

# 3

## Large Scale Survey

### 3.1 INTRODUCTION

The programme envisages the conduct of an in-depth study, at micro-level, of the socio-economic, agro-climatic, agronomic, infrastructural and other relevant factors prevailing in different agro-climatic zones of the country, which have a bearing on the spread of agricultural mechanization, agricultural productivity therein; and formulation of appropriate long-term farm mechanization strategies for the respective zones. It is likely that for a number of Zones/States, a single set of strategy/programme may not be uniformly conducive to the spread of farm mechanization and all-round and sustainable agricultural development there. As such, appropriate packages of agricultural mechanization strategies and programmes for the different Zones/States need to be formulated according to the present status, potential and future needs of agricultural mechanization there.

### 3.2 DIFFERENT AGRO CLIMATIC ZONES

The Planning Commission initiated the Agro-climatic Regional Planning Project in June 1988. Under this system, the country is divided into 15 Agro Climatic Zones (Table 1) on the basis of a commonality of factors such as soil type, rainfall, temperature, water resources, etc., 14 in the main land and remaining one in the islands of Bay of Bengal and Arabian sea (Fig. 3.1).

These 15 Zones cut across state boundaries and were further sub-divided into 73 sub-zones. The district formed the lowest unit of reckoning. The demarcation of these agro-climatic zones assume importance in planning strategies for agricultural development.

### 3.3 STUDY PLANNED PHASE-WISE

The study was planned in three phases, which were implemented simultaneously.

#### 3.3.1 Phase-I: Engagement of Experts, Preparation of Sectoral Status Papers and Organisation of Workshop

The project started from July, 2000. A Seminar-cum-Group Discussion to crystallise the approach and

Table 1. Agro Climatic Zones in India

Zone Number	Agro-climatic Zones	States represented
I	Western Himalayan region	Himachal Pradesh, Jammu and Kashmir, Uttaranchal
II	Eastern Himalayan region	Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, West Bengal
III	Lower Gangetic Plains region	West Bengal
IV	Middle Gangetic Plains region	Uttar Pradesh, Bihar
V	Upper Gangetic Plains region	Uttar Pradesh
VI	Trans Gangetic Plains region	Chandigarh, Delhi, Haryana, Punjab, Rajasthan
VII	Eastern Plateau and Hills region	Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Orissa, West Bengal
VIII	Central Plateau and Hills region	Madhya Pradesh, Rajasthan, Uttar Pradesh
IX	Western Plateau and Hills region	Madhya Pradesh, Maharashtra
X	Southern Plateau and Hills region	Andhra Pradesh, Karnataka, Tamil Nadu
XI	East Coast Plains and Hills region	Andhra Pradesh, Orissa, Pondichery, Tamil Nadu
XII	West Coast Plains and Ghat region	Goa, Karnataka, Kerala, Maharashtra, Tamil Nadu
XIII	Gujarat Plains and Hills region	Gujarat, Dadra and Nager Haveli, Daman and Diu
XIV	Western Dry region	Rajasthan
XV	Island region	Andman and Nicobar Islands, Lakshdweep

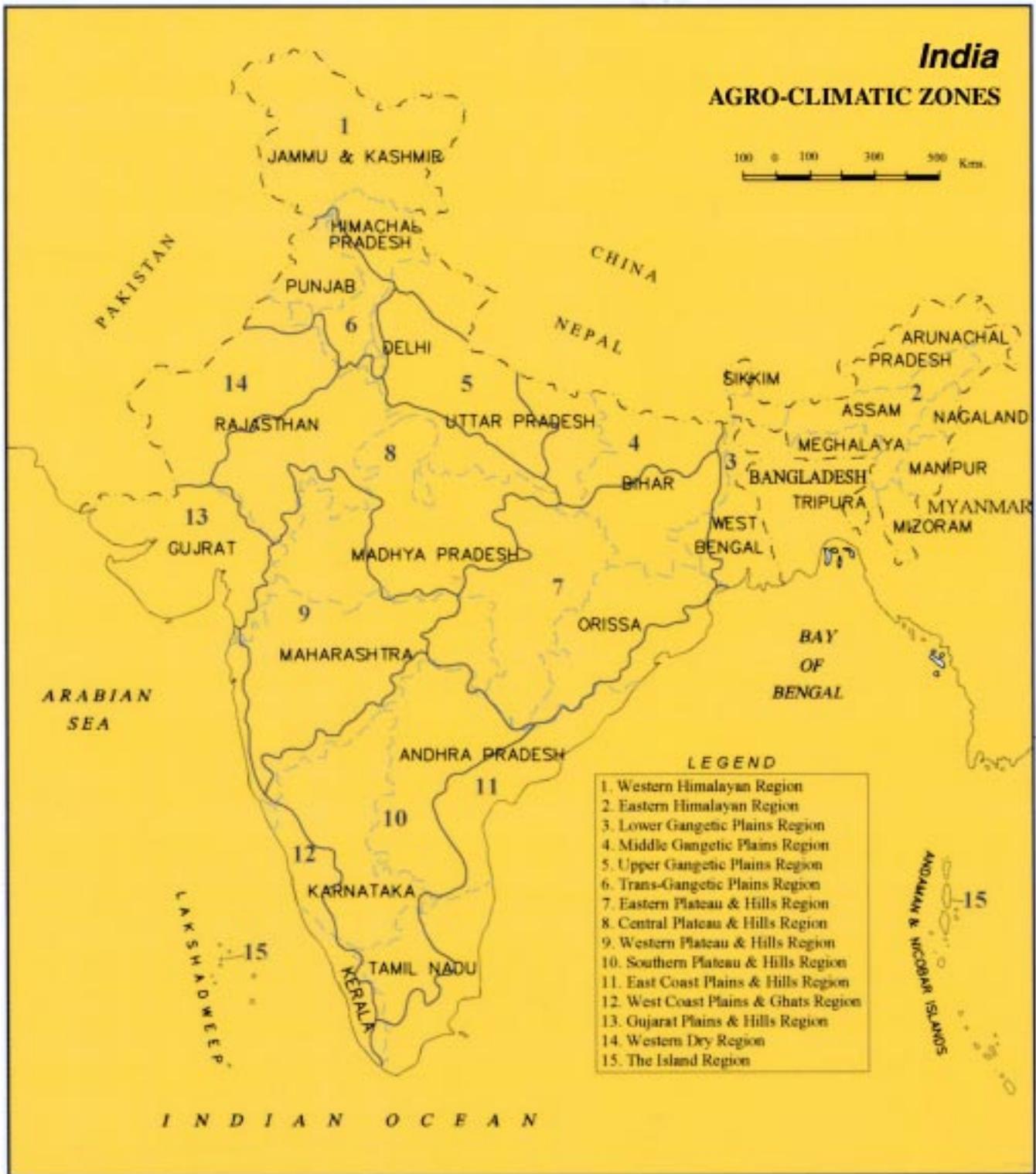


Fig. 3.1 Agro-climatic Zones of India

Table 2. Topics of the Status Papers along with Authors

Sl No	Topic	Author	Designation and Address
1.	AGRO-ECOLOGICAL ZONES, THEIR SOIL RESOURCE AND CROPPING SYSTEMS	DR K S GAJBHIYE <sup>1</sup> AND C MANDAL <sup>2</sup>	NATIONAL BUREAU OF SOIL SURVEY AND LAND USE PLANNING, AMRAVATI ROAD, NAGPUR – 440 010
2.	CROPPING PATTERN (AGRICULTURAL AND HORTICULTURAL) IN DIFFERENT ZONES, THEIR AVERAGE YIELDS IN COMPARISON TO NATIONAL AVERAGE/CRITICAL GAPS/REASONS IDENTIFIED AND YIELD POTENTIAL	DR P DAS	DY DIRECTOR GENERAL (AGRIL EXTENSION), ICAR, KAB, NEW DELHI – 110 012
3.	SCOPE, PROGRESS AND CONSTRAINTS OF FARM MECHANIZATION IN INDIA	DR JOGINDER SINGH	PROF-CUM-HEAD DEPARTMENT OF ECONOMICS, PUNJAB AGRICULTURAL UNIVERSITY, LUDHIANA-141 004
4.	FARM POWER SOURCES, THEIR AVAILABILITY AND FUTURE REQUIREMENTS TO SUSTAIN AGRICULTURAL PRODUCTION	DR N S L SRIVASTAVA	ASSISTANT DIRECTOR GENERAL (ENGG) RETD ICAR, KAB, NEW DELHI –110 012
5.	PRESENT STATUS AND FUTURE REQUIREMENTS OF FARM EQUIPMENT FOR CROP PRODUCTION	DR M M PANDEY	PROJECT COORDINATOR AICRP ON FIM CENTRAL INSTITUTE OF AGRICULTURAL ENGINEERING, BHOPAL – 462 038
6.	AGRO-PROCESSING INDUSTRIES IN INDIA-GROWTH, STATUS AND PROSPECTS	DR R P KACHRU	ASSISTANT DIRECTOR GENERAL (ENGG) ICAR, KAB, NEW DELHI – 110 012
7.	CUSTOM HIRING OF AGRICULTURAL MACHINERY AND ITS FUTURE SCOPE	DR V K SHARMA <sup>3</sup> , DR KULVINDER SINGH <sup>4</sup> AND DR B S PANESAR <sup>5</sup>	PUNJAB AGRICULTURAL UNIVERSITY, LUDHIANA –141 004
8.	IMPACT OF AGRICULTURAL MECHANIZATION ON PRODUCTION, PRODUCTIVITY, CROPPING INTENSITY INCOME GENERATION AND EMPLOYMENT OF LABOUR	DR S R VERMA	PROF OF AGRIL ENGG AND EX-DEAN COLLEGE OF AGRIL ENGG PUNJAB AGRICULTURAL UNIVERSITY, LUDHIANA –141 004
9.	AGRICULTURAL MACHINERY INDUSTRY IN INDIA (MANUFACTURING, MARKETING AND MECHANIZATION PROMOTION)	DR GYANENDRA SINGH	DIRECTOR CENTRAL INSTITUTE OF AGRICULTURAL ENGINEERING, BHOPAL – 462 038
10.	FUTURE REQUIREMENTS OF AGRICULTURAL MACHINES FOR MECHANIZING AGRICULTURE	DR ANWAR ALAM	DY DIRECTOR GENERAL (AGRIL ENGG), ICAR, KAB, NEW DELHI – 110 012

<sup>1</sup>Director; <sup>2</sup>Principal Scientist; <sup>3</sup>Registrar; <sup>4</sup>Assistant Agricultural Engineer, Department of Farm Power and Machinery; <sup>5</sup>Professor, School of Energy Studies for Agriculture.

modalities of the project was organised at the Institute during July 24–25, 2000 under the chairmanship of Dr BS Pathak, Director, SPRERI, Vallabh Vidyanagar, Gujarat & Ex-Professor of Eminence (Agril Engg), ICAR. Senior Officials from ICAR Hqrs; CIAE, Bhopal; IARI, New Delhi; NBSS&LUP, Delhi Centre along with the scientists/officials of the Institute associated with the project participated in the Seminar-cum-Group Discussion. Keeping in view the objectives of the project, topics of different status papers were finalised and letters relating to preparation of status papers were sent to the experts, identified for the purpose. For reviewing the work done through these status papers, an Editorial Committee under the chairmanship of Dr BS Pathak was constituted, other members being Prof MM Mehta, Managing Director, Maharishi Technology Corporation Ltd, New Delhi & Ex-Prof (Engg), GBPUAT, Pantnagar and Ex-Vice President, Escorts Limited, Faridabad and Dr Anwar Alam, Vice Chancellor, SKUAST(K), Srinagar & Ex-Deputy Director General (Agril Engg), ICAR, New Delhi. Dr KK Tyagi, Principal Scientist and Principal Investigator of the project was the convener of the committee. Finally, a document entitled “STATUS OF FARM MECHANIZATION IN INDIA”, comprising of 10 status papers, as indicated in Table 2, was prepared, finalised and published.

### 3.3.2 Phase-II: Planning and Organisation of a Large-scale Sample Survey

During Phase-II, a large-scale sample survey with the farm mechanization (at Village-level as well as at Household-level) in focus was planned and conducted. The sampling design adopted was stratified multi-stage random sampling.

#### 3.3.2.1 Sampling Design

The study was conducted for each Agro-climatic Zone/State covering about 20% of the districts representing a mix of developed, developing and least developed pockets. The basic purpose was to have complete insight of the situation and future needs in the direction of achieving full mechanization in a suitable time frame.

The sampling design adopted was Stratified Multi-stage Random Sampling. At present, the total number of districts in India is 585, out of which a sample of 120 districts was selected randomly with due consideration to mechanization index of different districts within strata (State or group of States), following proportional allocation. From each selected district, a random sample of 40 villages was also selected. Accordingly, the total

number of selected villages was 4,800. Keeping in view the level and adoption of mechanization (holding-size wise), out of each selected village, a sample of 10 households was selected. Hence, the total number of randomly selected households was 48,000.

#### 3.3.2.2 Reference Year

The reference year was the agricultural year 2000–2001.

#### 3.3.2.3 Characters on which Data Collected

Data on general particulars of the randomly selected villages along with list of households (frame) with varying levels of farm mechanization and growing different crops was collected. This has helped in the preparation of a frame of households, which was used for random selection of households for detailed enquiry on various aspects of farm mechanization. At the village level, information on local wage rates for casual labour, hire rates per pair of draught labour, hire rates for machine labour and irrigation charges from various sources was collected. At household level, general information about the holding of the selected household viz, details of area of operational holding and crop-wise agronomic practices adopted during each season of the agricultural year 2000–2001 was collected. In addition, record of different field operations carried out and various material inputs applied (quantity of seed, fertilisers, pesticides etc.), labour employed (human, animal and machine; along with type, their number, total number of hours for which labour was employed, amount paid etc.), production (yield as well as residues if any) etc. has been collected. An inventory of all the agricultural implements (conventional as well as improved) possessed by the selected households was also prepared. The data on socio-economic aspects of the household was also collected.

#### 3.3.2.4 Allocation and Selection of Primary Stage Sampling Units (PSUs)—Districts

The strata were the States/group of States (e.g. NEH-Northern Eastern Hilly States). Some of the States like Punjab, Haryana and Western part of Uttar Pradesh etc. are highly mechanized while States located in hilly areas especially Northern Eastern Hills etc., mechanization levels are of low order, in rest of the States/UTs, the mechanization levels are of moderate levels. At the time of planning for the large scale survey, India was divided into 26 States and 6 Union Territories comprising 585 districts. Out of total number of districts, at primary stage sampling unit (psu) level, a sample of 120 districts was

selected randomly with due consideration to mechanization levels following proportional allocation. The total sample size of 120 districts was allocated to different strata, keeping in view the number of districts within each strata/State, following proportional allocation. Within each Stratum/State, all the districts were arranged in ascending order of magnitude of mechanization indices (number of tractors per thousand ha unit of area in each district), which varied in between 0 and 75. Homogenous groups of 10 or more districts were prepared and from each group, at least 2 districts (1 out of about 5 districts) were selected randomly. The sample of districts so selected were post-stratified according to agro-climatic zones (ACZ) to ensure ACZ-wise representation.

### 3.3.2.5 SELECTION OF SECONDARY STAGE SAMPLING UNITS (SSUs)—VILLAGES

#### 3.3.2.5.1 Determination of Sample Size—Number of Villages/Households to be Selected within a District

In the absence of any apriori information on the coefficient of variation (cv) relating to the characteristic—total number of tractors within a village as well as on number of tractors possessed by a household, different levels of cv were assumed. Accordingly, for different levels of assumed coefficient of variation, the sample sizes, i.e. total number of villages/households to be selected within a district was determined on the criterion of desired level of efficiency ( $t_0 = 95\%$ ) at a tolerable margin of error ( $d = 5\%$ ), as follows:

For  $cv = 100\%$ , the sample size  $n_0$  is worked out as follows:

$$n_0 = ((t_0/d) \times cv)^2 = 1,600$$

For  $cv = 50\%$ , the sample size  $n_0$  is worked out as follows:

$$n_0 = ((t_0/d) \times cv)^2 = 400$$

For  $cv = 40\%$ , the sample size  $n_0$  is worked out as follows:

$$n_0 = ((t_0/d) \times cv)^2 = 256$$

Assuming cv to be around 50%, the sample size  $n_0$  came out to 400 households. Accordingly, within a district, it was decided to select 40 villages and 10 households within each village.

