is sold, then the place of sale such as market, place of slaughter etc. is to be recorded in column 7. In column 8 to whom the by-product was sold such as wholesale dealer etc. is to be recorded. In column 9, price per piece/per kg. in Rs. to be recorded. Column 10 is meant for recording remarks, if any.

6. Schedule VI

This schedule is meant for recording information on socio-economic status of householders handling hides and skins.

In item No. 1 the name of the householder with father's name is to be recorded. Item 2 is meant for recording social status such as Patwari, headman of the village, member of any recognized society etc. In item 3 main and subsidiary occupations such as agriculture, labour, service etc. of the householder is to be recorded. In item 4 the income of the householder from main and subsidiary occupations during the previous month is to be recorded. Size of the family i.e. number of adults and children is to be recorded in item 5. In item 6 size of holding such as owned irrigated, owned unirrigated, leased in irrigated and leased in unirrigated in hectare is to be recorded. Place of living such as kachcha, semi-pacca or pacca house etc. is to be given in item 7. Location of the household i.e. within the village or outside the village is to be given in item 8.

In the table provided in the schedule, socio-economic status of the individual member of the family is to be given. In columns 1 to 3 serial number, name of the family members, their relationship with the householder respectively are to be recorded. In column 4 age in years and months is to be given. In column 5 whether the member is educated or not is to be given if educated then the qualification such as primary, middle, matric, B.A. etc. is to be given in column 6.

Occupation such as agriculture, labour, service etc. is to be recorded in column 7. In column 8 indicate whether the member is earning. If earning, then in column 9, his income during the previous month from all sources is to be given. Column 10 is meant for recording the number of days devoted in handling hides/skins during the previous month.

Appendix II

Estimation Procedure for Milk, Egg, Meat and Wool

The procedure is discussed for one season and for one category of animals

Let V = total number of villages in the State;

n' = total number of villages for complete enumeration = $0.15 * V$.

$$n = \frac{n'}{3}$$

T = number of strata formed in a State.

V_h = number of villages in the stratum

n_h = number of villages allocated to the h^{th} stratum for complete enumeration of livestock numbers.

Thus
$$n = \sum_{h=1}^T n_h$$

$v_{sh} = v_h$ = sub sample of villages selected from the n_h villages in the h -th stratum during the r -th round of s -th season.

(A) Estimation of Milk Production

M_{srhi} = number of animals in milk as enumerated in the i -th village of the h -th stratum during the r -th round of the s -th season.

Assumption: changes in the number of animals within a season negligible.

Thus $M_{srhi} = M_{shi}$ for $r = 1, 2, 3, 4$

U_{srhi} = number of households in the sample from the i -th village of the h -th stratum during the r -th round of the s -th season.

m_{srhij} m_{srhij} = number of animals in milk for which a day's milk yield is recorded from the j -th household in the i -th village of the h -th stratum during the r -th round of the s -th season.

M'_{hi} = number of animals in milk in the i -th village of the h -th stratum according to the livestock census.

Thus
$$M'_h = \sum_{i=1}^{V_h} M'_{hi} \text{ and } M' = \sum_{h=1}^T M'_h.$$

1. Estimates of number of Animals in milk and their estimates of variance

Estimate of number of animals in milk in a season is given by:

$$\hat{M}'_s = \sum_{h=1}^T \hat{M}_{sh}$$

where

$$\hat{M}_{sh} = \hat{R}_{sh} * M'_h$$

and

$$\hat{R}_{sh} = \frac{\sum_{i=1}^{n_h} M_{shi}}{\sum_{i=1}^{n_h} M'_{hi}}$$

Estimate of variance of M'_s is given by

$$Est.V(M'_s) = \sum_{h=1}^T Est.V(M'_{sh}), \text{ which is approximated by}$$

$$Est.V(\hat{M}_{sh}) = \frac{V_h^2}{n_h(n_h - 1)} \sum_{i=1}^{n_h} (M_{shi} - \hat{R}_{sh} * M'_{hi})^2$$

2. Estimation of Average Yield per animal per day and total milk production and their variances

Let y_{srhijk} = milk yield of the k-th animal in the j-th household of the i-th village of the h-th stratum during the r-th round of the s-th season.

Estimate of average milk yield per animal per day is given by:

$$\bar{y}_{sh} = \frac{\sum_{i=1}^{v_h} M_{shi}}{\sum_{i=1}^{v_h} M'_{shi}} * \bar{y}_{shi} \text{ where } \bar{y}_{shi} = \frac{1}{d_s} \sum_{r=1}^{d_s} \bar{y}_{srhi}; d_s = \text{number of rounds / observations in the}$$

s-th season

$$\text{and } \bar{y}_{srhi} = \frac{\sum_{j=1}^{u_{srhi}} \sum_{k=1}^{m_{srhij}} y_{srhijk}}{\sum_{j=1}^{u_{srhi}} m_{srhij}}.$$