For each of the randomly 120 selected districts, complete list of villages for each of the district was obtained from the office of Registrar General of India. Selection of 40 (+10) villages out of the total number of villages in the district, was done using simple random

sampling through a computer program prepared for the purpose. For each of the 120 selected districts, separate lists of randomly selected 40 (+10) villages along with their tehsil and block were prepared. Additional 10 villages were selected so as to replace any of the selected village in the list of 40 villages, which may not be identified/approachable etc. Accordingly, at the secondary stage sampling unit (ssu), the total number of selected villages was 4,800.

### 3.3.2.6 Selection of Tertiary (third) Stage Sampling Units (TSUs)—Household

For each of the selected villages, a list of all the households was prepared according to Households having Tractor (HT)/not having Tractor (NHT) under the Small (up to 2 ha)/Medium (2 to 4 ha)/Large Holding (more than 4 ha). For regions, where use of Tractors was not prevalent, while Power Tillers were in use, the Power Tiller was used in place of Tractor. Each category was further divided into three holding size classes as mentioned above. Keeping in view the level and adoption of mechanization, out of each selected village, a sample of 10 households was selected. Hence, the total number of randomly selected households was 48,000. In each village, total 10 (ten) cultivators were selected randomly out of which, 3 (three) from the category of cultivators having tractor and 7 (seven) from the category of cultivators not having tractor. From the category of cultivators having tractor, 1 (one) cultivator from each of the holding sizes (small, medium and large) was selected. From the category of cultivators not having tractor, 3 (three) from small holding, 2 (two) from medium holding and 2 (two) from large holding size were selected randomly as follows:

Holding size	Category of cultivator	
	Having tractor	Not having tractor
Small	1	3
Medium	1	2
Large	1	2
Total	3	7

### 3.3.2.7 Field Data Collection Work

#### 3.3.2.7.1 Field Data Collection Agency

For field data collection work, Co-operating Centres of All India Coordinated Research Project on Farm Implements and Machinery (AICRP on FIM), spread

Table 3. State-wise allocation of 120 randomly selected districts

Sl No.	Name of the State	Total number of districts/villages in the State	Number of selected districts	Name of the selected districts
1.	Andhra Pradesh	23 (28,123)	5	Rangareddi, Kurnool, Medak, Nalgonda, Warangal
2.	Assam	23 (26,247)	5	Jorhat, Dibrugarh, Dhemaji, Sibsagar, Golaghat
3.	Bihar	37 (45,113)	6	Lakhisarai, Madhubani, Samastipur, Katihar, Vaishali, Siwan
4.	Gujarat	25 (18,544)	5	Ahmedabad, Rajkot, Valsad, Vadodara, Banaskantha
5.	Haryana	19 (6,955)	4	Bhiwani, Faridabad, Kaithal, Sonipat
7.	Himachal Pradesh	12 (19,831)	2	Kangra, Una
8.	Jammu and Kashmir	14 (6,652)	3	Jammu, Kathua, Udhampur
9.	Jharkhand	18 (32,615)	5	Ranchi, Dumka, Dhanbad, Deoghar, Gumla
10.	Karnataka and Goa	29 (29,483 + 359)	6	Haveri, Belgaum, Gadag, Dharwad, Chitradurga, Goa
11.	Kerala	14 (1,364)	4	Idukki, Pathanamthitta, Kollam, Alappuzha
12.	M. P. and Chhattisgarh	61 (55,392 + 20,308)	13	Vidisha, Sehore, Bhopal, Raisen, Seoni, Chhindwara, Damoh, Nimar, Umeria, Katni, Jabalpur, Rewa, Korba
13.	Maharashtra	35 (43,722)	7	Yavatmal, Akola, Amravati, Thane, Raigarh, Pune, Satara
14.	NEH Region	49 (Arunachal Pradesh-4,065; Manipur-2,391; Meghalaya-6,023; Mizoram-817; Nagaland-1,315; Tripura-870;	9	Tawang, West Kameng, East Siang (Arunachal Pradesh); Imphal (Manipur), Jaintia Pahar, East Khasi Hills (Meghalaya), Aizwal (Mizoram), Mon (Nagaland), West Tripura (Tripura)
15.	Orissa	30 (51,352)	6	Sonpur, Angul, Ganjam, Nayagarh, Khurda, Jagatsinghpur
16.	Punjab	17 (12,729)	4	Gurdaspur, Mansa, Ludhiana, Navashehar
17.	Rajasthan	32 (41,353)	6	Udaipur, Kota, Chittorgarh, Sirohi, Jalore, Banswara
18.	Tamil Nadu	30 (16,317)	7	Namakkal, Nilgiris, Tiruvanamalai, Coimbatore, Tuticorin, Erode, Salem
19.	Uttranchal	13 (16,805)	3	Almora, Bageshwar, Nainital
20.	Uttar Pradesh	70 (1,07,440)	14	Baghpat, Bijnor, Muzaffarnagar, Varanasi, Mirzapur, Kanpur (Dehat), Lalitpur, Lucknow, Barabanki, Balia, Gonda, Mau, Basti, Gorakhpur
21.	West Bengal and Sikkim	22 (40,783 + 452)	5	Bankura, Hooghly, Midinipur, Burdhan, West Sikkim
22.	UTs	12 (Chandigarh-24; Delhi-165; Daman and Diu-23; Dadra and Nagar Haveli-70; Lakshadweep-24; Pondicherry-92; Andaman and Nicobar Islands-547)	1	Karaikal (Pondicherry)
Total Number of Districts		585	120	

Nation-wide and located at various State Agricultural Universities (SAUs); ICAR Institutes; and IIT, Kharagpur were involved.

As part of Phase-II, a large scale survey, adopting stratified multi-stage random sampling design, was planned and conducted in 120 randomly selected districts through Nation-wide spread 24 Centres (21 Centres of AICRP on FIM; NDUAT, Faizabad, Uttar Pradesh; GAU, Ahmedabad, Gujarat; SKUAST, Jammu, Jammu & Kashmir). The State-wise allocation of 120 randomly selected districts is as given in Table 3.

### 3.3.2.7.2 Schedules for Field Data Collection Work

After lot of deliberations, different types of Schedules for data collection, i.e. at district-level, village-level and household-level were finalized. For clear-cut instructions to the field investigators relating to filling of these schedules, an Instruction Manual was also prepared. Adequate number of different types of schedules and instruction manuals were printed.

### 3.3.2.7.3 Financial Norms for Field Data Collection Work

The financial norms for filling up of district, village and household schedules were fixed after lot of discussion and expenditure on field data collection work was worked out on per district basis, and was approved by the Project Management Committee, as follows:

#### APPROVED BUDGET PER DISTRICT

- Expenditure on field data collection work per district.
- In each district, 40 villages were selected.
- In each selected village, 10 households were selected.

Sampling stage	No. of schedules	Remuneration schedule (Rs)	Total amount (Rs)
District Schedule	1	250	250
Village Schedules	40	150	6,000
Household Schedules	40V × 10HH = 400HH	45	18,000
Total			24,250

- In each district, 5 Field Investigators (FIs) were hired.
- Each Field Investigator (FI) was allotted 8 villages.

- FI's job was to fill the Village and Household Schedule for 8 villages.

Payment to be made to each FI (for 8 villages)

Item	Number	Rate (Rs)	Total amount (Rs)
Village Schedules	8 V	150	1,200
Household Schedules	80 HH	45	3,600
Travel Expenses subject to max. of Rs 200 per village	8 V	200	1,600
Training Allowance (travel, boarding and lodging) for 3 days training in schedule filling	3 days	200	600
Total			7,000

Payment made for filling of schedules for a district

Item	Payment (Rs)
District Schedule (to be filled by FIM Research Engineer)	Rs 250
Payment to 5 FI's @ Rs 7,000 per FI	Rs 35,000
Remuneration to village leader @ Rs 100 per village (for 40 villages)	Rs 4,000
Total	Rs 39,250

Expenditure per District

Item	Expenditure (Rs)
Filling Up of Schedules	39,250
Supervision by FIM Centre (TA and DA)	8,000
Honorarium to FIM centre	2,000
Expenses to be incurred on organising training programme	200
Miscellaneous (stationary, postage etc.)	1,000
Total (Amount to be transferred to FIM Centres per district)	50,450

Mentioning the names of the selected districts and the above-mentioned norms, the Vice-Chancellors of SAUs/ Directors of ICAR Institutes (where the FIM/other Centres were located), were approached. After receiving their concurrence, the required funds for field data collection work were transferred to all the Centres, on the basis of total number of districts allotted to concerned Centre.

### 3.3.2.7.4 Training Programmes for Field Data Collection work

Training relating to organisation of field data collection work including filling up of the schedules etc. was imparted by the Institute Scientists in two stages, first to the Research Engineers of all the different Centres and in the second stage to the hired Field Investigators at different FIM/Other Centres.

#### 3.3.2.7.4.1 Training Programme Organised for Research Engineers of FIM/Other Centres

Table 4. Details of Research Engineers Training Programmes organised at different locations

Date	Venue	Research Engineer of FIM/Other Centre
December 18–20, 2000	CIAE, Bhopal	Research Engineers of 5 FIM Centres namely: CIAE, Bhopal; AAI, Allahabad; PDKV, Akola; JNKVV, Jabalpur and RAU, Samastipur
May 01–03, 2001	CIAE, Bhopal	Research Engineers of 11 FIM Centres namely: ANGRAU, Hyderabad; BAU, Ranchi; GBPUAT, Pantnagar; HAU, Hisar; ICAR Research Complex for NEH Region, Umiam; IIT, Kharagpur; IISR, Lucknow; MPKV, Pune; PAU, Ludhiana; TNAU, Coimbatore and UAS, Raichur.
July 07–09, 2001	IISR, Lucknow	Research Engineer of NDUAT, Faizabad
July 26–30, 2001	TNAU, Coimbatore	Research Engineer of KAU, Tavanur
August 19–20, 2001	IASRI, New Delhi	Research Engineer of NDUAT, Faizabad
September 28–29, 2001	IASRI, New Delhi	Research Engineers of 2 FIM Centres namely RAU, Samastipur and OUAT, Bhubaneswar
November 15–16, 2001	AAU, Jorhat	Research Engineer of AAU, Jorhat
December 19–20, 2001	IASRI, New Delhi	Research Engineer of SKUAST, Jammu
January 22–23, 2002	GAU, Ahmedabad	Research Engineers of GAU, Ahmedabad

#### 3.3.2.7.4.2 Training Programme Organised for Imparting Training to the Hired Field Investigators at Different FIM/Other Centres

At most of the Centres, for field data collection work, five Field Investigators (FIs) per district were hired (each FI was allotted about 8 villages). These FIs were among the unemployed graduates/village school teachers/state government officials etc. Training programmes for the hired Field Investigators were organised at different FIM/Other centres, the tentative dates for which were fixed in consultation with the concerned Research Engineer of the Centre.

In the second stage, the Scientists and Field Officer of the Institute assisted the concerned Research Engineers of the Centre in imparting the training relating to field data collection work, to the hired FIs, at all the 24 Centres. Invariably, at each Centre, three days training programme for the hired Field Investigators were organised as per the following programme:

- 1st Day : Training for filling up the Village and Household Schedules, visit to FIM Centre Workshop having various farm machinery/implements.
- 2nd Day : Field visit to the nearby village with the Field Investigators for actual filling of the Schedules (Research Engineer to contact in advance some farmers in the nearby village for the purpose).
- 3rd Day : Clarification of queries etc. and distribution of schedules, instruction manuals to the Field Investigators Filling of Movement Plan by the respective Field Investigators.

For facilitating allocation of 40 randomly selected villages of a district among the 5 Field Investigators hired for data collection work, district village maps were used. IASRI Officials who participated in the Field Investigators Training programme, carried along with them total number of Schedules, Instruction Manuals etc. which were distributed among the Field Investigators during the organization of the training programme. At some Centres, immediately after the training programme, the IASRI Officials went to some of the selected villages along with the concerned Field Investigators for immediate supervision of field data collection work.

The details of the training programmes organised at different FIM/Other Centres is given in Table 5.

Table 5. Details of Field Investigators Training Programmes organised at various FIM/other Centres

Sl. No.	Name of the FIM Centre	Selected Districts No. Name	Name of IASRI Officials who imparted training	Sl. No.	Name of the FIM Centre	Selected Districts No. Name	Name of IASRI Officials who imparted training
1.	CIAE, Bhopal (MP) 26-27 April, 2001	4 Vidisha, Sehore, Bhopal, Raisen	Sh A.K. Gupta Dr Man Singh Sh S.C. Agarwal Sh K.K. Kher	11.	UAS, Raichur (Karnataka) 09-11 October, 2001	6 Haveri, Belgaum, Gadag, Dharwad, Chitradurga, Goa	Dr M.S. Narang Sh S.C. Agarwal
2.	AAI, Allahabad (UP) 06-08 June, 2001	4 Varanasi, Mirzapur, Kanpur (Dehat), Lalitpur	Sh A.K. Gupta Dr Man Singh Sh S.C. Agarwal	12.	Ch. SKKV, Palampur (HP) 05-07 November, 2001	2 Kangra, Una	Dr M.S. Narang Sh Satya Pal
3.	IISR, Lucknow (UP) 10-12 July, 2001	2 Lucknow, Barabanki	Dr D.L. Ahuja Dr Man Singh	13.	PDKV, Akola (Maharashtra) 19-21 November, 2001	3 Yavatmal, Akola, Amravati	Sh A.K. Gupta Sh K.K. Kher
4.	TNAU, Coimbatore (Tamil Nadu) 26-30 July, 2001	8 Namakkal, Nilgiris, Tiruvanamalai, Coimbatore, Tuticorin, Erode, Salem, Karaikal (Pondicherry)	Sh R.M. Sood Sh S.C. Agarwal Dr Man Singh	14.	RAU, Samastipur (Bihar) 05-07 November, 2001	6 Lakhisarai, Madhubani, Samastipur, Katihar, Vaishali, Siwan	Dr Man Singh Sh Bhagwan Dass
5.	BAU, Ranchi (Jharkhand) 16-18 August, 2001	5 Ranchi, Dumka, Dhanbad, Deoghar, Gumla	Sh R.M. Sood Sh R.C. Gola Sh Bhagwan Dass	15.	ICAR Res. Complex for NEH Region, Umiam (Meghalaya) 22-23 November, 2001	1 Imphal (Manipur)	Dr H.V.L. Bathla Dr K.K. Tyagi
6.	PAU, Ludhiana (Punjab) 08-10 August, 2001	4 Gurdaspur, Mansa, Ludhiana, Navashehar	Dr M.S. Narang Sh S.C. Agarwal Sh Satya Pal	16.	OUAT, Bhubaneswar (Orissa) 18-20 December, 2001	6 Sonpur, Angul, Ganjam, Nayagarh, Khurda, Jagatsinghpur	Sh R.M. Sood Sh Bhagwan Dass
7.	KAU, Thrissur (Kerala) 19-21 September, 2001	4 Idukki, Pathanamthitta, Kollam, Alappuzha	Sh Bhagwan Dass Sh D.C. Mathur	17.	CCSHAU, Hisar (Haryana) 04-06 January, 2002	4 Bhiwani, Faridabad, Kaithal, Sonapat	Dr M.S. Narang Sh Satya Pal
8.	ANGRAU, Hyderabad (AP) 25-27 September, 2001	5 Rangareddi, Kurnool, Medak, Nalgonda, Warangal	Sh R.M. Sood Sh A.K. Gupta	18.	MPUAT, Udaipur (Rajasthan) 07-09 January, 2002	6 Udaipur, Kota, Chittorgarh, Sirohi, Jalore, Banswara	Sh S.C. Agarwal Dr Man Singh
9.	GBPUAT, Pant Nagar (Uttaranchal) 27-29 September, 2001	6 Baghpat, Almora, Bageshwar, Bijnor, Nainital, Muzaffarnagar	Sh S.C. Agarwal Dr Man Singh	19.	MPKV, Pune (Maharashtra) 16-18 January, 2002	4 Thane, Raigarh, Pune, Satara	Sh K.K. Kher Sh D.C. Mathur
10.	CIAE, Bhopal (MP) 30 August to 02 September, 2001	4 Seoni, Chhindwara, Damoh, Nimar	Dr K.K. Tyagi Dr Man Singh Sh S.C. Agarwal Sh K.K. Kher				

Sl. No.	Name of the FIM Centre	Selected Districts No.	Name	Name of IASRI Officials who imparted training
20.	JNKVV, Jabalpur (MP) 19–21 February, 2002	5	Umeria, Katni, Jabalpur, Rewa, Korba	Sh K.K. Kher Sh S.C. Agarwal
21.	AAU, Jorhat (Assam) 11–13 March, 2002	5	Jorhat, Dibrugarh, Dhemaji, Sibsagar, Golaghat	Dr D.L. Ahuja Sh R.M. Sood
22.	ICAR Res. Complex for NEH Region, Umiam (Meghalaya) 15–16 March, 2002	8	Jaintia Pahar, East Khasi Hills (Meghalaya), Aizwal (Mizoram), West Tripura (Tripura), Mon (Nagaland), Tawang, West Kameng, East Siang (Arunachal Pradesh)	Dr D.L. Ahuja Sh R.M. Sood
23.	SKUAST, Jammu (J & K) April 30 – May 02, 2002	3	Jammu, Kathua, Udhampur	Sh A.K. Gupta Dr Man Singh
24.	IIT, Kharagpur (West Bengal) 06–17 May, 2002 08–10 May, 2002 13–14 May, 2002 16–17 May, 2002	5	Bankura**, Hooghly, Midinipur, Burdhman, West Sikkim** Midinipur (West) Midinipur (East) Burdhman	Dr HVL Bathla** Dr K.K. Tyagi** Sh S.C. Agarwal Dr Man Singh
25.	GAU, Ahmedabad (Gujarat) 27–28 June, 2002	5	Ahmedabad, Rajkot, Valsad, Vadodara, Banaskantha	Sh Satya Pal Dr Man Singh
26.	NDUAT, Faizabad (UP) 10–12 October, 2002	5	Balia, Gonda, Mau, Basti, Gorakhpur	Dr K.K. Tyagi Dr Man Singh

### 3.3.2.7.5 Completion of Field Data Collection Work

At most of the Centres, the field data collection work was completed during 2002–2003. Filled-in village and household schedules were received from all the Centres by March 2004.