Estimate of variance of \bar{y}_{sh} is given approximately by

$$Est.V(\bar{y}_{sh}) = \frac{1}{v_h(v_h - 1)} * \sum_{i=1}^{v_h} \frac{M_{shi}^2}{\hat{M}_{sh}^2} (\bar{y}_{shi} - \bar{y}_{sh})^2 \text{ where } \hat{M}_{sh} = \frac{\sum_{i=1}^{v_h} M_{shi}}{v_h}.$$

3. Estimate of Total Milk Production

Estimate of total milk production per day in the h-th stratum and in the s-th season is given by

$$\hat{P}_{sh} = \hat{M}_{sh} * \bar{y}_{sh}$$

Estimate of the variance of P_{sh} is given by

$$Est.V(\hat{P}_{sh}) = \hat{M}_{sh}^2 * Est.V(\bar{y}_{sh}) + \bar{y}_{sh}^2 * Est.V(\hat{M}_{sh})$$

where $Est.V(\bar{y}_{sh})$ and $Est.V(\hat{M}_{sh})$ are already defined.

Estimate of total milk production per day in a season over all the strata is given by

$$\hat{P}_s = \sum_{h=1}^T \hat{P}_{sh}$$

$$Est.V(\hat{P}_s) = \sum_{h=1}^T Est.V(\hat{P}_{sh})$$

An estimate of average milk yield per animal per day pooled over all the strata is given by

$$\bar{y}_s = \frac{\hat{P}_s}{\hat{M}_s} = \frac{\sum_{h=1}^T \hat{P}_{sh}}{\sum_{h=1}^T \hat{M}_{sh}}$$

Estimate of the variance of \bar{y}_s is given by

$$Est.V(\bar{y}_s) = \frac{1}{\hat{M}_s^2} \left[Est.V(\hat{P}_s) + \bar{y}_s^2 * Est.V(\hat{M}_s) - 2 * \bar{y}_s * Cov(\hat{P}_s, \hat{M}_s) \right],$$

where $Est.Cov(\hat{P}_s, \hat{M}_s) = \sum_{h=1}^T Est.Cov(\hat{P}_{sh}, \hat{M}_{sh})$ and

$$Est.Cov(\hat{P}_{sh}, \hat{M}_{sh}) = \frac{1}{v_h(v_h - 1)} * [V_h^2 \sum_{i=1}^{v_h} (M_{shi} * \bar{y}_{shi} - \hat{R}_{sh}'' * M_{hi}') * (M_{shi} - \hat{R}_{sh} * M_{hi}')] ,$$

$$\hat{R}_{sh}'' = \frac{\sum_{i=1}^{v_h} M_{shi} \bar{y}_{shi}}{\sum_{i=1}^{v_h} M_{hi}'}$$

4. Pooling of the estimates and the estimates of their variances over the different seasons

Let, \hat{M} , \bar{y} and \hat{p} be the estimates of animals in milk, average milk yield per day per animal in milk animal and total milk production per day in the entire year.

Then,
$$\hat{M} = \sum_{s=1}^3 Q_s \hat{M}_s$$

Q_s is the relative period of the season viz $\frac{D_s}{D_y}$, D_s is number of days in s^{th} season and

D_y is number of days in the y^{th} year and therefore $\sum_{s=1}^3 Q_s = 1$

$$\hat{P} = \sum_{s=1}^3 Q_s P_s$$

$$\bar{y} = \frac{\sum_{s=1}^3 \hat{M}_s \bar{y}_s}{\hat{M}}; \quad \bar{y} = \frac{\hat{P}}{\hat{M}} \text{ approximately}$$

$$Est.V(\hat{M}) = \sum_{s=1}^3 Q_s Est.V(\hat{M}_s)$$

$$Est.V(\hat{P}) = \sum_{s=1}^3 Q_s Est.V(\hat{P}_s)$$

$Est.V(\bar{y})$ may be taken as approximately equal to:

$$Est.V(\bar{y}) = \frac{1}{\hat{M}^2} * \left[Est.V(\hat{P}) + \bar{y}^2 Est.V(\hat{M}) - 2 \bar{y} Est.Cov.(\hat{P}, \hat{M}) \right]$$

$$Est.Cov.(\hat{P}, \hat{M}) = \sum_{s=1}^3 Q_s^2 * Est.Cov.(\hat{P}_s, \hat{M}_s)$$

(B)- Estimation of Egg Production

The mathematical expressions used for obtaining estimates of number of layers (adult female birds), average egg production per layer and total egg production and estimates of variances of these estimates are given. The procedure, in the first instance, is discussed for one season and with reference to one species and breed of poultry birds. The procedure for other species and breeds will be identical. Methods of pooling the estimates and estimates of their variances over different seasons are also given at the end.

Notation:

Let there be T strata in the population and the number of villages in the h-th stratum be V_h . A sample of n' villages is selected from the total number of villages, say V in the state during the year which is 15 percent of total number of villages i.e. $n' = 0.15 * V$

Further let,

n = number of villages selected in a season i.e. $n = n'/3$

n_h = number of sampled villages allocated to the h -th stratum for complete enumeration of livestock numbers.

$$n = \sum_{h=1}^T n_h$$

v_h be a sub-sample of villages selected from the n_h villages in the h -th stratum for yield estimation.

M_{s1hi} be the number of layers (of the breed and species under consideration) in the i -th village of the h -th stratum during the first round of the s -th season.

U_{srhi} be the number of households in the sample (observed for recording egg production) from the i -th village in the h -th stratum during r -th round of the s -th season.

m_{srhij} be the number of layers on the day of visit in the j -th household of the i -th village of the h -th stratum during the r -th round of the s -th season.

y_{srhij} be the number of eggs laid by m_{srhij} birds defined above.

M'_{hi} be the number of layers in the i -th village of the h -th stratum according to the latest livestock Census data.

$$\text{Thus } M'_h = \sum_{i=1}^{v_h} M'_{hi} \quad \text{and} \quad M' = \sum_{h=1}^T M'_h$$

(a) Estimate of Number of Layers and Estimate of its variance

Estimate of Number of Layers in a season is given by:-

$$\hat{M}_s = \sum_{h=1}^T \hat{M}_{sh} \quad \text{where} \quad \hat{M}_{sh} = \frac{\sum_{i=1}^{n_h} M_{s1hi}}{\sum_{i=1}^{n_h} M'_{hi}} M'_h$$

Estimate of variance of \hat{M}_{sh} may be approximately taken as:-

$$Est.V(\hat{M}_{sh}) = \frac{V_h^2}{n_h(n_h - 1)} \sum_{i=1}^{n_h} (M_{s1hi} - \hat{R}_{sh} M'_{hi})^2 \quad \text{where} \quad \hat{R}_{sh} = \frac{\sum_{i=1}^{n_h} M_{s1hi}}{\sum_{i=1}^{n_h} M'_{hi}} \quad \text{and}$$

$$Est.V(\hat{M}_s) = \sum_{h=1}^T Est.V(\hat{M}_{sh})$$

(b) Estimate of Average Egg production per layer per day and total egg production and estimates of their variances:

Estimate of average egg production per layer per day in the h-th stratum during the s-th season is given by:

$$\bar{y}_{sh} = \frac{\sum_{i=1}^{v_h} M_{shi} \bar{y}_{shi}}{\sum_{i=1}^{v_h} M_{shi}}, \quad \text{where } \bar{y}_{shi} = \frac{1}{d_s} \sum_{r=1}^{d_s} \bar{y}_{srhi}, \quad d_s = \text{number of rounds in the}$$

s-th season.and

$$\bar{y}_{srhi} = \frac{\sum_{j=1}^{u_{srhi}} y_{srhij}}{\sum_{j=1}^{u_{srhi}} m_{srhij}}$$

Estimate of the variance of \bar{y}_{sh} is given approximately by

$$Est.V(\bar{y}_{sh}) = \frac{1}{v_h} \frac{1}{(v_h - 1)} \frac{\sum_{i=1}^{v_h} M_{shi}^2}{\bar{M}_{sh}^2} (\bar{y}_{shi} - \bar{y}_{sh})^2 \quad \text{where } \bar{M}_{sh} = \frac{\sum_{i=1}^{v_h} M_{shi}}{v_h}$$

Estimate of total egg production per day in the h-th stratum and in the s-th season is given by:-

$$\hat{P}_{sh} = \hat{M}_{sh} * \hat{\bar{y}}_{sh}$$

Estimate of the variance of total egg production is given by:

$$\hat{V}(\hat{P}_{sh}) = \hat{M}_{sh}^2 \hat{V}(\bar{y}_{sh}) + \bar{y}_{sh}^2 \hat{V}(\hat{M}_{sh})$$

Estimate of total egg production per day in a season for the entire population is given by:-

$$\hat{P}_s = \sum_{h=1}^T \hat{P}_{sh}, \quad \hat{V}(\hat{P}_s) = \sum_{h=1}^T \hat{V}(\hat{P}_{sh})$$

An estimate of average egg production per layer per day pooled over all the strata is given by:-

$$\bar{y}_s = \frac{\hat{P}_s}{\hat{M}_s} = \frac{\sum_{h=1}^T \hat{P}_{sh}}{\sum_{h=1}^T \hat{M}_{sh}}$$

Estimate of the variance of \bar{y}_s is given by:-

$$Est.V(\bar{y}_s) = \frac{1}{\hat{M}_s^2} \left[Est.V(\hat{P}_s) + \bar{y}_s^2 Est.V(\hat{M}_s) - 2 \bar{y}_s Cov.(\hat{P}_s, \hat{M}_s) \right], \quad \text{where}$$

$$Est.Cov.(\hat{P}_s, \hat{M}_s) = \sum_{h=1}^T Est.Cov.(\hat{P}_{sh}, \hat{M}_{sh})$$

$$Est.Cov.(\hat{P}_{sh}, \hat{M}_{sh}) = \frac{1}{v_h} \frac{1}{(v_h - 1)} \left[V_h^2 \sum_{i=1}^{v_h} (M_{shi} \bar{y}_{shi} - \hat{R}'_{sh} M'_{hi}) (M_{shi} - \hat{R}_{sh} M'_{hi}) \right] \text{ where}$$

$$\hat{R}'_{sh} = \frac{\sum_{i=1}^{v_h} M_{shi} \bar{y}_{shi}}{\sum_{i=1}^{v_h} M'_{hi}}$$