The district profiles for each of the 120 districts were prepared. Scrutiny and checking of the filled-in data schedules was done with the help of technical personnel of the Institute. Regular correspondence with Research Engineers of the Centres was done during the period of field data collection work as well as for early dispatch of filled-in schedules to IASRI.

### 3.3.2.7.6 Data Entry in Digital Form

The entire information from the filled-in data Schedules was transferred in digital form for which a software package in MS Access was prepared at the Institute. List of different crops, agricultural operations, fertilizers/manures, plant protection chemicals, power sources, farm implements, etc. and their codes were finalized and transferred in software package for data entry. Lists of selected villages in different districts/States/agro-climatic zones along with their codes were prepared and transferred in software package for data entry. After lot of discussions, formats of different output Tables were also prepared.

### 3.3.2.7.7 Statistical Analysis of Data

Statistical analysis of data in village and household schedules was done for each selected district/State on computer by preparing different types of computer programs for analysis of data. Keeping in view the objectives of the study, various summary tables containing information related to, availability of basic amenities, connectivity of villages through roads etc. and availability of various modes of transport, were prepared to assess the overall infrastructural development in and around the region. Land topography, type and texture of soil and ground water table for the region were also tabulated. To study the social and economic conditions of the farmers, twelve parameters were considered. These parameters were medical consultations, type of house, drinking water, hired permanent labour, membership of committees, family education level, family size, basic amenities, total annual income, holding size, animal possession and material possession. Each of the parameter had five to six options and accordingly scores from 0 to 5 were allotted to these options for each parameter. Total score for each household was calculated

which was an indicator of its socio-economic condition. The households getting the score up to 12 were considered as poor, from 13 to 24 as in low-income class, from 25 to 36 as in low middle class, from 37 to 48 as in high middle class and more than 48 to 60 in rich class.

Information on farm power sources, availability of labour along with prevailing wage rates and employment of labour for different agricultural operations, viz. Tillage, Sowing, Irrigation, Plant Protection Practices, Inter-culture Operations, Threshing and Harvesting etc., was analysed. Custom hiring rates in the region for Tractors with various matching implements namely Disc Plough, M.B. Plough, Disc Harrow, Cultivator, Seed Drill, Harvester, and Thresher etc. were calculated. Different types of implements drawn by animals were also worked out and tabulated. Average rate of custom hiring for different farm power sources (Tractor, Power Tiller, Electric Motor and Diesel Engine) were also worked out. Estimated number of farm power sources per thousand ha of net area sown were worked out. District-level as well as State-level estimates of total number of farm power sources and net area sown based on the estimation procedure as per the sampling design were also worked out and tabulated.

For estimating total number of Tractors, Power Tillers, Diesel Engines, Electric Motors etc., at the district-level, state-level and all-India level, different types of estimators were used. The detailed estimation procedure is given in sub-section 3.3.2.7.8.

### 3.3.2.7.8 Estimation Procedure

Under stratified multi-stage (two-stage) random sampling design, different types of estimators, making use of auxiliary information, for estimating the population parameter at State-level as well as at district-level were investigated. In case when no auxiliary information was available, simple two-stage sampling estimator was taken into consideration.

### NOTATIONS

Let the country be divided into L strata i.e. States/group of States. Let  $i$ -th stratum comprises of  $D_i$  districts.

Further, let

- $y_{ijk}$  : total number of tractors corresponding to  $k$ -th village of the  $j$ -th district in the  $i$ -th stratum.
- $x_{ijk}$  : net area sown corresponding to  $k$ -th village of the  $j$ -th district in the  $i$ -th

- stratum,
- $D_i$  : total number of districts in the  $i$ -th stratum,
- $d_i$  : total number of districts selected randomly out of  $D_i$  districts in the  $i$ -th stratum,
- $V_{ij}$  : total number of villages in the  $j$ -th district of  $i$ -th stratum,
- $v_{ij}$  : total number of villages selected randomly out of  $V_{ij}$  villages,
- $y_{ij}$  : total number of tractors corresponding to the  $j$ -th village in the  $i$ -th stratum
- $x_{ij}$  : total net area sown for the  $j$ -th village in the  $i$ -th stratum,
- $y_i$  : total number of tractors in the  $i$ -th stratum,
- $x_i$  : net area sown in the  $i$ -th stratum,
- $y$  : total number of tractors in India,
- $x$  : total net area sown in India.
- $R_i = y_i/x_i$  : total number of tractors per unit net area sown in the  $i$ -th stratum and
- $R = y/x$  : total number of tractors per unit net area sown in India.

**Estimator-I:** In case when no auxiliary information is available, a simple estimator of the total number of tractors in India,  $y$  is given by

$$\hat{y} = \sum_{i=1}^L \frac{D_i}{d_i} \sum_j \frac{V_{ij}}{v_{ij}} \sum_k y_{ijk} \quad \dots (1.1)$$

The estimator  $\hat{y}$  is unbiased. The variance expression of  $\hat{y}$  is given by

$$V(\hat{y}) = \sum_{i=1}^L D_i^2 \left( \frac{1}{d_i} - \frac{1}{D_i} \right) S_{y_i}^2 + \sum_{i=1}^L \frac{D_i}{d_i} \sum_{j=1}^{D_i} V_{ij}^2 \left( \frac{1}{v_{ij}} - \frac{1}{V_{ij}} \right) S_{y_{ij}}^2 \quad (1.2)$$

where 
$$S_{y_i}^2 = \frac{1}{D_i - 1} \sum_{j=1}^{D_i} \left[ y_{ij} - \left( \sum_{j=1}^{D_i} y_{ij} \right) / D_i \right]^2 \quad \dots (1.3)$$

$$y_{ij} = \sum_{k=1}^{V_{ij}} y_{ijk}$$

and

$$S_{y_{ij}}^2 = \frac{1}{V_{ij}-1} \sum_{k=1}^{V_{ij}} \left[ y_{ijk} - \left( \sum_{k=1}^{V_{ij}} y_{ijk} \right) / V_{ij} \right]^2 \dots (1.4)$$

An unbiased estimator of  $V(\hat{y})$  is given by

$$\hat{V}(\hat{y}) = \sum_{i=1}^L D_i^2 \left( \frac{1}{d_i} - \frac{1}{D_i} \right) s_{y_i}^2 + \sum_{i=1}^L \frac{D_i}{d_i} \sum_j^{d_i} V_{ij}^2 \left( \frac{1}{v_{ij}} - \frac{1}{V_{ij}} \right) s_{y_{ij}}^2 \dots (1.5)$$

where

$$s_{y_i}^2 = \frac{1}{(d_i-1)} \left[ \hat{y}_{ij} - \left( \sum_j^{d_i} \hat{y}_{ij} \right) / d_i \right]^2 \dots (1.6)$$

$$s_{y_{ij}}^2 = \frac{1}{(v_{ij}-1)} \sum_k^{v_{ij}} \left[ y_{ijk} - \left( \sum_k^{v_{ij}} y_{ijk} \right) / v_{ij} \right]^2 \dots (1.7)$$

$$\hat{y}_{ij} = \frac{V_{ij}}{v_{ij}} \sum_k^{v_{ij}} y_{ijk} \dots (1.8)$$

**Estimator-II:** In case when no auxiliary information is available, a simple estimator of the total number of tractors in the  $j$ -th district of  $i$ -th stratum,  $y_{ij}$  is given by

$$\hat{y}_{ij} = \frac{V_{ij}}{v_{ij}} \sum_k^{v_{ij}} y_{ijk} \dots (2.1)$$

The estimator  $\hat{y}_{ij}$  is unbiased. The variance expression of  $\hat{y}_{ij}$  is given by

$$V(\hat{y}_{ij}) = V_{ij}^2 \left( \frac{1}{v_{ij}} - \frac{1}{V_{ij}} \right) S_{y_{ij}}^2 \dots (2.2)$$

where 
$$S_{y_{ij}}^2 = \frac{1}{V_{ij}-1} \sum_{k=1}^{V_{ij}} \left[ y_{ijk} - \left( \sum_{k=1}^{V_{ij}} y_{ijk} \right) / V_{ij} \right]^2 \dots (2.3)$$

An unbiased estimator of  $V(\hat{y}_{ij})$  is given by

$$\hat{V}(\hat{y}_{ij}) = V_{ij}^2 \left( \frac{1}{v_{ij}} - \frac{1}{V_{ij}} \right) s_{y_{ij}}^2 \dots (2.4)$$

where

$$s_{y_{ij}}^2 = \frac{1}{(v_{ij}-1)} \sum_k^{v_{ij}} \left[ y_{ijk} - \left( \sum_k^{v_{ij}} y_{ijk} \right) / v_{ij} \right]^2 \dots (2.5)$$

**Estimator-III:** In case the information on total net sown area for the randomly selected villages, districts and for different strata is available, making use of ratio-type method of estimation, an estimator of the proportion  $R_i$ , is given by

$$\hat{R}_i = \frac{\frac{D_i}{d_i} \sum_j \frac{V_{ij}}{v_{ij}} \sum_k \frac{v_{ij}}{v_{ij}} y_{ijk}}{\frac{D_i}{d_i} \sum_j \frac{V_{ij}}{v_{ij}} \sum_k \frac{v_{ij}}{v_{ij}} x_{ijk}} \quad \dots (3.1)$$

The estimator of the total number of tractors in the  $i$ -th stratum is given by

$$\hat{y}_{iR} = \hat{R}_i \cdot x_i \quad \dots (3.2)$$

Clearly  $\hat{y}_{iR}$ , being ratio-type, is a biased estimator.

An approximate expression for the estimator of bias in  $\hat{y}_{iR}$  is given by

$$\hat{Bias}(\hat{y}_{iR}) = \frac{1}{x_i} \left[ D_i^2 \left( \frac{1}{d_i} - \frac{1}{D_i} \right) \left( \hat{R}_i s_{x_i}^2 - s_{y_{xi}} \right) + \frac{D_i}{d_i} \sum_j V_{ij}^2 \left( \frac{1}{v_{ij}} - \frac{1}{V_{ij}} \right) \left( \hat{R}_i s_{x_{ij}}^2 - s_{y_{xij}} \right) \right] \quad \dots (3.3)$$

The variance expression of  $\hat{y}_{iR}$  using the theory of ratio-type method of estimation is given by

$$\begin{aligned} V(\hat{y}_{iR}) &= D_i^2 \left( \frac{1}{d_i} - \frac{1}{D_i} \right) (S_{y_i}^2 + R_i^2 S_{x_i}^2 - 2R_i S_{y_{xi}}) + \\ &\frac{D_i}{d_i} \sum_{j=1}^{D_i} V_{ij}^2 \left( \frac{1}{v_{ij}} - \frac{1}{V_{ij}} \right) (S_{y_{ij}}^2 + R_i^2 S_{x_{ij}}^2 - 2R_i S_{y_{xij}}) \\ &= D_i^2 \left( \frac{1}{d_i} - \frac{1}{D_i} \right) M_i^2 + \frac{D_i}{d_i} \sum_{j=1}^{D_i} V_{ij}^2 \left( \frac{1}{v_{ij}} - \frac{1}{V_{ij}} \right) M_{ij}^2 \dots (3.4) \end{aligned}$$

where

$$M_i^2 = S_{y_i}^2 + R_i^2 S_{x_i}^2 - 2R_i S_{y_{xi}} = \frac{1}{(D_i - 1)} \sum_{j=1}^{D_i} (y_{ij} - R_i x_{ij})^2 \dots (3.5)$$

and

$$M_{ij}^2 = S_{y_{ij}}^2 + R_i^2 S_{x_{ij}}^2 - 2R_i S_{y_{xij}} = \frac{1}{V_{ij} - 1} \sum_{k=1}^{V_{ij}} (y_{ijk} - R_i x_{ijk})^2 \dots (3.6)$$

where  $S_{y_i}^2$  and  $S_{y_{ij}}^2$  are as defined in expressions (1.3) and (1.4), while  $S_{x_i}^2$ ,  $S_{y_{xi}}$ ,  $S_{x_{ij}}^2$  and  $S_{y_{xij}}$  are defined as

$$S_{x_i}^2 = \frac{1}{(D_i - 1)} \sum_{j=1}^{D_i} \left[ x_{ij} - \left( \sum_{j=1}^{D_i} x_{ij} \right) / D_i \right]^2 \quad \dots (3.7)$$

$$S_{y_{xi}} = \frac{1}{(D_i - 1)} \sum_{j=1}^{D_i} \left[ y_{ij} - \left( \sum_{j=1}^{D_i} y_{ij} \right) / D_i \right] \left[ x_{ij} - \left( \sum_{j=1}^{D_i} x_{ij} \right) / D_i \right] \dots (3.8)$$

$$S_{x_{ij}}^2 = \frac{1}{(V_{ij} - 1)} \sum_{k=1}^{V_{ij}} \left[ x_{ijk} - \left( \sum_{k=1}^{V_{ij}} x_{ijk} \right) / V_{ij} \right]^2 \quad \text{and} \dots (3.9)$$

$$S_{y_{xij}} = \frac{1}{(V_{ij} - 1)} \sum_{k=1}^{V_{ij}} \left[ y_{ijk} - \left( \sum_{k=1}^{V_{ij}} y_{ijk} \right) / V_{ij} \right] \left[ x_{ijk} - \left( \sum_{k=1}^{V_{ij}} x_{ijk} \right) / V_{ij} \right] \quad \dots (3.10)$$

An approximate expression for the estimator of the variance of  $\hat{y}_{iR}$  is given by

$$\hat{V}(\hat{y}_{iR}) = D_i^2 \left( \frac{1}{d_i} - \frac{1}{D_i} \right) \hat{M}_i^2 + \frac{D_i}{d_i} \sum_j V_{ij}^2 \left( \frac{1}{v_{ij}} - \frac{1}{V_{ij}} \right) \hat{M}_{ij}^2 \dots (3.11)$$

where  $\hat{M}_i^2 = s_{y_i}^2 + \hat{R}_i^2 s_{x_i}^2 - 2\hat{R}_i s_{y_{xi}}$  and

$$\hat{M}_{ij}^2 = s_{y_{ij}}^2 + \hat{R}_i^2 s_{x_{ij}}^2 - 2\hat{R}_i s_{y_{xij}}$$

Here  $s_{y_i}^2$  and  $s_{y_{ij}}^2$  are as defined in expressions (1.6) and (1.7) while  $s_{x_i}^2$ ,  $s_{y_{xi}}$ ,  $s_{x_{ij}}^2$  and  $s_{y_{xij}}$  are defined as

$$s_{x_i}^2 = \frac{1}{(d_i - 1)} \sum_j \left[ \hat{x}_{ij} - \left( \sum_j \hat{x}_{ij} \right) / d_i \right]^2 \quad \dots (3.12)$$

$$s_{y_{xi}} = \frac{1}{(d_i - 1)} \sum_j \left[ \hat{y}_{ij} - \left( \sum_j \hat{y}_{ij} \right) / d_i \right] \left[ \hat{x}_{ij} - \left( \sum_j \hat{x}_{ij} \right) / d_i \right] \dots (3.13)$$

$$s_{x_{ij}}^2 = \frac{1}{(v_{ij} - 1)} \sum_k \left[ \hat{x}_{ijk} - \left( \sum_k \hat{x}_{ijk} \right) / v_{ij} \right]^2 \quad \text{and} \dots (3.14)$$

$$s_{y_{xij}} = \frac{1}{(v_{ij} - 1)} \sum_k \left[ \hat{y}_{ijk} - \left( \sum_k \hat{y}_{ijk} \right) / v_{ij} \right] \left[ \hat{x}_{ijk} - \left( \sum_k \hat{x}_{ijk} \right) / v_{ij} \right] \quad \dots (3.15)$$

**ESTIMATOR-IV:** In case the information on total

net area sown is available only for the selected cultivators and for the district, i.e. no information on total net area sown for the selected villages and for the different strata is available, an estimator of the total number of tractors in the country,  $y$  is given by

$$\hat{y}_{RC} = \left[ \left( \sum_{i=1}^L \frac{V_i}{v_i} \sum_j \frac{v_i}{j} \frac{N_{ij}}{n_{ij}} \sum_k \frac{n_{ij}}{k} y_{ijk} \right) / \left( \sum_{i=1}^L \frac{V_i}{v_i} \sum_j \frac{v_i}{j} \frac{N_{ij}}{n_{ij}} \sum_k \frac{n_{ij}}{k} x_{ijk} \right) \right] x$$

$$= \frac{\hat{y}}{\hat{x}} x$$

$$= \hat{R} x \quad \dots (4.1)$$

Again  $\hat{y}_{RC}$ , being a combined ratio-type estimator is also biased. An estimator for the bias in  $\hat{y}_{RC}$  is given by

$$\hat{Bias}(\hat{y}_{RC}) = \frac{1}{x} \sum_{i=1}^L \left[ V_i^2 \left( \frac{1}{v_i} - \frac{1}{V_i} \right) (\hat{R} s_{xi}^2 - s_{yxi}) \right. \\ \left. + \frac{V_i}{v_i} \sum_j \frac{v_i}{j} N_{ij}^2 \left( \frac{1}{n_{ij}} - \frac{1}{N_{ij}} \right) (\hat{R} s_{xij}^2 - s_{yxij}) \right] \dots (4.2)$$

An approximate expression for the variance of  $\hat{y}_{RC}$  is given by

$$V(\hat{y}_{RC}) = \sum_{i=1}^L V_i^2 \left( \frac{1}{v_i} - \frac{1}{V_i} \right) (S_{yi}^2 + R^2 S_{xi}^2 - 2R S_{yxi}) \\ + \sum_{i=1}^L \frac{V_i}{v_i} \sum_j \frac{v_i}{j} N_{ij}^2 \left( \frac{1}{n_{ij}} - \frac{1}{N_{ij}} \right) (S_{yij}^2 + R^2 S_{xij}^2 - 2R S_{yxij}) \dots (4.3)$$

where  $S_{yi}^2, S_{xi}^2, S_{yxi}, S_{yij}^2, S_{xij}^2$  and  $S_{yxij}$  are as defined earlier.

An approximate expression for the estimator of the variance of  $\hat{y}_{RC}$  is given by

$$\hat{V}(\hat{y}_{RC}) = \sum_{i=1}^L V_i^2 \left( \frac{1}{v_i} - \frac{1}{V_i} \right) (s_{yi}^2 + \hat{R}^2 s_{xi}^2 - 2\hat{R} s_{yxi}) \\ + \sum_{i=1}^L \frac{V_i}{v_i} \sum_j \frac{v_i}{j} N_{ij}^2 \left( \frac{1}{n_{ij}} - \frac{1}{N_{ij}} \right) (s_{yij}^2 + \hat{R}^2 s_{xij}^2 - 2\hat{R} s_{yxij}) \quad (4.4)$$

where  $s_{yi}^2, s_{xi}^2, s_{yxi}, s_{yij}^2, s_{xij}^2$  and  $s_{yxij}$  are as defined earlier.

### 3.3.2.7.9 Summary of the Survey Results for Different States

#### ANDHRA PRADESH

Agro Climatic Zone-X : Southern Plateau and Hills Region

### General information

There were 23 districts in the State out of which 5 districts, viz. Nalgonda, Kurnool, Rangareddy, Warrangal and Medak were randomly selected for this survey based on the mechanization index. Andhra Pradesh was surplus in food grains. It produced 10 million tonnes of rice. Agricultural sector accounts for about 50% of the State's income and provide livelihood for 62% of the population. The crops extensively cultivated in the State were Paddy, Groundnut, Cotton, Castor and Sugarcane. Andhra Pradesh leads all other States in the production of Tobacco. The survey results show that the villages in the State were widely scattered. Only 21% villages were located at a distance up to 5 km from block head quarter. Over the State, 52% of the villages were connected by metal road and 32% villages were at a distance greater than 2 km from metal road. Most of the villages had Bus/Taxi/Tempo/Jeep as main mode of transport from village to block head quarter. The basic amenities like Drinking water, Electricity and School were available in more than 90% villages. Telephone and Post Office facilities were available in 69% and 59% of villages respectively. The basic amenities like Co-operative Society, Co-operative Credit Society, Commercial Bank, TV/Radio/Newspaper, Rice Mills and Input Supply Agency were available between 10% to 35% villages. The provision of subsidy/loan for agricultural purposes was quite satisfactory. Loan from Banks/Co-operative Society was available in 83% villages, while subsidy for agriculture inputs was available in 74% villages of the State. Water table of the State was not satisfactory. Only 5% villages had water up to 10 metres and 13% villages had it between 10–20 metres and rest more than 20 metres.

### Cropping pattern

The major crops grown in the State in *kharif* season were Paddy, Cotton and Ground nut and in *rabi* season the major crops were Paddy, Sunflower and Black Gram. Sugarcane and Tobacco were the other main crops of the State.

### Percentage area irrigated and cropping intensity

The overall per cent area irrigated in the State under category of cultivators not having tractors (NHT) was 38% and under category of cultivators having tractors (HT), it was 49%. The overall Cropping Intensity under NHT category of cultivators was 133% while under HT category of cultivators, it was 145%.

### Socio economic conditions of the farmers

Based on the socio-economic parameters, it was found

that 30% cultivators were under Low income class, 61% cultivators were under Low middle class and 9% were under High middle class.

### Land holding pattern

Majority of the farmers, i.e. about 67% had land holding upto 2 ha, 19% farmers had 2–4 ha and only 10% farmers had above 4 ha land holding under NHT category of cultivators while about 1.3% farmers had land each in holding size upto 2 ha and above 4 ha and 0.7% farmers had land holding of 2–4 ha under HT category of cultivators.

### Farm Machinery/Equipment/Implements used

The implements like Cultivator, *Desi* Plough, Disc Harrow, Disc Plough, Groundnut Digger, Hand Hoe, Leveller, M.B. Plough, Puddler, Rotavator, Seed Drill, Sickle, Sprayer, Tractor Mounted Reaper, Weeder, Winnowing, Soil Turning Plough etc. were mainly used by the farmers of the State for various agricultural operations.

Details of different farm machinery and equipment in use, gaps and future requirements according to different crops as well as operations are given in Appendix-A.

Due to lack of proper infrastructure in the State, repair and maintenance facilities of different types of machinery/equipment/implements are inadequate.

### Average rate of custom hiring of tractor with implements

To perform various agricultural operations, the custom hiring rates of Tractor with various implements were Tractor (T)+Disc Plough: Rs 1,027 per ha; T+ MB Plough: Rs 1,397 per ha; T+Disc Harrow: Rs 815 per ha; T+Cultivator: Rs 932 per ha; T+Seed Drill: Rs 702 per ha; T+Thresher varied from Rs 283 to Rs 538 with an average of Rs 370 per hr; T+Trolley: Rs 197 per hr.

### Average rate of custom hiring of farm power sources

The average rates for the custom hiring of power sources, viz. Tractor, Electric Motor and Diesel Engine for Irrigation and threshing were worked out for all the selected districts and over the State. Average rate of custom hiring over the State, for Tractor used for irrigation was Rs 263 per hr and for threshing, it was Rs 265 per hr. The corresponding rates for Electric Motor ranged in between Rs 44 to 200 per hr and for Diesel Engine, it ranged in between Rs 92 to 200 per hr respectively.

### Estimated number of farm power sources per

### thousand ha of net area sown

The average number of different types of power sources per thousand ha of net area sown in the State for Tractors, Power Tillers, Electric Motors, Diesel Engines and Draught Animals were 30, 1, 431, 8 and 1,497 respectively. The Draught Animals were available in all the districts. The Power Tiller was available in Warrangal district only.

### Estimates of total number of farm power sources

On overall State basis, estimated number of Tractors, Electric Motors, Diesel Engines and Draught Animals were 1,13,663; 17,49,119; 22,622 and 58,24,793 respectively.

## ASSAM

### Agro Climatic Zone-II : Eastern Himalayan Region

### General information

There were 23 districts in the State out of which 5 districts, viz. Dhemaji, Dibrugarh, Golaghat, Jorhat and Sibsagar were randomly selected for this survey. Assam is an agricultural State. The principal food crops were Paddy, Sali, Sisal, Maize, Tea, Mustard, Cabbage, Cauliflower, Sugarcane, Jute and Potato etc. Noteworthy horticultural crops were Orange, Banana, Pineapple, Coconut, Guava, Mango etc. The State had an estimated 39.44 lakh ha gross cropped area, out of which net area sown was about 27.01 lakh ha. Assam is known for its rich forest wealth. The villages in Assam State were widely scattered. 21% villages had block head quarter at a distance up to 5 km, 27% villages between 5–10 km and rest 52% had block head quarter at a distance more than 10 km. Only 17% villages were connected by metal road, 26% villages had metal road up to a distance of 2 km and 57% villages had metal road at a distance greater than 2 km. 97% villages had Bus/Taxi/Tempo/Auto/Jeep as main mode of transport from village to block head quarter. The basic amenities like Drinking water, Electricity, T.V./Radio, School were available in most of the villages, while amenities like Co-operative Society, Co-operative Credit Society, Marketing agency, Telephone, Post office, Dispensary, Input Supply agencies and Commercial Banks were available in 47%, 30%, 26%, 39%, 51%, 36%, 18% and 12% villages respectively. The position of loan/subsidy was not satisfactory in the State. On overall basis, loan from bank was easily available in very few villages, for 33%

villages, it was available with some efforts, for 39% villages, it was available with great difficulty and for 27% villages, it was not available at all. The loan from co-operative societies was easily available in very few villages. It was available with some efforts for 28% villages, with great difficulty for 21% villages, while for 50% villages, it was not available at all. The subsidy for agriculture inputs was available in 4% villages, it was available with some efforts for 32% villages. For 25% villages, it was available with great difficulty and for 39% villages, it was not available at all. The overall position of ground water table was satisfactory in Assam. In 40% villages, water was available at a depth up to 10 metres only, in another 40% villages water was available at a depth between 10–20 metres and in rest 20% villages it was available at a depth more than 20 metres.

### **Cropping pattern**

The major crops of the State in *kharif* season were Paddy, Sali, Sisal and Maize and in *rabi* season, these were Potato, Mustard, Cabbage and Cauliflower and in *zaid* season, Paddy and Jute. Perennial crops were Tea, Betal leaves, Sugarcane and Banana.

### **Percentage area irrigated and cropping intensity**

The area under irrigation was relatively low in the State. Overall, only 16% area was irrigated. However, 32% of area owned by HT category of cultivators was irrigated as compared to only 15% in the NHT category of cultivators. The cropping intensity under HT category of cultivators was 132%, and under NHT category of cultivators, it was 140%. In Dhemaji district, the cropping intensity under HT category of cultivators was 232%, which was quite high as compared to the State average.

### **Socio-economic conditions of the farmers**

Based on socio-economic parameters, it was found that 18% cultivators fall in Low income class, 64% fall in Low middle class and 9% fall in High middle class.

### **Land holding pattern**

Majority of the farmers, i.e. about 56% had land holding upto 2 ha, 19% farmers had 2–4 ha and 24% farmers had above 4 ha land under NHT category of cultivators, while about 0.4% farmers had land each in holding size 2–4 ha and above 4 ha and 0.2% farmers had land holding upto 2 ha under HT category of cultivators.

### **Farm Machinery/Equipment/Implements used**

The implements like *Desi* Plough, Disc Plough, Leveller, Hand Hoe, Long Handle Hoe, Sickle, Rotavator, Sprayer etc. were mainly used by the cultivators of the State for various agricultural operations.

Details of different farm machinery and equipment in use, gaps and future requirements according to different crops as well as operations are given in Appendix-A.

Due to lack of proper infrastructure in the State, repair and maintenance facilities of different types of machinery/equipment/implements are inadequate.

### **Average rate of custom hiring of tractor with implements**

The average rates of custom hiring of Tractor with implements in the State were:- Tractor(T)+ Disc Plough, Rs 982 per ha; T+MB Plough, Rs 910 per ha; T+Disc Harrow, Rs 1,011 per ha; T+Cultivator, Rs 935 per ha. For T+Thresher, the average custom hiring rate was Rs 123 per hr and for T+Trolley, it was Rs 115 per hr.

### **Average rate of custom hiring of farm power sources**

Electric Motors and Diesel Engines were used for carrying out the agriculture operations of irrigation and threshing. The custom hiring rates of Electric Motor for irrigation purpose varied from Rs 80 to 153 per hr with an average of Rs 130 per hr. The average custom hiring rate of Electric Motor for threshing purposes was Rs 35 per hr. The hiring rates of Diesel Engine for irrigation purposes varied from Rs 44 to 88 per hr with an average of Rs 71 per hr. The average hiring rate of Diesel Engine for threshing purposes was Rs 40 per hr.

### **Average rate of custom hiring of implements drawn by animals**

The implements drawn by animals and used in the State for various agricultural operations were *Desi* Plough, Disc Harrow and Cultivator. Planking was not used in the State at all. The custom hiring rate of *Desi* Plough was Rs 294 per ha, Disc Harrow was Rs 180 per ha and the custom hiring rate of Cultivator was Rs 421 per ha.

### **Estimated number of farm power sources per thousand ha of net area sown**

The estimated number of Tractors per thousand ha of net area sown was 6. The estimated number of Draught Animals per thousand ha of net area sown was 1,467. Bullock was the main Draught Animal. There was no Tractor/Power Tiller in Dhemaji district. In Jorhat district, the number of Tractors per thousand ha of net area sown was 3 only. Power Tillers were also found in

19% villages of the State. On an average, the State had 18 Power Tiller per thousand ha of net area sown. Electric Motor was scarcely used in the State. Overall, only 3 Electric Motors per thousand of net area sown were available. In comparison to this, the State had 38 Diesel Engines per thousand ha of net area sown.

### **Estimate of total number of farm power sources**

In the State, the estimate of total number of Tractors was 9,541, and the estimate of total number of Power Tillers was 30,428. Similarly, the estimate of total number of Electric Motors and Diesel Engines was 5,181 and 67,021 respectively. The estimate of Draught Animals was 2,715,913.

## **BIHAR**

### **Agro Climatic Zone-IV : Middle Gangetic Plains Region**

#### **General Information**

There were 37 districts in the State out of which 6 districts viz Katihar, Lakhisarai, Madhubani, Samastipur, Siwan and Vaishali were randomly selected for this survey. Bihar is bounded by Nepal in north, Jharkhand in south, West Bengal in east and Uttar Pradesh in west. The agriculture is the main occupation in the State. The principal food grain crops were rice, wheat, maize and pulses. Main cash crops were sugarcane, oilseeds, tobacco, jute and potato. Bihar had cotton spinning mills, sugar mills, jute mills and leather industries. It was also famous for production of tussar. With the creation of Jharkhand, Bihar lost several mineral rich districts.