(c) Pooling of the estimates and the estimates of their variances over different seasons

Let \hat{M} , \bar{y} and \hat{P} be the estimates of number of layers, average egg production per layer per day and total egg production per day in the season,

then
$$\hat{M} = \sum_{s=1}^3 Q_s \hat{M}_s$$

Q_s is the relative period of the season and therefore $\sum_{s=1}^3 Q_s = 1$

$$\hat{P} = \sum_{s=1}^3 Q_s P_s, \quad \bar{y} = \frac{\sum_{s=1}^3 \hat{M}_s \bar{y}_s}{\hat{M}}, \quad \bar{y} = \frac{\hat{P}}{\hat{M}} \text{ approximately}$$

$$Est.V(\hat{M}) = \sum_{s=1}^3 Q_s Est.V(\hat{M}_s)$$

$$Est.V(\hat{P}) = \sum_{s=1}^3 Q_s^2 Est.V(\hat{P}_s)$$

$Est.V(\bar{y})$ may be taken as approximately equal to

$$Est.V(\bar{y}) = \frac{1}{\hat{M}^2} \left[Est.V(\hat{P}) + \bar{y}^2 Est.V(\hat{M}) - 2 \bar{y} Est.Cov(\hat{P}, \hat{M}) \right]$$

$$Est.Cov(\hat{P}, \hat{M}) = \sum_{s=1}^3 Q_s^2 Est.Cov(\hat{P}_s, \hat{M}_s)$$

(C)- Estimation of Wool Production

The procedure for estimating sheep numbers, average wool yield per sheep and total wool production and also the estimates for their variances are given below. The procedure is discussed for one category of sheep say (ewes) only. For others the procedure is identical

Notations

Let N=number of villages in the state

n' = total number of villages selected during the year which is 15 per cent of the total number of villages in the state i.e. $n' = 0.15 \times N$.

h=number of villages selected in a season i.e. $n = \frac{n'}{3}$

T= number of strata formed in the state

V_h = total number of villages in the h-th stratum

n_h = number of villages allotted to the h-th stratum for complete enumeration of livestock numbers in a season

$$\text{Thus } n = \sum_{h=1}^T n_h$$

v_h = sub-sample of villages selected from the n_h villages in the h-th stratum for yield estimation

X_{shi} = enumerated number of sheep in the s-th season, h-th stratum and i-th village.

y_{shijk} = wool yield in the s-th season, h-th stratum, i-th village, j-th flock and k-th sheep.

Let X'_{hi} , X'_h and X' be the number of sheep in the i-th village, h-th stratum and in the entire state as per latest livestock census respectively and

$$W_h = \frac{X'_h}{X'}$$

(a) Estimation of Sheep population:

Estimation for a season:- The estimate of sheep population in the s-th season is given by:

$$\hat{X}_s = \sum_{h=1}^T \hat{X}_{sh}, \text{ Where } \hat{X}_{sh} \text{ is the estimate for the h-th stratum in the s-th season and is}$$

given by

$$\hat{X}_{sh} = \frac{\sum_{i=1}^{n_h} X_{shi}}{\sum_{i=1}^{n_h} X'_{hi}} X'_h \quad \text{or} \quad \hat{X}_{sh} = \hat{R}_{sh} \hat{X}_h$$

Estimate of variance of \hat{X}_{sh} is given by

$$\hat{V}(\hat{X}_{sh}) = \frac{V_h^2 \sum_{i=1}^{n_h} (X_{shi} - \hat{R}_{sh} X'_{hi})^2}{n_h(n_h - 1)}$$

Estimate of variance of \hat{X}_s is given by

$$\hat{V}(\hat{X}_s) = \sum_{h=1}^T \hat{V}(\hat{X}_{sh})$$

(b) Estimate of average sheep population in the state

(average over three season)

The estimate of average sheep population in the h-th stratum is given by:

$$\hat{X}_h = \frac{1}{3} \sum_{s=1}^3 \hat{X}_{sh}$$

The estimate of sheep population in the state is given by

$$\hat{X} = \sum_{h=1}^T \hat{X}_h$$

Estimate of variance of \hat{X}_h is given by

$$\hat{V}(\hat{X}_h) = \frac{1}{9} \sum_{s=1}^3 \hat{V}(\hat{X}_{sh}) = \frac{1}{9} [\hat{V}(\hat{X}_{1h}) + \hat{V}(\hat{X}_{2h}) + \hat{V}(\hat{X}_{3h})]$$

$$\hat{V}(\hat{X}) = \sum_{h=1}^T \hat{V}(\hat{X}_h)$$

(c) Estimation of Average Wool yield per Sheep

(i) Estimation of average wool yield per sheep in a season: During each shearing season, v_h villages would be selected and from each flock in a sample of five flocks within a village, 2 rams, 2 whethers, 2 ewes and 2 lambs will be selected for recording individual fleece weight. The following estimates are for a sheep whether/ram or ewe or lamb.