In Bihar State, 33% of the villages were situated at a distance up to 5 km from block head quarter and 24% villages were situated at a distance more than 10 km from the block head quarter. 43% villages were situated at a distance between 5–10 km from the block head quarter. The villages in Bihar were well connected by metalled road. 91% villages in the State had metalled road at a distance upto 5 km. Only 9% villages had metalled road at more than 5 km. 39% villages had bus/taxi/tempo/auto/jeep as main mode of transport, 25% villages had tonga/rickshaw as main mode of transport and 33% villages had more than one mode of transport. The basic amenities such as Co-operative society, Commercial Bank, Drinking water, Electricity, Telephone, Post office, TV/Radio, Dispensary and School were available in 24%, 7%, 89%, 57%, 46%, 44%, 84%, 43% and 72% of the villages respectively.

Over the State, in 84% of villages, loan/subsidy from bank was available. In 77% villages, loan/subsidy from Cooperative Society was available. For agricultural inputs, subsidy was available in 55% villages. The position of water table was not satisfactory in Bihar. Only in 23% villages of the State, water was available at a depth up to 10 metres, 31% villages had water at a depth

between 10–20 metres and 46% villages had water at a depth of more than 20 metres.

### **Cropping pattern**

The major crops grown in *kharif* season was Paddy, while during *rabi* season, the crops grown were Green Gram, Paddy, Black Gram and Chickling. No crop was grown in *zaid* season.

### **Percentage area irrigated and cropping intensity**

The percentage area irrigated under NHT category of cultivators was 34% and under HT category of cultivators, it was 59%. The cropping intensity under NHT category of cultivators was 135% and under HT category of cultivators, it was 159%.

### **Socio-economic conditions of the farmers**

Based on socio-economic parameters, 35% of cultivators fall under Low income class.

### **Land holding pattern**

Majority of the farmers, i.e. about 74% had land holding upto 2 ha, 14% farmers had 2–4 ha and only 6% farmers had above 4 ha land under NHT category of cultivators while about 2.2% farmers had land in holding size upto 2 ha, 1.7% farmers had land holding of 2–4 ha and 1.8% farmers had land holding above 4 ha under HT category of cultivators.

### **Farm Machinery/Equipment/Implements used**

Various implements like Cultivator, *Desi* Plough, Disc Plough, Hand Hoe, Leveller, Long Handle Hoe, M.B. Plough, Puddler, Scythe, Sickle, Thresher, Tractor Mounted Reaper, Winnower etc. were mainly used by the cultivators of the State for different agricultural operations.

Details of different farm machinery and equipment in use, gaps and future requirements according to different crops as well as operations are given in Appendix-A.

Due to lack of proper infrastructure in the State, repair and maintenance facilities of different types of machinery/equipment/implements are inadequate.

### **Average rate of custom hiring of tractor with implements**

The average rate of custom hiring of Tractor(T) +Disc Plough was Rs 1,389 per ha. For T + MB Plough, it was Rs 950 per ha; T+Disc Harrow, it was Rs 1,375 per ha and for T+Cultivator, it was Rs 598 per ha. The custom hiring rates in Siwan district were higher than in other selected districts.

### **Average rate of custom hiring of power sources**

The average rate of custom hiring of Tractors when used for irrigation was Rs 233 per hr and when used for threshing, it was Rs 245 per hr. The average rate of Diesel Engine when used for irrigation was Rs 53 per hr and when used for threshing, it was Rs 71 per hr. The average rate of Electric Motor when used for irrigation was Rs 28 per hr and when used for threshing, it was Rs 38 per hr.

### **Average rate of custom hiring of Implements drawn by animals**

Implements drawn by animals used for various agricultural operations were *Desi* Plough, Cultivator and Planter. The average rate of custom hiring of *Desi* Plough was Rs 671 per ha; of Cultivator, it was Rs 579 per ha. The average rate of custom hiring of Planter was Rs 170 per ha.

### **Estimated number of farm power sources per thousand ha of net area sown**

The overall number of power sources per thousand ha of net area sown in the selected districts for Tractors, Electric Motors, Diesel Engines and Draught Animals were 35, 6, 152, and 316 respectively.

### **Estimate of total number of farm power sources**

The estimates for the number of Tractors, Electric Motors, Diesel Engines and Draught Animals in the State were 1,09,375; 16,065; 5,10,156 and 10,73,163 respectively. The maximum number of Tractors were estimated in Katihar district, Electric Motors and Diesel Engines in Madhubani district and Draught Animals in Siwan district.

## **CHHATTISGARH**

### **Agro Climatic Zone-VII : Eastern Plateau and Hills region**

#### **General Information**

Chhattisgarh is a land locked State bound by the States of Andhra Pradesh, Orissa, Jharkhand, Uttar Pradesh, Madhya Pradesh and Maharashtra. There were 12 districts in the State, out of which Korba district came under random selection from among the list of selected districts under erstwhile Madhya Pradesh State.

#### **Distance of villages from Block Headquarter**

The villages in Korba district were widely scattered. The average distance of block headquarter from village, in 95% of villages, was more than 10 km, out of which 72.5% of villages were located at a distance more than 20 km.

**Distance of villages from metalled road**

Most of the villages in Korba district were not connected by metalled road. Only 12.5% of the villages were connected by metalled roads in the district, whereas, 77.5% of the villages were at a distance of up to 10 km from metalled road, out of which 52.5% of villages were located at a distance of up to 5 km from metalled road.

**Main mode of transport from village to block headquarter**

Bus/Taxi/Tempo/Jeep/Auto Rickshaw etc. were the main mode of transport used in 91.6% of villages in Korba district to travel from block headquarter to village.

**Basic amenities available in the village**

Basic amenities like Drinking water, Electricity, School etc. were reported to be good in Korba district. 97.4% of villages were reported to have Drinking water available in the village itself. Similarly, 69.4% of villages had Electricity and 97.4% of villages had School in the village itself. Other amenities like T.V./Radio/Newspaper were available within village itself in 77.1% of villages. The facility of Telephone was available within village in 43.8% of villages. Post Office within the village was available in 36.1% of villages. Medical facilities in Korba district were scarce, only 38.9% of villages had it within the village. Agricultural machinery supply agency and Workshop facilities were almost non-existent, only 6.7% and 4.5% villages respectively had it in the village itself.

**Availability of subsidy/loan for agricultural purposes**

Subsidy/loan was easily available from co-operative societies with 92.1% of villages getting it easily. Similarly, subsidy/loan from banks was also easily available in 79.5% of villages, and another 12.8% of villages had it with some effort. The position of the availability of subsidy for agricultural inputs was also very good in most of the villages being 86.8%.

**Ground Water Table**

The overall position of ground water table was satisfactory in Korba district. In 54.1% of villages of Korba district, water was available at a depth of upto 10 metres only. It was available at a depth of upto 20 metres in 64.9% of villages, at a depth of upto 40 metres in 83.8% of villages.

**Land holding pattern**

Majority of the cultivators, i.e. about 61% had land holdings upto 2 ha, 22% cultivators had 2–4 ha and only

16% cultivators had above 4 ha land holdings under NHT category of cultivators, while about 0.1% cultivators had land each in holding size upto 2 ha, 2–4 ha and 0.3% cultivators had land holding above 4 ha under HT category of cultivators.

**Socio-economic conditions of the farmers**

In Korba district, 32.5% of households fall in Low income class and 53.2% of households fall in Low middle class. Only 13.3% of households fall in High middle class category.

**Farm Machinery/Equipment/Implements used**

Desi Plough, M.B. Plough, Disc Harrow, Seed Drill, Planter, Cultivator, Sickle, Hand Hoe, Tractor Mounted Reaper, Thresher etc. were being used for various agricultural operations in the selected districts of the State.

Due to lack of proper infrastructure in the State, repair and maintenance facilities of different types of machinery/equipment/implements are inadequate.

**Average rate of custom hiring**

Average rate of custom hiring of Tractor with various implements such as Disc Plough, Disc Harrow and Seed Drill etc. was about Rs 250 per ha. In case of Tractor+Cultivator, it was Rs 363 per ha. Custom hiring rates of Tractor+Harvester and Tractor+Thresher were Rs 264 and Rs 250 per ha respectively. Average rate for custom hiring of Tractor used for irrigation was Rs 250 per ha and for threshing, it was Rs 217 per ha. The rate for irrigation by Electric Motor was Rs 76 per ha and by Diesel Engine, it was Rs 66 per ha. Custom hiring rates of animal drawn implements was Rs 30 per ha in case of Seed Drill, Rs 77 per ha in case of *Desi* Plough, Rs 91 per ha in case of Bakhar, Rs 125 per ha in case of Soil Turning Plough and Rs 160 per ha in case of Cultivator.

**Major crops grown**

Major crops grown in the Korba district in *kharif* season were Maize, Arhar, Paddy, Black gram etc. In *rabi* season, the major crops were Wheat, Bengal gram etc.

**Area under irrigation and cropping intensity**

The area under irrigation was very low in the Korba district. About 10.3% of the area was irrigated. 14.7% of the area held by HT category of cultivators was irrigated as compared to 10.2% held by NHT category of cultivators.

Cropping intensity for the district was low at 111%.

Cropping intensity of the HT category of cultivators was 123% and for NHT category of cultivators, it was 110%.

### **Estimated number of farm power sources per thousand ha of net area sown**

The estimated number of Tractors per thousand ha of net area sown was 2 only. Power Tillers were almost non-existent in Korba district. The overall figures for Electric Motors and Diesel Engines were also very low being 8 Electric Motors per thousand ha of net area sown and 7 Diesel Engines per thousand ha of net area sown. In comparison, it had an estimated number of 754 Draught Animals per thousand ha of net area sown.

### **Estimate of total number of farm power sources**

The estimate of total number of Tractors in the district was 325. Estimate of number of Electric Motors was 1,019 and estimate of the number of Diesel Engines was 991 for the district. The estimate of total number of Draught Animals in the district was 1,02,206.

## **GOA**

### **Agro Climatic Zone–XII : West Coast Plains and Ghat Region**

#### **General Information**

The State had 2 districts out of which North Goa district came under random selection for this survey. 13% of the selected villages were located at a distance up to 5 km from block head quarter, 30% of the villages at a distance between 5–10 km, 50% villages at a distance between 10–20 km and rest of the villages were located at a distance more than 20 km from block head quarter. 95% villages were well connected by metal road and the rest 5% villages were at a distance of 2 km. The main mode of transport of all the selected villages was Bus/Taxi/Tempo/Auto/Jeep etc.

The basic amenities like Drinking water, Electricity, Telephone, Post office, TV/Radio, Dispensary and Schools were available in almost all the selected villages, whereas, the amenities like Cooperative societies, Commercial Bank, Marketing agencies and Bakery were available in 38%, 30%, 33% and 24% villages respectively. Other basic amenities like Input Supply Agency, Agricultural machinery agency, Workshop facilities, Milk processing plant and Food processing plant were available in very few selected villages.

Loans from Bank were easily available in the selected villages; loans from Cooperative society were available

in 96% selected villages. Subsidy on Agricultural inputs was available in 97% selected villages.

### **Cropping pattern**

Paddy was the main crop in *kharif* season, Wheat and Groundnut were main crops in *rabi* season. Cashew nut, Coconut, Malta, Banana and Mango were the other crops grown in the selected villages of the district.

### **Percentage area irrigated and cropping intensity**

Area irrigated had not been reported for NHT category of cultivators, whereas, it was 10% for the HT category of cultivator. Cropping intensity for NHT category of cultivators was 124% and for HT category of cultivators, it was 200%.

### **Socio-economic conditions of the farmers**

Based on socio-economic parameters, it was observed that 24% cultivators falls in Low income class, 72% in Low middle class and only 4% in High middle class.

### **Land holding pattern**

Majority of the cultivators, i.e. about 84% had land holding upto 2 ha, 11% cultivators had 2–4 ha and only 5% cultivators had above 4 ha land holding under NHT category of cultivators. Only 0.2% cultivators had land holding above 4 ha under HT category of cultivators.

### **Farm Machinery/Equipment/Implements used**

The implements drawn by power sources were not observed in use in the State. However, the implements drawn by animals like *Desi* Plough, Disc Harrow, Disc Plough, M.B. Plough, Cultivator, Bakhar, Seed Drill, Planter, Hand Hoe, Wheel Hoe, Cane Crusher etc. were mainly used by the cultivators of the State for various agricultural operations.

Due to lack of proper infrastructure in the State, repair and maintenance facilities of different types of machinery/equipment/implements are inadequate.

### **Average rate of custom hiring of Tractor with implements**

Custom hiring of Tractors was not reported in any of the selected villages.

### **Average rate of custom hiring of farm power sources**

Custom hiring of any power source was not reported in the district.

### **Average rate of custom hiring of implements drawn by animals**

The rates of custom hiring of implements drawn by

animals vary from Rs 236 per day for Seed Drill to Rs 250 per day for Cane Crusher. The rates for *Desi* Plough, Disc Harrow, Cultivator, Bakhar and Planter were reported as Rs 245, Rs 246, Rs 243, Rs 242 and Rs 245 per day respectively.

#### **Estimated number of farm power sources per thousand ha of net area sown**

Estimated number of Draught Animals in the selected villages of the district were 105 per thousand ha of net area sown. The number of Tractors and Electric Motors per thousand ha of net area sown were negligible.

#### **Estimate of total number of farm power sources**

The estimate of the number of Tractors, Electric Motors and Draught Animals were 13, 6 and 825 respectively.

## **GUJARAT**

### **Agro Climatic Zone–XIII : Gujarat Plains and Hills Region**

#### **General Information**

There were 25 districts in the State out of which 5 districts, viz. Ahmedabad, Banaskantha, Rajkot, Vadodara and Valsad had been randomly selected for this study on the basis of farm mechanization index. More than 70% selected villages were reported to be on the metal road in Ahmedabad, Vadodra and Valsad districts, while 42% and 25% selected villages were reported to be on the metal road in Banaskantha and Rajkot districts respectively. The main mode of transport in all the five selected districts were reported as Bus/Taxi/Tonga/Auto/Jeep. In Ahmedabad and Rajkot districts, Tractor trolley and Rickshaw were also used as a mode of transport.

The basic amenities like Electricity, School, Drinking water and TV/Radio/Newspaper were available in almost all the selected villages of the selected districts. Very few selected villages had amenities viz. Agricultural machinery/Workshop facility/Commercial Bank/Marketing agency.

Over all the selected districts, loan from Banks was available in 53% selected villages and loan from Co-operative Societies was available in 64% selected villages. Subsidy for agricultural inputs was available in 57% selected villages.

#### **Cropping pattern**

In all the selected districts, the main crops grown in *kharif* season were Great Millet, Bajra, Maize, Paddy, Groundnut and in *rabi* season these were Cotton, Wheat, Mustard, Cumin and Vegetables. Sugarcane was also

grown.

#### **Percentage area irrigated and cropping intensity**

In all the selected districts, 50% area under NHT category of cultivators and 74% area under HT category of cultivators was irrigated. The cropping intensity was almost of the same order for all the selected districts. The overall cropping intensity under NHT category of cultivators was 134% and under HT category of cultivators, it was 143%.

#### **Socio-economic conditions of the farmers**

Based on socio-economic parameters, it was observed that 20% of cultivators belong to Low income class, 56% to Low middle class and 22% to High middle class.

#### **Land holding pattern**

Under NHT category of cultivators, about 51% of cultivators had land holding upto 2 ha, 24% cultivators had 2–4 ha and only 16% cultivators had land holding above 4 ha. Under HT category of cultivators, 1.5% cultivators had land in holding size upto 2 ha, 2.4% cultivators had land holding of 2–4 ha and 4.9% cultivators had land holding above 4 ha.

#### **Farm Machinery/Equipment/Implements used**

The implements like Disc Plough, *Desi* Plough, Cultivator, Leveller, Puddler, Seed Drill, Hand Hoe, Weeder, Sickle, Thresher, Winnower, Bund Maker, Groundnut Digger, Dibbler, Scythe, Bakhar etc. were mainly used by the cultivators of the State for various agricultural operations.

#### **Average rate of custom hiring of tractor with implements**

The average rate of custom hiring of Tractor with Disc Plough and Cultivator was Rs 942 per ha and Rs 507 per ha respectively. The average rate of custom hiring for Combine, Harvester and Thresher was Rs 388 per hr, Rs 316 per hr and Rs 270 per hr respectively in all the selected districts.