Let $\bar{y}_{shi} = \frac{\sum_{j=1}^{f_{shi}} \sum_{k=1}^{x_{shij}} y_{shijk}}{\sum_{j=1}^{f_{shi}} x_{shij}}$. Average wool yield per sheep in the i-th village

x_{shij} be the number of sheep selected in the s-th stratum, i-th village, j-th flock, f_{shi} be the number of flocks selected in the i-th village.

The estimate of wool production in the i-th village is given by:

$$P_{shi} = X''_{shi} * \bar{y}_{shi}$$

$$X''_{shi} = (\% \text{ Sheep shorn}) \times X_{shi}$$

where X''_{shi} is the number of sheep sheared in the i-th village. This is obtained by multiplying X_{shi} with percentage of sheep shorn in the i-th village.

The estimate of average wool yield per sheep is given by:

$$\bar{y}_{sh} = \frac{\sum_{i=1}^{v_h} P_{shi}}{\sum_{i=1}^{v_h} X''_{shi}}, \text{ for h-th stratum.}$$

Estimate of variance of \bar{y}_{sh} is approximately given by:-

$$\hat{V}(\bar{y}_{sh}) = \frac{1}{v_h(v_h - 1)} \frac{1}{\bar{X}_{sh}^2} \sum_{i=1}^{v_h} (P_{shi} - \bar{y}_{sh} X''_{shi})^2 \quad \text{where} \quad \bar{X}_{sh}'' = \frac{1}{v_h} \sum_{i=1}^{v_h} X''_{shi}$$

Estimate of average wool yield per sheep during the s-th season in the State is given by:

$$\bar{y}_s = \sum_{h=1}^T W_h \bar{y}_{sh}$$

Estimate of variance \bar{y}_s is given by:

$$\hat{V}(\bar{y}_s) = \sum_{h=1}^T W_h^2 \hat{V}(\bar{y}_{sh})$$

(ii) Estimate of annual wool yield per sheep (added over three season)

The estimate of annual wool yield per sheep in the h-th stratum is given by:-

$$\bar{y}_h = \sum_{s=1}^3 \bar{y}_{sh}, \text{ say there are three shearing season}$$

Estimate of variance of \bar{y}_h is given by:

$$\hat{V}(\bar{y}_h) = \hat{V}(\bar{y}_{1h}) + \hat{V}(\bar{y}_{2h}) + \hat{V}(\bar{y}_{3h}) \text{ where } \hat{V}(\bar{y}_{1h}), \hat{V}(\bar{y}_{2h}), \hat{V}(\bar{y}_{3h}) \text{ are given earlier.}$$

An estimate of annual wool yield per sheep on the State is given by:

$$\bar{y} = \sum_{h=1}^T W_h \times \bar{y}_h$$

Estimate of variance of \bar{y} is given by:

$$\hat{V}(\bar{y}) = \sum_{h=1}^T W_h^2 \times \hat{V}(\bar{y}_h)$$

Similarly estimate of annual wool yield per ram, ewe and lamb can be obtained.

(d) Estimate of Total Wool Production in the State:-

(i) Estimate of Total Wool Production in a season:- The estimate of wool production is given by:-

$$\hat{P}_{sh} = \hat{X}_{sh}'' \bar{y}_{sh}$$

where \hat{X}_{sh}'' be the estimated number of sheep shorn in the h-th stratum in the s-th season and is obtained by multiplying \hat{X}_{sh} with percentage of sheep shorn in the h-th stratum.

Estimate of variance of \hat{P}_{sh} is given by:

$$\hat{V}(\hat{P}_{sh}) = \hat{X}_{sh}''^2 \hat{V}(\bar{y}_{sh}) + \bar{y}_{sh}^2 \hat{V}(\hat{X}_{sh}'')$$

where $\hat{V}(\bar{y}_{sh})$ is already defined.

Let P_{sh} be the estimated total wool production in the h-th stratum during the s-th season obtained by adding the estimated wool production for rams, ewe and lambs. The estimate of variance of P_{sh} is obtained by adding the estimated variances of rams, wheathers, ewes and lambs.