#### **Average rate of custom hiring of farm power sources**

The average rates of custom hiring of Electric Motor and Diesel Engine for irrigation purpose varies in between Rs 31 to Rs 60 per hr in all the selected districts.

#### **Average rate of custom hiring of implements drawn by animals**

The average rates of custom hiring of *Desi* Plough/ Disc Harrow/Cultivator drawn by animals were in

between Rs 200 to Rs 483 per day in all the selected districts.

### Estimated number of farm power sources per thousand ha of net area sown

The estimated number of Tractors per thousand ha of net area sown was 29. The estimated number of Draught Animals per thousand ha of net area sown was 396. On an average, the State had 104 Electric Motors per thousand ha of net area sown. Power Tillers were scarcely used in the State (only 2 Power Tillers per thousand of net area sown were available). In contrast, State had an estimated 50 Diesel Engines per thousand ha of net area sown.

### Estimate of total number of farm power sources

The estimates of the number of Tractors, Power Tillers, Electric Motors, Diesel Engines and Draught Animals were 2,60,757; 18,240; 11,10,241; 3,84,450 and 44,20,146 respectively in the State.

## HARYANA

### Agro Climatic Zone-VI : Trans Gangetic Plains Region

#### General information

There were 20 districts in the State out of which four districts, viz. Sonapat, Bhiwani, Faridabad and Kaithal had been randomly selected for this study on the basis of mechanization index. Over all the selected districts, 87% selected villages were reported to be on the metal road, 10% villages within a distance of 2 km and 3% villages within a distance of 2–5 km from the metal road. Pooled over all the selected districts, 21% selected villages were within a distance of 5 km from the block head quarter, 26% selected villages were in between 5-10 km, 41% selected villages in between 10-20 km and 12% selected villages were at distance more than 20 km from the block head quarter.

The main mode of transport from block head quarter to village was Bus/Taxi/Tonga/Auto/Jeep in 98% selected villages.

The basic amenities like Drinking water was available in 90% selected villages, Electricity in 96%, Telephone in 85%, T.V./Radio/Newspaper in 96%, School in 95%, Post office in 51%, Dispensary in 49%, Co-operative Society in 46%, Co-operative Credit Society in 27%, and Commercial Bank was available in 19% selected villages. Input Supply Agency was available in 15%

selected villages, Agricultural Machinery supply agency in 5%, Workshop facility in 8%, Marketing agency in 7% selected villages. Other basic amenities were scarcely available.

Pooled over all the selected districts, the loan facilities were reported to be available in 99% selected villages each from Bank and Co-operative Societies, while subsidy for agricultural input was available in 88% selected villages.

#### Cropping pattern

Over all the four selected districts, the main crops grown were Jowar, Bajra, Paddy and Cotton in *kharif* season and Wheat, Barley, Mustard, Barseem in *rabi* season. Sugarcane was the other crop grown.

#### Percentage area irrigated and cropping intensity

Over all the selected districts, for NHT category of cultivators, area irrigated and cropping intensity were 85% and 189% while that for HT category of cultivators, these figures were 93% and 189% respectively.

#### Socio-economic conditions of the farmers

Based on socio-economic parameters, over all the selected districts, it was observed that 11% of cultivators fall in Low income class, 66% in Low middle class and 22% in High middle class. Only 1% cultivators fall in Rich category.

#### Land holding pattern

Of all the cultivators, about 49% had land holding size upto 2 ha, 21% cultivators had 2–4 ha and only 8% cultivators had above 4 ha land under NHT category of cultivators while about 5.4% cultivators had land holding size upto 2 ha, 7.2% cultivators had land holding of 2–4 ha and 8.9% cultivators had land holding above 4 ha under HT category of cultivators.

#### Farm Machinery/Equipment/Implements used

The implements like Bakhar, Bund Maker, Cultivator, *Desi* Plough, Disc Harrow, Disc Plough, Groundnut Digger, Hand Hoe, Leveller, Long Handle Hoe, Puddler, Rotavator, Scythe, Seed Drill, Sickle, Sowing (manual metering), Sprayer, Combine, Thresher, Tractor Mounted Reaper, Weeder, Wheel Hoe etc. were mainly used by the cultivators of the State for various agricultural operations.

#### Average rate of custom hiring of tractor with implements

Pooled over all the selected districts, the average rate

of custom hiring for Tractor(T)+Disc Plough, T+Cultivator and Combine, T+Harvester and T+Thresher was Rs 430, Rs 421 per ha, Rs 949, Rs 745 and Rs 612 per hr respectively.

#### **Average rate of custom hiring of farm power sources**

Over all the selected districts, the average rates of custom hiring for Tractor, Electric Motor and Diesel Engine for irrigation purpose were Rs 214, Rs 103 and Rs 104 per hr respectively and for threshing purpose, these rates were Rs 350, 311 and 162 per hr respectively.

#### **Average rate of custom hiring of implements drawn by animals**

Over all the selected districts, the average rate of custom hiring per ha for implements drawn by animals were, for *Desi* Plough-Rs 435; for Disc Harrow-Rs 385; for Cultivator-Rs 391; for Seed Drill-Rs 451; for Bakhra-Rs 242; for Soil Turning Plough-Rs 332; and for Planking-Rs 204.

#### **Estimated number of farm power sources per thousand ha of net area sown**

Pooled over the selected districts, estimated number of Tractors, Power Tillers, Electric Motors, Diesel Engines and Draught Animals per 1,000 ha of net area sown were 87, 2, 147, 173 and 167 respectively. The number of power sources per 1,000 ha of net area sown in the selected villages of Sonipat, Bhiwani, Faridabad and Kaithal districts were: Tractor 125, 50, 143 and 77; Electric Motor 112, 112, 212 and 192; Diesel Engine 265, 85, 15 and 223; Draught Animals 252, 68, 69 and 275 respectively.

#### **Estimate of total number of farm power sources**

Over all the selected districts, the estimate of the number of Tractors, Power Tillers, Electric Motors, Diesel Engines and Draught Animals were 2,23,638; 4,694; 3,76,278; 4,22,466 and 3,89,621 respectively.

## **HIMACHAL PRADESH**

**Agro Climatic Zone-I : Western Himalayan Region**

#### **General information**

There were 12 districts in the State, out of which 2 districts namely Kangra and Una had been randomly selected for this study. Overall, 18% of the selected villages were at a distance up to 5 km, 24% villages in between 5–10 km, 42% villages in between 10–20 km and 16% villages at a distance more than 20 km from the

respective block head quarter. The results show that 49% and 22% villages were reported to be on the metal road for Kangra and Una district respectively. All the selected villages in Kangra district and 90% villages in Una district were within 5 km distance from metal road. In both the districts, the main mode of transport was Bus/Taxi/Tempo/Auto/Jeep.

Basic amenities like Drinking water, Electricity, Telephone, TV/Radio/Newspaper were available in more than 90% of the selected villages of both the districts, Schools were available in 76% villages, Post Office and Dispensary were available in 51% villages and Co-operative societies were available in 39% villages. Basic amenities like Workshop, Agricultural Machinery Supply agency, Marketing agency and Commercial Bank were scarcely available in the selected villages of both the districts.

Loan facilities from bank, co-operative societies and subsidy for agricultural inputs were available in more than 90% selected villages.

#### **Cropping pattern**

Major crops grown in the selected villages of Kangra district were Maize, Paddy, Black gram and Til in *kharif* season and Wheat and Mustard in *rabi* season. In Una district, main crops in *kharif* season were Maize, Til, Paddy and Black gram while in *rabi* season, main crops were Wheat, Rai, Bengal gram and Colicosa. In *zaid season*, Potato and Turmeric were grown.

#### **Percentage area irrigated and cropping intensity**

The results show that 100% area in Kangra and 64% area in Una district was irrigated in HT category of cultivators while for NHT category of cultivators, the area irrigated was 47% in Kangra and 32% in Una district. Cropping intensity for both of the districts was around 200%.

#### **Socio-economic conditions of the farmers**

Based on socio-economic parameters, it was observed that 11% cultivators fall in Low income class, 66% in Low middle class and 22% in High middle class.

#### **Land holding pattern**

Majority of the cultivators, i.e. about 95% had land holding upto 2 ha and 2% cultivators had 2–4 ha land under NHT category of cultivators while about 1.4% cultivators had land holding size upto 2 ha and 1.2% cultivators had land holding of 2–4 ha under HT category of cultivators.

#### **Farm Machinery/Equipment/Implements used**

The implements like Cultivator, *Desi* Plough, Disc Harrow, Hand Hoe, Leveller, Long Handle Hoe, Puddler, Scythe, Seed Drill, Sickle, Sowing (manual metering), Sprayer, Thresher, Wheel Hoe etc. were mainly used by the cultivators of the State for various agricultural operations.

Details of different improved implements suggested for introduction in the State are given in Appendix-A.

Due to lack of proper infrastructure in the State, repair and maintenance facilities of different types of machinery/equipment/implements are inadequate.

#### **Average rate of custom hiring of tractor with implements**

Average custom hiring rate for Tractor with Disc Plough was Rs 1,200 per ha, Tractor with M.B. Plough was Rs 1,563 per ha and Tractor with Trolley was Rs 238 per hr in Kangra district, whereas, in Una district, the average rate of custom hiring was Rs 750 per ha for Tractor with Disc Plough, Rs 909 per ha for Tractor with Disc Harrow, Rs 611 per ha for Tractor with Cultivator, Rs 717 per ha for Tractor with Seed Drill and Rs 140 per hr for Tractor with Trolley.

#### **Average rate of custom hiring of farm power sources**

Overall, average rates of custom hiring of Tractor for irrigation and threshing purposes were Rs 200, Rs 286 per hr respectively. For Electric Motor, these were Rs 140 and Rs 241 per hr respectively while for Diesel Engine, these were Rs 133 and Rs 196 per hr respectively.

#### **Average rate of custom hiring of implements drawn by animals**

Average rate of custom hiring per ha for *Desi* Plough and Disc Harrow were Rs 136 and Rs 1,400 respectively in Kangra district, whereas, in Una district, the rates of custom hiring per ha for Disc Harrow was Rs 938, for Cultivator it was Rs 813 and for Seed Drill it was Rs 875.

#### **Estimated number of farm power sources per thousand ha of net area sown**

In Kangra district, estimated number of Tractors, Electric Motors, Diesel Engines and Draught Animals per thousand ha of net area sown were 15, 2, 8 and 2,275 respectively, whereas, in Una district, these were 48, 342, 80, and 1,207 respectively. The number of Power Tillers per thousand ha of net area sown was negligible in both the selected districts.

#### **Estimate of total number of farm power sources**

Overall, the estimates of the number of Tractors, Power Tillers, Electric Motors, Diesel Engine and Draught Animals were 14,076; 178; 67,827; 18,068 and 9,30,659 respectively in the State.

## **JAMMU and KASHMIR**

### **Agro Climatic Zone-I : Western Himalayan Region**

#### **General Information**

There were 14 districts in Jammu & Kashmir State, out of which 3 districts namely Jammu, Kathua and Udhampur had been randomly selected for the survey. The results show that 90% villages of both Jammu and Kathua districts and 35% villages of Udhampur district were well connected with the metal road. Most of the selected villages of the State had Bus/Taxi/Tempo/Jeep/Auto as the main mode of transport from the village to block head quarter.

The basic amenities like Drinking Water, Electricity, Telephone, Television/Radio/News Paper and Schools were available in all the selected villages, while facilities like, Co-operative Societies, Input Supply Agency, Agricultural Machinery Supply Agency, Workshop Facility, Commercial Bank, Post Office, Dispensaries and Bakeries were available at a distance ranging from 5 to 20 km from the village. The facilities like Cold Storage, Dal Mill, Milk Processing Plant, Food Packaging etc. were available at a distance more than 50 km from the selected villages.

Overall, loan from Banks was easily available to the cultivators in 87% selected villages for agricultural purpose. From Co-operative societies, it was easily available in 37% selected villages only.

#### **Cropping Pattern**

Paddy, Maize, Bajra, Great Millet and Potato were the major crops grown in *kharif* season in most of the selected villages. Wheat, Mustard and Barseem were the major crops grown in *rabi* season, while Chari and Great Millet were main crops grown in *zaid* season in most of the selected villages. Sugarcane, Mango, Orange, Lemon and Apple were other major crops grown in most of the selected villages.

#### **Percentage area irrigated and Cropping Intensity**

Overall, under the NHT category of cultivators, 24% area was irrigated with maximum 62.8% in Jammu district while under HT category of cultivators, 74.9% area was irrigated with a maximum 85.2% in Jammu

district.

The cropping intensity under the NHT category of cultivators was observed as 194%, while under HT category of cultivators, it was 199%. Percentage area irrigated was very less in the selected villages of Udhampur district and cropping intensity of the district was also less as compared to the other two selected districts.

### **Socio-economic conditions of the farmers**

Based on socio-economic parameters, over all the selected districts, it was observed that 20% cultivators belong to Low income class, 70% cultivators fall under Low middle class, while only 10% cultivators belong to High middle class.

### **Land holding pattern**

Majority of the cultivators, i.e. about 89% had land holding up to 2 ha, 7% cultivators had 2–4 ha and only 2% cultivators had land holding above 4 ha under NHT category of cultivators, while about 0.8% cultivators had land holding size up to 2 ha, 0.7% cultivators had land holding of 2–4 ha and 0.2% cultivators had land holding above 4 ha under HT category of cultivators.

### **Farm Machinery/Equipment/Implements used**

The implements like Cultivator, *Desi* Plough, Disc Harrow, Disc Plough, Hand Hoe, Leveller, Long Handle Hoe, M.B. Plough, Maize Sheller, Olpad Thresher, Pedal Operated Rice Thresher, Puddler, Scythe, Sickle, Sprayer, Thresher, Weeder, Wheel Hoe, Soil Turning Plough were used by the cultivators.

Details of different improved implements suggested for introduction in the State are given in Appendix-A.

Due to lack of proper infrastructure in the State, repair and maintenance facilities of different types of machinery/equipment/implements are inadequate.

### **Average rate of custom hiring of tractor with implements**

Average rate of custom hiring of Tactor with Disc Plough was Rs 550 per ha, while these were Rs 624 per ha, Rs 734 per ha and Rs 632 per ha for Tractor with MB Plough, Disc Harrow, and Cultivator respectively. The average rates for custom hiring of Tractor with Harvester, Thresher and Trolley were Rs 100 per hr, Rs 289 per hr and Rs 253 per hr respectively.

### **Average rate of custom hiring of farm power sources**

Over all the selected districts, the custom hiring rates of Tractor, Electric Motor and Diesel Engine for

irrigation purpose were Rs 98 per hr, Rs 49 per hr and Rs 40 per hr respectively, while custom hiring rates of these power sources for threshing purpose were Rs 280 per hr by Tractor, Rs 314 per hr by Electric Motor and Rs 133 per hr by Diesel Engine.

### **Average rate of custom hiring of implements drawn by animals**

Practice of using traditional type of agricultural implements drawn by animals was observed in most of the selected villages. Over all the selected districts, custom hiring rates of *Desi* Plough, Disc Harrow, Cultivator, Seed Drill, Sowing (manual meter), Cane Crusher and Trolley, all drawn by animals, were Rs 962 per ha, Rs 1,066 per ha, Rs 956 per ha, Rs 1,000 per ha, Rs 1,500 per ha, Rs 833 per ha, and Rs 930 per ha respectively.

### **Estimated number of farm power sources per thousand ha of net area sown**

The number of Tractors, Electric Motors, Diesel Engines and Draught Animals per thousand ha of net area sown was estimated as 17, 47, 5 and 1,182 respectively. Among the three selected districts, estimated number of Tractors, Electric Motors and Diesel Engines were highest in the Jammu district while the estimated number of Draught Animals were comparatively less.

### **Estimate of total number of farm power sources**

Over the State, the estimate of the number of Tractors, Electric Motors, Diesel Engines and Draught Animals in J&K State was 24,408; 75,092; 8,271 and 12,08,157 respectively.