The estimated total wool production during the s-th season is given by

$$P_s^* = \sum_{h=1}^T P_{sh}^*$$

Estimate of variance of P_s^* is given by

$$\hat{V}(P_s^*) = \sum_{h=1}^T \hat{V}(P_{sh}^*)$$

Estimate of annual wool production for the State is given by:

$$P^* = \sum_{s=1}^3 P_s^*$$

Estimate of variance of P^* is given by:-

$$\hat{V}(P^*) = \sum_{s=1}^3 \hat{V}(P_s^*)$$

(D)- Estimation of Meat Production

The procedure of estimating:

- (d) the total number of animals slaughtered;
- (e) the average meat production per animal and
- (f) the total meat production are discussed in the following paragraphs:

The data on the number of animals slaughtered is obtained from two sources

- (i) from the sample of households reporting slaughter of animals and from all the butchers and other agencies in the villages selected in the sample and
- (ii) from records maintained at all the slaughter houses in the State.

Notations:

Let V be the number of villages in the state. n' be the total number of villages selected during the year which is 15 percent of total number of villages i.e.
 $n' = 0.15 * V$

Further let,

n = number of villages selected in a season i.e. $n = n'/3$

T = number of strata in the state.

V_h = total number of villages in the h -th stratum.

n_h = number of sampled villages allocated to the h -th stratum for complete enumeration of livestock numbers.

$$n = \sum_{h=1}^T n_h$$

v_h be a sub-sample of villages selected from the n_h villages in the h -th stratum for yield estimation.

U_h = number of registered slaughter houses in the h -th stratum.

u = number of registered slaughter houses selected out of U_h in the s -th season.

x'_{shi} = number of animals slaughtered by butchers and other agencies in the i -th village during the s -th season in the h -th stratum.

x''_{shi} = number of animals slaughtered by the household in the i-th village during the s-th season in the h-th stratum.

y_{smhkl} = meat production from the k-th animal of l-th slaughter house of h-th stratum during m-th month of the s-th season.

(a) Approximate Number of animals slaughtered

(i) Estimated number of animals slaughtered in households of butchers and those engaged privately in raw-leather works in a season is given by:-

$$\hat{X}_{sp} = \sum_{h=1}^T \frac{V_h}{n_h} * \sum_{i=1}^{n_h} x_{shi}$$

where x_{shi} is the total number of animals slaughtered in the i-th village and is given by

$$x_{shi} = x''_{shi} + x'_{shi}$$

Estimate of variance of \hat{X}_{sp} is approximately given by

$$\hat{V}(\hat{X}_{sp}) = \sum_{h=1}^T \left(\frac{1}{n_h} - \frac{1}{V_h} \right) V_h^2 S_{sh}^2 \text{ where } S_{sh}^2 = \frac{1}{(n_h - 1)} \sum_{i=1}^{n_h} (x_{shi} - \bar{x}_{sh})^2 \text{ and } \bar{x}_{sh} = \frac{1}{n_h} \sum_{i=1}^{n_h} x_{shi}$$

(ii) Number of animals slaughtered in registered slaughter houses:

Let X_{sr} be the total number of animals slaughtered in all the registered slaughter houses of the State during the s-th season.

(iii) Estimate of total number of animals slaughtered in the state during the s-th season is given by

$$\hat{X}_s = \hat{X}_{sp} + X_{sr}$$

Estimate of variance of \hat{X}_s is given by:

$$\hat{V}(\hat{X}_s) = \hat{V}(\hat{X}_{sp})$$

(iv) Estimate of total number of animal slaughtered in the State during the year is given by:

$$\hat{X} = \sum_{s=1}^3 \hat{X}_s \text{ and } \hat{V}(\hat{X}) = \sum_{s=1}^3 \hat{V}(\hat{X}_s)$$

(b) Estimate of Average Meat Production per animal

The average meat production per animal in the l-th slaughter house of the h-th stratum during the m-th month of the s-th season is given by:-

$$\bar{y}_{smhl} = \frac{1}{3} \sum_{k=1}^3 y_{smhlk} \quad (\text{as 3 animals selected in each season})$$

Let X_{smhl} be the number of animals slaughtered in the l -th slaughter house of the h -th stratum during m -th month of s -th season. The estimate of meat production in a month in the l -th slaughter house of the h -th stratum is

$$P_{smhl} = \bar{y}_{smhl} * x_{smhl}$$

(j) The estimate of average meat production from an animal in the s -th season in the State is given by:-

$$\bar{y}_s = \frac{\sum_{h=1}^T \sum_{m=1}^{d_s} \sum_{l=1}^u P_{smhl}}{\sum_{h=1}^T \sum_{m=1}^{d_s} \sum_{l=1}^u x_{smhl}}$$

d_s is the number of months in the s -th season, which is equal to 4 for all s

Estimate of variance of y_s is approximately given by:-

$$\hat{V}(\bar{y}_s) = \frac{1}{\hat{\bar{x}}_s^2} \sum_{h=1}^T \sum_{m=1}^{d_s} \left(\frac{1}{u} - \frac{1}{u_h} \right) \frac{1}{(u-1)} \sum_{l=1}^u (P_{smhl} - \bar{y}_s x_{smhl})^2$$

$$\text{where } \hat{\bar{x}}_s = \frac{1}{d_s u T} * \sum_{h=1}^T \sum_{m=1}^{d_s} \sum_{l=1}^u x_{smhl}$$

and d_s is the number of months in the s -th season.