## **JHARKHAND**

### **Agro Climatic Zone-VII : Eastern Plateau and Hills Region**

#### **General Information**

There were 18 districts in the State out of which 5 districts viz. Deogarh, Dhanbad, Dumka, Ranchi and Gumla came under random selection from among the list of selected districts under earstwhile Bihar State. Jharkhand is bounded by Bihar on the north, West Bengal on the east, Madhya Pradesh on the west and Orissa on the south. Jharkhand accounts for 45% of former Bihar's geographical area. 28% population of this area are tribal. Agriculture is poorly developed. Irrigation is negligible. Drought is a periodic phenomenon. Jharkhand is rich in minerals having big reserves of iron ore, coal etc.

Several important industries are located in Jharkhand. Ranchi is the Capital of Jharkhand State.

The villages in the State were widely scattered. Overall, the average distance of the village from block head quarter was more than 10 km in 54% villages and 26% villages were at a distance more than 15 km from block head quarter. Only 13% villages were at a distance up to 5 km from block head quarter.

70% villages were at a distance up to 5 km from metal road and 30% villages were at a distance greater than 5 km from metal road. In Dhanbad and Gumla districts, the metal road was at a distance of up to 5 km in 83% and 87% villages respectively. 83% villages had Bus/Taxi/Tempo/Auto/Jeep as main mode of transport, 12% villages had Tonga/Rickshaw as main mode of transport and rest 4% had other mode of transport. In Deoghar district, 30% villages had Tonga/Rickshaw as main mode of transport.

The basic amenity readily available in the State was Commercial Bank. The rest of the amenities such as Co-operative Society, Co-operative Credit Society, Drinking water, Electricity, Telephone, Post Office, TV/Radio, Dispensary, School, and Rice mill, were available in 45%, 6%, 34%, 20%, 21%, 78%, 27%, 64%, 43%, and 7% of the villages respectively.

Overall, in 80% villages, loan/subsidy was available from bank. In 68% villages, loan/subsidy was available from Co-operative Society. Subsidy for agricultural inputs was available in 57% villages.

### Cropping pattern

The major crops in *kharif* season were Maize, Arhar and Paddy. In *rabi* season, the major crops were Wheat, Potato, Tomato and Mustard. Onion and Brinjal were the crops grown in *Zaid* season,.

### Percentage area irrigated and cropping intensity

The per cent area irrigated and net area sown was very low in the State. The percentage area irrigated under NHT category of cultivators was 4% and under HT category of cultivators, it was 6%. The cropping intensity was 106% under NHT category of cultivators and 113% under HT category of cultivators.

### Socio-economic conditions of the farmers

Based on the socio-economic parameters, overall, it was found that 52% of cultivators fall in Low income class, 42% in Low middle class and 6% in High middle class.

### Land holding pattern

Majority of the cultivators, i.e. about 82% had land holding upto 2 ha, 13% cultivators had 2–4 ha and only 4.7% cultivators had above 4 ha land under NHT category of cultivators, while only 0.3% cultivators had land holding above 4 ha under HT category of cultivators.

### Farm Machinery/Equipment/Implements used

The implements like Cultivator, *Desi* Plough, Disc Plough, Hand Hoe, Leveller, Long Handle Hoe, M.B. Plough, Puddler, Sickle, Wheel Hoe etc. were used by the cultivators of the State.

Details of different farm tools and equipment in use, requiring improvement, and to be developed for future according to different crops as well as operations are given in the Appendix-A.

Due to lack of proper infrastructure in the State, repair and maintenance facilities of different types of machinery/equipment/implements are inadequate.

### Average rate of custom hiring of tractor with implements

The average rate of custom hiring of Tractor+Disc Plough was Rs 500 per ha, Tractor+MB Plough was Rs 200 per ha and Tractor+Cultivator was Rs 600 per ha.

### Average rate of custom hiring of farm power sources

The average rate of custom hiring of Tractor when used for irrigation purpose was Rs 50 per hr and when used for threshing purpose, was Rs 173 per hr. The average rate of custom hiring for Diesel Engine, used for irrigation purpose, was Rs 89 per hr.

### Average rate of custom hiring of Implements drawn by animals

The average rate of custom hiring of *Desi* Plough was Rs 367 per ha. For Planter, which was available in Deoghar district only, the average custom hiring rate was Rs 254 per ha .

### Estimated number of power sources per thousand ha of net area sown

The estimated number of Tractors per thousand ha of net area sown was very low. There were very few Power Tillers and Electric Motors in the State.

### Estimate of total number of farm power sources

The estimate of the total number of Tractors, Power Tillers, Diesel Engines and Draught Animals in the State was 4,434; 125; 86,720 and 34,86,337.

## KARNATAKA

Agro Climatic : Southern Plateau and

**Zones-X and XII****Hills Region  
West Coast Plains and  
Ghat Region****General information**

There were 27 districts in the State, out of which 5 districts namely Belgaum, Chitradurga, Dharwad, Gadag and Haveri had been randomly selected for this survey. Overall, 20% villages were up to a distance of 5 km from block head quarter, 27% villages at a distance between 5–10 km and 35% villages at a distance between 10–20 km and 18% villages were at a distance greater than 20 km from block head quarter. 58% selected villages in Dharwad district and 33% selected villages in Haveri district were up to a distance of 5 km from block head quarter. 45% selected villages in Haveri district were at a distance of 5–10 km and 65% selected villages in Gadag district were at a distance 10–20 km from block head quarter. Overall, 79% villages were well connected with metal road. The main mode of transport in all the selected villages from block head quarter was Bus/Taxi/Tempo/Auto/Jeep.

The basic amenities like, Drinking water, Electricity, T.V./Radio, Post office, Dispensary, School and Bakery were available in all the selected villages, while Agricultural Machinery Agency, Workshop Facility, Co-operative Credit Society, Rice Mills, Dal Mills were available in 24%, 18%, 31%, 18% and 44% selected villages respectively. Co-operative Society, Input Supply Agency, Commercial Bank were reported in 59%, 30% and 25% selected villages respectively.

Loan facilities to farmers from Banks were easily available in 62% of the villages, available with some effort in 22% of the villages, and available with difficulty in 11% of the selected villages. Similarly, loan facilities from Co-operative Society were easily available in 63% villages, available with some efforts in 21% villages, and available with difficulty in 10% of the selected villages.

**Cropping pattern**

Paddy, Maize, Jowar, Great Millet, Bajra, Green Gram, Groundnut, Sun Flower, Cotton and Soybean were the major crops grown in *khari* season in most of the selected villages of Karnataka State. Great Millet, Wheat, Maize, Cotton, Bajra, Chillies, Onion and Groundnut were the major crops grown in *rabi* season. Sugarcane was the other major crop grown in most of the selected villages.

**Percentage area irrigated and Cropping Intensity**

Overall, 9% area in the selected villages owned by

NHT category of cultivators was irrigated, while 15% area owned by HT category of cultivators was irrigated. It was 36% (maximum) in Belgaum district and 13% (minimum) in Dharwad district.

The cropping intensity varied from 123% to 195% in NHT category of cultivators and 118% to 202% in HT category of cultivators for the selected districts.

**Socio-economic conditions of the farmers**

Based on socio-economic parameters, 17% of cultivators fall under Low income class, 74% under Low middle class and 9% under High middle class.

**Land holding pattern**

Out of all the selected cultivators, about 53% had land holding upto 2 ha, 28% cultivators had 2–4 ha and 17% cultivators had land holding above 4 ha under NHT category of cultivators while about 0.3% cultivators had land each in holding size upto 2 ha and in holding size of 2–4 ha and 0.9% cultivators had land holding above 4 ha under HT category of cultivators.

**Farm Machinery/Equipment/Implements used**

The implements like Bund Maker, Cane Crusher, Cultivator, *Desi* Plough, Disc Harrow, Disc Plough, Duster, Hand Hoe, Leveller, Long Handle Hoe, M.B. Plough, Olpad Thresher, Puddler, Rotavator, Scythe, Seed Drill, Sickle, Sowing (manual metering), Sprayer, Tractor Mounted Reaper, Weeder, Wheel Hoe etc. were used by the cultivators of the State.

Details of different farm tools and equipment in use, requiring improvement, and to be developed for future according to different crops as well as operations are given in the Appendix-A.

**Average rate of custom hiring of tractor with implements**

The average rates of custom hiring of Tractor(T) with implements were: T+Disc Plough-Rs 872/ha with minimum in Haveri (Rs 500/ha) and maximum in Dharwad (Rs 1,164/ha); T+MB Plough- Rs 1,254/ha with minimum in Chitradurga (Rs 717/ha) and maximum in Haveri (Rs 1,581/ha); T+Disc Harrow-Rs 781/ha with minimum in Belgaum (Rs 565/ha) and maximum in Dharwad (Rs 826/ha); T+Seed Drill-Rs 652/ha with minimum in Haveri (Rs 542/ha) and maximum in Gadag (Rs 800/ha); T+Cultivator-Rs 734/ha with minimum in Gadag (Rs 500/ha) and maximum in Haveri (Rs 793/ha); T+Thresher-Rs 198/hr with minimum in Dharwad (Rs 121/hr) and maximum in Haveri (Rs 262/hr); T + Trolley Rs 365/hr with minimum in Gadag (Rs 300/hr)

and maximum in Chitradurg (Rs 443/hr).

#### **Average rate of custom hiring of farm power sources**

The average rates of custom hiring of Tractor for irrigation purpose varied from Rs 147/hr in Haveri to Rs 155/hr in Dharwad with an average of Rs 150/hr. The custom hiring rates of Tractor for threshing purpose varied from Rs 150/hr in Dharwad to Rs 250/hr in Haveri with an average of Rs 220/hr. The custom hiring rates of Electric Motor for irrigation purposes varied from Rs 60/hr in Chitradurga to Rs 91/hr in Haveri with an average of Rs 74/hr. The custom hiring rates of Electric Motor for threshing purpose varied from Rs 70/hr in Dharwad to Rs 178/hr in Haveri with an average of Rs 145/hr. The custom hiring rates of Diesel Engine for irrigation purpose varied from Rs 70/hr in Dharwad to Rs 93/hr in Haveri with an average of Rs 86/hr. The custom hiring rates of Diesel Engine for threshing purpose varied from Rs 70 in Dharwad to Rs 168/hr in Haveri with an average of Rs 157/hr.

#### **Average rate of custom hiring of implements drawn by animals**

The average rates of custom hiring of *Desi* Plough varied from Rs 150/ha to Rs 300/ha with an average of Rs 245/ha. The custom hiring rates of Disc Harrow varied from Rs 243/ha to Rs 300/ha with an average of Rs 268/ha. The custom hiring rates of Cultivator varied from Rs 220/ha to Rs 265/ha with an average of Rs 245/ha. The custom hiring rates of Planter varied from Rs 200/ha to Rs 240/ha with an average of Rs 227/ha. The custom hiring rates of Seed Drill varied from Rs 165/ha to Rs 400/ha with an average of Rs 274/ha. The custom hiring rate of Broadcasting was Rs 188/ha. The custom hiring rates of Bakhar varied from Rs 125/ha to Rs 230/ha with an average of Rs 155/ha. The average custom hiring rate of Trolley was Rs 250/hr.

#### **Estimated number of farm power sources per thousand ha of net area sown**

Estimated number of Tractors, Power Tillers, Electric Motors, Diesel Engines and Draught Animals per thousand ha of net area sown in the State were 15, 2, 80, 4 and 659 respectively.

#### **Estimate of total number of farm power sources**

The estimates of the number of Tractors, Power Tillers, Electric Motors, Diesel Engines and Draught Animals in the State were 30,407; 4,095; 4,56,268; 11,888 and 27,00,140 respectively.

### **KERALA**

#### **Agro Climatic Zone–XII : West Coast Plains and Hills Region**

##### **General information**

There are 17 districts in the State, out of which 4 districts, viz. Idukki, Pathanamthitta, Kollam and Alappuzha had been randomly selected for the survey. Kerala is one of the smaller State of India in terms of area. Its area is 1.3% of the total area of India. The State is divided into three natural parts, one of which is the low land of the coastal belt where lies some of its most picturesque region with extensive backwaters, lagoons, coconut trees and lush green rice fields which brings a unique distinction to Kerala. The second is coastal area of low lands lies the mid lands watered by numerous streams, where the presence of rice fields, arecanut and coconut trees continues to dominate the landscape. The third natural part of the State is the high lands of the Western ghats, eastern ramparts of Kerala. The average annual rainfall was about 240 cms, the rain in the highlands being heavier than elsewhere. Kerala accounts for a large share of marine products in India. Fish, for both local and internal consumption and for export market was produced from the abundant sea waters and back waters. But it was agriculture which gives nearly half the people their livelihood and the nation many of its rare spices which were also foreign exchange earners in a big way. The cash crops like Coconut, Rubber, Tea and Coffee, Pepper & Cardamom, Cashew nut, Arecanut, Nut mug, Ginger, Cinnamon, Cloves etc. give the agriculture of Kerala a distinct flavour. It was coconuts which bring the people their principal source of earning in agriculture. Nearly seventy per cent of India's output of coconuts is provided by Kerala. The output of food grains and edible stuff like Tapioca was also important and was being encouraged. Rice and pulses, the staple diet of the people were among the main food crops like Tapioca.

The villages in the State were widely scattered. Over all the selected districts, the average distance of block headquarter from village was more than 10 km in 36% of the villages. 37% villages were situated at a distance between 5–10 km from block head quarter, 91% villages in the State were connected by metal road, in which the two districts, viz. Pathanamthitta and Kollam were cent per cent connected by metal road. Overall, 86% villages had Bus/Taxi/Tempo/Auto, as main mode of transport. Kerala is among the developed States of India. Almost all the basic amenities such as Co-operative Society, Input Supply Agency, Commercial Bank, Drinking Water, Electricity, Telephone, Post Office, TV/Radio, School, Bakery were available in almost all the selected

villages of the districts, while Agril. Machinery Supply Agency, Workshop Facility, Co-operative Credit Society, Rice Mills, Dal Mills were available in 47%, 43%, 88%, 85% and 63% of the villages respectively. The loan was easily available from Bank in 19% villages, for 62% villages it was available with some efforts, for 17% villages it was available with great difficulty and for 2% villages it was not available at all. The loan was easily available from Co-operative Society in 49% villages, for 39% villages it was available with some efforts, for 11% villages it was available with great difficulty and for 1% villages it was not available at all. The subsidy for agricultural inputs was easily available in 47% villages, for 31% villages it was available with some efforts, for 15% villages, it was available with great difficulty and for 7% villages, it was not available at all. The provision of subsidy/loan for agricultural purposes needs to be improved as from banks, loan was easily available in only 19% of villages. The position of ground water was very satisfactory in the State. In 75% of selected villages, water was available at a depth of up to 10 metres only. The position of water table in Idukki district was not satisfactory. It was available at a depth up to 10 metres in only 22% of villages, whereas, in 70% of villages, it was available at a depth greater than 20 metres.

### **Cropping pattern**

The major crops grown in the State were Paddy, Ginger and Banana in *kharif* season, Paddy in *rabi* season and Paddy, Pea, Ginger and Tapioca in *zaid* season. The important Perennial crops grown in the selected district of the State were Coconut, Banana, Arecanut, Rubber, Tapioca and Peppermint. The other perennial crops grown in Idukki district were Cardamom and Coffee.

### **Percentage area irrigated and cropping intensity**

The area under irrigation was relatively low in the State. Overall, only 43% of the area was irrigated. 43% of the area held by NHT category of cultivators was irrigated as compared to the 32% area held by HT category of cultivators. The overall cropping intensity under NHT category of cultivators was 203% and under HT category of cultivators, it was 171%.

### **Socio-economic conditions of the farmers**

Based on socio-economic parameters, overall, it was found that 12% of cultivators fall under Low income class, 71% in Low middle class and 17% in High middle class.

### **Land holding pattern**

Majority of the cultivators, i.e. about 96% had land holding upto 2 ha, 3.3% cultivators had 2–4 ha and only 0.5% cultivators had above 4 ha land holding under NHT category of cultivators, while there were very less number of cultivators under HT category of cultivators.

### **Farm Machinery/Equipment/Implements used**

The implements like Combine Harvester, *Desi* Plough, Hand Hoe, Leveller, Puddler, Scythe, Sickle, Thresher etc. were used by the farmers of the State.

Details of different farm tools and equipment in use, requiring improvement, and to be developed for future according to different crops as well as operations are given in the Appendix-A.

Due to lack of proper infrastructure in the State, repair and maintenance facilities of different types of machinery/equipment/implements are inadequate.