(ii) The estimate of average meat production from an animal in the State is given by:

$$\hat{\bar{y}} = \frac{\sum_{s=1}^3 \hat{X}_s * \bar{y}_s}{\sum_{s=1}^3 \hat{X}_s} = \frac{\hat{P}}{\hat{X}}, \quad \text{where } X_s \text{ is already defined.}$$

Estimate of variance y is approximately given by:-

$$\hat{V}(y) = \frac{1}{\hat{X}^2} \left[\hat{V}(\hat{P}) + \bar{y}^2 \hat{V}(\hat{X}) - 2\bar{y} \text{Cov}(\hat{P}, \hat{X}) \right]$$

where

$$\text{Cov}(\hat{P}, \hat{X}) = \sum_{s=1}^3 \text{Cov}(\hat{P}_s, \hat{X}_s) = \sum_{s=1}^3 \bar{y}_s \hat{V}(\hat{X}_s)$$

(c) Estimate of Total Meat Production in the State

Estimate of total meat production in a State is obtained by multiplying the estimated number of animals slaughtered in the s-th season in a State with the average meat production per animal in the s-th season and added over the different seasons and is given by:-

$$\hat{P} = \sum_{s=1}^3 \hat{X}_s \bar{y}_s \quad \text{and estimate of variance of } \hat{P} \text{ is given by}$$

$$\hat{V}(\hat{P}) = \sum_{s=1}^3 \left[\bar{y}_s^2 \hat{V}(\hat{X}_s) + \hat{X}_s^2 \hat{V}(\bar{y}_s) \right].$$

Appendix III

Livestock Survey- Canada

(Source <http://www.statcan.gc.ca/>)

The purpose of this survey is to collect information on cattle and calves, hogs, and sheep and lambs. The statistics produced from this survey enable those active in the agricultural sector to observe and assess changes in the industry, measure performance and keep the agricultural community and general public informed of the development.

Description

The Livestock Survey consists of four survey occasions designed to provide inventories of the number of livestock animals on Canadian farms on four specific dates. The January 1 and July 1 surveys collect data related to cattle, hogs and sheep while the April 1 and October 1 surveys focus on hogs. The principal data releases include inventories and summarized supply-disposition tables. These data are used by agricultural industry analysts and producers as they make production and marketing decisions and by government analysts to monitor the livestock industry or develop agricultural policies in Canada. The data are used in the calculation of farm income estimates and flow to the Canadian System of National Accounts. Further, the data are used in the calculation of net farm income projections, produced by Agriculture and Agri-Food Canada in co-operation with Statistics Canada and the provinces. January and July Livestock Survey Cattle and calves inventory: Bulls, Dairy cows, Beef cows, Calves, Dairy replacement heifers, Beef replacement heifers, Slaughter or feeder heifers, Steers ; number of cattle farms; steers and heifers per weight classes. Hogs inventory: Boars; sows; market hogs per weight classes; total hogs. Also sows that farrowed, pigs born and pigs death before weaning. Number of hogs operations. Hogs shipments questions. Sheep inventory: Rams, Ewes, Replacement lambs, Market lambs, total sheep. Number of sheep farms. April and October Hogs Survey Hogs inventory: Boars; sows; market hogs per weight classes; total hogs. Also sows that farrowed, pigs born and pigs death before weaning. Number of hogs operations. Hogs shipments questions.

Reference period:

January 1, April 1 (hogs), July 1, October 1 (hogs)

Collection period:

March, June, September, December

Subjects

1. Agriculture
2. Livestock and aquaculture

Data sources and methodology

Target population

The target population for the survey consists of all Canadian agriculture operations that have a livestock inventory during the reference year. Specific farms are excluded from the target population to obtain the survey population such as farms with less than

\$10,000 in sales from agricultural activities or with 10 or fewer heads in each of the cattle, hogs and sheep categories, institutional farms, community pastures, farms on Indian reserves.

Instrument design

The original development of the Computer Assisted Telephone Interview questions was based on the well established Livestock Survey paper questionnaire that it replaced and the livestock module on the Census of Agriculture. The Census of Agriculture questionnaire was tested using focus groups and pilot surveys.

The questions used in the ongoing survey have been tested using focus groups. In addition, staff observe training and collection, providing observation reports. All survey occasions include debriefing sessions where the results of the testing and observation are incorporated into the development cycle of the next survey, normally to fine-tune the survey.

Sampling

This is a sample survey with a cross-sectional design.

The target population consists of all farms in Canada with a livestock inventory, excluding the four Atlantic Provinces, which are surveyed independently. (see Atlantic Agriculture Survey, record number 3465). The survey frame includes all agricultural producers with a livestock inventory, excluding institutional farms, community pastures and farms on Indian reserves, who reported \$10,000 or more in sales from agricultural operations, and who had more than 10 cattle, hogs or sheep on the Census of Agriculture, supplemented by known new hog operations. The survey focuses on cattle, hog and sheep producers during sample selection as the stratification and allocation is multi-variate, by type and size of livestock operation. The sample is selected using a stratified simple random sampling method. The sample size of the survey depends on the survey occasion. January Livestock Survey sample size equals about 10,260 April Hog Survey sample size equals about 2,100 July Livestock Survey sample size equals about 16,260 (about 10,000 in census years) October Hog Survey sample size equals about 2,500

Data sources

Responding to this survey is mandatory.

Data are collected directly from survey respondents.

The survey information is collected by telephone interview in Statistics Canada Regional Offices, using a Computer Assisted Telephone Interview (CATI) application. Farm operators are contacted directly by phone and, in cases where the operator is difficult to contact, there are multiple follow-up telephone calls that ultimately result in a high contact rate.

Error detection

The CATI application used for collection contains range and consistency edits and help text. A set of reports is run to identify problem items early in collection for remedial action (e.g. variables with a significant number of edits or missing information). Processing includes checking interviewer notes, manually reviewing significant inconsistencies and reviewing the top contributors to the unweighted and weighted estimates (for each variable in each province).

Imputation

Total non-response (e.g. refusals and no contacts) is accounted for by weighting adjustments to each stratum. Some item non-response is estimated deterministically (using other information in the respondent's questionnaire). Some missing information is imputed manually during the edit process, and others are imputed using a "hot-deck" donor imputation method. The automated imputation system looks for donors within the stratum and then verifies that the donor record and the record to be imputed are acceptable. A final review of the imputed data is then performed.

Estimation

The response values for sampled units are multiplied by a sampling weight in order to estimate for the entire surveyed population. The sampling weight is calculated using a number of factors, including the probability of the unit being selected in the sample. Raising factor (weight) adjustment is used in the estimation process to account for sampled units who could not be contacted or who refused the survey.

Once the weights have been calculated for each record, any level of required estimates may be obtained using domain estimation (i.e. provincial, agricultural region, etc.). The 2006 Census of Agriculture data are then used to make macro adjustments to the estimates to account for the specific farms excluded from the survey population.

Quality evaluation

The survey results are evaluated through comparisons to previous estimates and other sources when available. Biological factors affecting livestock are used as a guide when evaluating the data or comparing to other data sets. A primary tool in the evaluation and final determination of the data involves supply-demand analysis and survey-based models that track the supply and demand of the particular type of livestock by province over time.

The survey results are analysed and corrected before the data are used to analyse the industry and fine-tune the estimates. The survey data are reviewed in a board environment before the commodity analyst works with the data primarily using supply-disposition analysis. The results of the industry analysis are reviewed by the board before being sent to the individual provinces. Once the data are finalised they are released to the public and disseminated.

Disclosure control

Statistics Canada is prohibited by law from releasing any data which would divulge information obtained under the Statistics Act that relates to any identifiable person, business or organization without the prior knowledge or the consent in writing of that person, business or organization. Various confidentiality rules are applied to all data that are released or published to prevent the publication or disclosure of any information deemed confidential. If necessary, data are suppressed to prevent direct or residual disclosure of identifiable data.

Revisions and seasonal adjustment

Once every five years the published livestock data are aligned with the results of the Census of Agriculture. Due to conceptual differences between the datasets, the match is not normally 1 to 1. For instance, the 2006 Census was conducted on May 16 and the livestock statistics refer to either April 1 or July 1. Any adjustments made to the data during the Census year are then smoothed in over the historical five-year period between the Censuses. The impact of the revisions is normally less than 5%, however, for specific livestock in certain provinces, the impact can be higher.

Data accuracy

Sample surveys are designed to provide the highest sampling efficiency (the smallest sample that will produce a sampling error of a given size). This optimization is usually performed for only a few variables, limited by the data items that are available at the time of sample design and selection, the resources available, and the complexity introduced by trying to optimize for many variables at one time. The sample used for these statistics was designed to produce a high level of accuracy for provincial level totals.

The following ratings are based on the value of the coefficient of variation (CV). Using this rating system, the vast majority of the total estimates at the provincial level are excellent. This is particularly true in provinces where the livestock type is prevalent. If they are not excellent, the results are normally very good. Letter Rating CV Rating A 0.00% to 4.99% Excellent B 5.00% to 9.99% Very good C 10.00% to 14.99% Good D 15.00% to 24.99% Acceptable E 25.00% to 34.99% Use with caution F $\geq 35.00\%$ Too unreliable to publish The variability in the estimates can be obtained by constructing confidence intervals around the estimate using the estimate and the coefficient of variation.

The overall response rate of the survey is very good ranging normally from 89% to 97%, and item non-response is low. Overall, the impact of the edits and imputations is small. The data are generally of excellent quality, with some under-coverage due to intercensal frame degradation (i.e. coverage of new operations).