### **Average rate of custom hiring of Tractor with implements**

The average rates of custom hiring of Tractor with implements were: Tractor(T)+Disc Plough-Rs 607 per ha; T+MB Plough-Rs 968 per ha; T+Disc Harrow- Rs 1,920 per ha; T+Cultivator-Rs 561 per ha; T+Harvester-Rs 216 per hr; T+Trolley-Rs 179 per hr and T+Thresher-Rs 172 per hr.

### **Average rate of custom hiring of farm power sources**

The average custom hiring rate of Tractor for irrigation purpose was Rs 215 per hr and for threshing purpose, it was Rs 241 per hr. The custom hiring rate of Electric Motor for irrigation was Rs 68 per hr and for threshing, it was Rs 228 per hr. The custom hiring rate of Diesel Engine for irrigation purpose was Rs 169 per hr. The custom hiring rate of Diesel Engine for threshing purpose was Rs 300 per hr.

### **Average rate of custom hiring of implements drawn by animals**

Two implements viz. *Desi* Plough and Planter, drawn by animals was used in the State. The custom hiring rates of *Desi* Plough varied from Rs 335 per ha to Rs 639 per ha with an average of Rs 522 per ha. The custom hiring rate of Planter was Rs 307 per ha.

### **Estimated number of farm power sources per thousand ha of net area sown**

The estimated number of Tractors and Power Tillers per thousand ha of net area sown was very less. However, the Draught Animals were 33 per thousand ha of net

area sown. Electric Motors were widely used and were estimated at 177 per thousand ha of net area sown and Diesel Engines were estimated at 13 per thousand ha of net area sown in the State.

### Estimate of total number of farm power sources

In the State, only 53 Tractors, 419 Power Tillers, 19,625 Electric Motors and 935 Diesel Engines were estimated. The Draught Animals in the State were estimated at 4,255.

### Madhya Pradesh

**Agro Climatic Zones–VII, VIII and IX** : **Eastern Plateau and Hills Region**  
**Central Plateau and Hills Region**  
**Western Plateau and Hills Region**

### General information

Madhya Pradesh is a land locked State bound by the States of Rajasthan, Uttar Pradesh, Chhattisgarh, Maharashtra and Gujarat. The total geographical area of the State is 308,252 sq km. The economy of the State is predominantly rural with 73.3% of population living in rural area and depending on agriculture and allied occupations.

It consists of 45 districts out of which 12 districts were selected. Districts, viz. Bhopal, Chindwara, Damoh, Jabalpur, Katni, Raisen, Rewa, Sehore, Seoni, Vidisha belong to Central Plateau and Hills Region, whereas, district Umeria belongs to Eastern Plateau and Hills Region and district Khandwa belongs to Western Plateau and Hills Region.

As per the 2001 census, the total population of Madhya Pradesh was 6,03,85,118 of which 3,14,56,873 were males and 2,89,28,245 were females. Sex ratio of the State was 920 females for 1,000 males. Its population density was 196 per sq km. The literacy rate of Madhya Pradesh was 64.11% (it was 76.80% for males and 50.28% for females). As per Livestock Census 2003, the total number of Tractors was 2,34,600 and number of Power Tillers was 12,500.

The villages in Madhya Pradesh State were widely scattered, the average distance of block headquarter from village was more than 10 km in 75.5% of villages.

Most of the villages in Madhya Pradesh were not connected by metalled road. Only 18.6% of the villages were connected by metalled roads in the State, whereas, 82.6% of the villages were at a distance of upto 10 km from metalled road.

Bus/Taxi/Tempo/Jeep/Auto Rickshaw etc. were the main modes of transport used in 84.4% of villages in Madhya Pradesh to travel from Block Headquarter to village.

### Basic amenities available in the village

Basic amenities like Drinking Water, Electricity, School etc. were reported to be good in Madhya Pradesh State. Overall 96% of villages in Madhya Pradesh were reported to have Drinking Water available in the village itself. Similarly, 97% of villages had Electricity and 92% of villages had School in village itself (in another 5% of villages the School was situated within 5 km of the village). Other amenity like TV/Radio/Newspaper was available within village itself in 88% of villages (another 6% of villages had this amenity within 5 km of the village). The facility of Telephone was available within village in 48% of villages (another 24% of villages had it within 5 km distance). Though Post Office within the village was available in 23% of villages, but another 51% of villages had it within 5 km. Medical Facilities in Madhya Pradesh were scarce. Whereas, only 19% of villages had it within village, another 34% of villages had it within 5 km.

### Availability of subsidy/loan for agricultural purposes

Overall, subsidy/loan was easily available from Cooperative Societies in 63.5% of villages in the selected districts, whereas, in another 27.4% of villages, it was available with some effort. In Khandwa district, it was easily available in as much as 97.4% of villages. In the districts of Sehore and Rewa also, the loan was easily available in more than 90% of villages. Similarly, subsidy/loan from Banks was easily available in 45% of the villages of the selected districts and in another 36.2% of villages, it was available with some effort. The districts of Rewa and Umeria were comfortable with Bank loans (easily available in 88.9% and 72.2% of villages respectively). The position of the availability of subsidy for Agricultural Inputs was sufficiently good in Madhya Pradesh State, 65.1% of villages had it easily, whereas, another 22.4% had it with some effort. In Khandwa district, it was easily available in 100% of villages, and in the districts of Raisen, Rewa and Sehore, it was easily available in more than 90% of villages. In Seoni district also, it was easily available in 86.1% of villages.

### Ground Water Table

The overall position of ground water table was satisfactory in Madhya Pradesh. In 33% of villages of Madhya Pradesh, water was available at a depth of upto

10 metres only. It was available at a depth of upto 20 metres in 69.4% of villages, at a depth of upto 40 metres in 89% of villages and at a depth of upto 60 metres in 96% of the villages.

### Socio-economic conditions of the farmers

Based on the socio-economic parameters, 43.1% of households in Madhya Pradesh State fall in Low income class and 47.5% of households fall in Low middle class. Sehore district had the highest percentage of households (66%) falling in the category of Low middle class followed by districts of Bhopal and Rewa (58.5% and 56% respectively). In Seoni district, highest percentage of households (56.3%) was in Low income class category followed by the districts of Umeria, Khandwa and Katni (55%, 51.5% and 50% respectively). Bhopal had the highest percentage of households (15.8%) falling in High middle class category.

### Land holding pattern

Majority of the cultivators, i.e. about 61% had land holding upto 2 ha, 21% cultivators had 2–4 ha and only 14% cultivators had above 4 ha land holding under NHT category of cultivators, while about 0.6% cultivators had land each in holding size upto 2 ha, 2–4 ha and 3% cultivators had land holding above 4 ha under HT category of cultivators.

### Farm Machinery/Equipment/Implements used

Desi Plough, M.B. Plough, Disc Harrow, Seed Drill, Planter, Cultivator, Sickle, Hand Hoe, Tractor Mounted Reaper, Thresher etc. were being used for various agricultural operations in the selected districts of the State.

Details of different farm machinery and equipment in use, gaps and future requirements according to different crops as well as operations are given in the Appendix-A.

Due to lack of proper infrastructure in the State, repair and maintenance facilities of different types of machinery/equipment/implements are inadequate.

### Average rate of custom hiring

The average rate of custom hiring of Tractor+Seed Drill was Rs 399 per ha in the selected districts, while it was Rs 410 per ha for Tractor+Cultivator. The average rate of custom hiring of Tractor+Thresher was Rs 289 per ha in the selected districts. The custom hiring rate of Combine was Rs 444 per ha in the selected districts.

Average rate for custom hiring of Tractor used for irrigation was Rs 176 per ha and for threshing it was Rs

224 per ha. The corresponding rates for irrigation & threshing for Electric Motor were Rs 59 per ha and Rs 88 per ha respectively and for Diesel Engine, Rs 75 per ha and Rs 103 per ha respectively.

The rate of custom hiring for Animal drawn implement, viz. *Bakhar* in the selected districts was Rs 126 per day.

### Major crops grown

Major Crops grown in the State of Madhya Pradesh in *kharif* season were Soybean, Maize, Arhar, Great Millet, Paddy, Black gram etc. In *rabi* season, the major crops were Wheat, Bengal gram, Lentil etc. Sugarcane was the major perennial crop of the State. Other important crops grown in various regions of the State in *kharif* season were Til in the districts of Damoh, Seoni and Umeria, Green gram in the districts of Damoh, Katni and Rewa. Other major crops grown in *rabi* season were Pea in the districts of Chindwara, Damoh, Jabalpur and Seoni, Linseed in the districts of Damoh, Katni, Rewa and Seoni. Mustard was also another major crop of *rabi* season mainly grown in the districts of Seoni and Umeria.

### Area under irrigation and cropping intensity

The area under irrigation was relatively low in the State of Madhya Pradesh. Overall, only 40.9% of the area was irrigated. But 62.2% of the area held by HT category of cultivators was irrigated as compared to 36.9% held by NHT category of cultivators. This difference was significant. In the district of Bhopal, 72.3% of the area was irrigated. This was highest among the selected districts, followed by 62.2% in Vidisha district. In Bhopal district, there was no significant difference of per cent area irrigated in case of HT and NHT category of cultivators. It was 77.9% and 71.4% respectively. In contrast, these figures were 73.4% and 54.2% respectively in case of Vidisha district. Seoni district had the lowest percentage of area irrigated (11.5% only) among the selected districts. Other districts on the lower side as regards the percentage area irrigated were Umeria (24.7%) and Chindwara (27.5%). In all the selected districts, the HT category of cultivators had higher percentage of area irrigated as compared to NHT category of cultivators of the same district.

Over all the selected districts, the cropping intensity was 150% and there was no significant difference of it between NHT category of cultivators and HT category of cultivators. Khandwa district had low cropping intensity at 120%, followed by Chindwara district with 134%. In Bhopal district, the cropping intensity was

181%, highest among the selected districts. The other districts which had higher percentage cropping intensity were Jabalpur (178%), Rewa (174%) and Katni (167%). Cropping intensity of Vidisha district was comparatively low at 133%. Seoni district had a cropping intensity of 145%. Umeria district also had lower cropping intensity at 150%. The district of Katni had a reasonably good cropping intensity at 167%.

#### Estimated number of farm power sources per thousand ha of net area sown

The estimated number of Tractors per thousand ha of net area sown was 19.1. The district of Vidisha had the highest number of Tractors per thousand ha of net area sown (39.9). In contrast, Seoni district had lowest number of Tractors per thousand ha of net area sown at 5.4 only. Power Tillers were almost non-existent in the State of Madhya Pradesh. Electric Motors were quite widely in use in the State of Madhya Pradesh. The overall figure for the State was 144. Electric Motors per thousand ha of net area sown was highest in Bhopal district at 325.7 and was lowest at 52.7 in Seoni district. In contrast, Vidisha district had the highest number of Diesel Engines at 66.7 per thousand ha of the net area sown as against the estimated average of 26.6 for the State.

The State had an estimated number of 667.8 Draught Animals per thousand ha of net area sown. Bullock was the main Draught Animal constituting 625.3 bullocks per thousand ha of net area sown followed by he-buffalo, which constitute 40.1 he-buffalo per thousand ha of net area sown only.

#### Estimate of total number of farm power sources

The estimate of number of Tractors in the State was 2,33,540. Maximum number of Tractors were estimated in Vidisha district at 15,306 and minimum number of Tractors were estimated in Umeria district at 461. Total number of Electric Motors was estimated at 16,13,201 for the State. Similarly, total number of Diesel Engines was estimated at 3,09,559 for the State. Chindwara district was estimated to have maximum number of Electric Motors at 1,05,742 and Vidisha district was estimated to have maximum number of Diesel Engines, i.e. 25,578. There was an estimated 83,15,170 Draught Animals in the State.

### MAHARASHTRA

Agro Climatic Zones-IX and XII : Western Plateau and Hills Region  
West Coast Plains and

### Hills Region

#### General information

Maharashtra State consists of 33 districts, out of which 7 districts namely Akola, Amaravati, Pune, Satara, Yavatmal, Raigarh and Thane had been randomly selected for this study. It had broadly three agro-climatic zones viz. Western plateau and hills region consisting of 24 districts, West coast plains and hills region consisting of 6 districts and Eastern plateau and hills region consisting of 3 districts. Maharashtra is in Central India. The majority of the selected districts were from Western plateau and hills region. About 70% population in the State depends on agriculture. The principal crops grown in the State were Rice, Jowar, Bajra, Wheat and Pulses. The State was an important producer of Oilseeds. Groundnut and Safflower being major oil seed crops. Important cash crops were Cotton, Sugarcane, Tobacco, Turmeric and Vegetables. The State was also producing fruits and had a substantial area under orchards of Orange, Banana, Mango, Grapes, Cashew nut, Sweet Lime etc. Production from major crops were: Rice 1.93 mt, Wheat 0.95 mt, Pulses 1.64 mt, Cotton 1.80 m bales of 170 kg each, Sugarcane 49.59 mt and Groundnut 0.47 mt. during the year 2000–2001.

Over all the selected districts, the average distance of Block head quarter from village was more than 10 km in 58% villages, while 25% villages were more than 20 km away from block head quarter. Over the State, 46% villages were connected by metal road. 93% selected villages had Bus/Taxi/Tempo/Auto as main mode of transport. The basic amenities like Drinking Water, Electricity, TV/Radio, School were available in most of the villages, while rest of the amenities like Co-operative Society, Input Supply Agency, Agril. Machinery Supply Agency, Workshop, Co-operative Credit Society, Commercial Bank, Telephone, Post Office, Dispensary and Rice Mills were available in 38%, 13%, 5%, 6%, 23%, 14%, 64%, 37%, 28% and 4% villages respectively. The loan was easily available from Bank in 24% villages and from Co-operative Society in 37% villages. The subsidy for Agriculture Inputs was easily available in 15% villages.

#### Cropping pattern

The major crops grown in the State in *kharif* season were Jowar, Paddy, Cotton and Oil seeds etc. In *rabi* season, the crops grown were Wheat and Bengal Gram and in *zaid* season, it was Groundnut. The major Perennial crops were Sugarcane, Mango and Orange. Other crops grown in *kharif* season were Red Gram in

Akola & Yavatmal districts, Green Gram in Akola district and Bajra in Pune & Satara districts. In *rabi* season, the crops grown were Jowar in Akola, Pune & Satara districts and vegetables in Raigarh, Thane & Yavatmal districts. In *zaid* season, Chillies were grown in Satara district. Lemon was grown in four districts, viz. Akola, Amaravati, Pune and Raigarh. Sapota was grown in Thane district. Banana was grown in Thane & Yavatmal districts.

### Percentage area irrigated and cropping intensity

Area under irrigation was relatively low in the State. Overall, only 46.8% of the area was irrigated. But 75.5% area held by HT category of cultivators was irrigated as compared to 43.5% in case of NHT category of cultivators. This difference was significant. In Pune district, 75% area was irrigated. This was highest among the selected districts followed by 41.3% in Satara district and 35.1% in Raigarh district. The overall cropping intensity was 165%. Under HT category of cultivators, it was 203% and under NHT category of cultivators, it was 161%. The maximum cropping intensity was in Satara, i.e. 198% and minimum in Thane, i.e. 106%.

### Socio-economic conditions of the farmers

Based on socio-economic parameters, over the State, 29% of cultivators fall under Low income class, 58% in Low middle class and 13% in High middle class.

### Land holding pattern

Majority of the cultivators, i.e. about 63% had land holding upto 2 ha, 22% cultivators had 2–4 ha and only 11% cultivators had above 4 ha land holding under NHT category of cultivators, while about 0.9% cultivators had land in holding size upto 2 ha, 1% cultivators had land holding of 2–4 ha and 1.7% cultivators had land holding above 4 ha under HT category of cultivators.

### Farm Machinery/Equipment/Implements used

The implements like *Desi* Plough, Disc Plough, M.B. Plough, Cultivator, Seed Drill, Hand Hoe, Long Handle Hoe, Sickle, Leveller, Bund Maker, Rotavator, Tractor Mounted Reaper, Groundnut Digger, Thresher etc. were used by the farmers of the State.

Details of different farm machinery and equipment in use, gaps and future requirements according to different crops as well as operations are given in the Appendix-A.

### Average rate of custom hiring of tractor with implements

Overall, the average rates of custom hiring of Tractor(T) with implements in the State were: T+Disc Plough-Rs 1,842 per ha; T+MB Plough-Rs 1,555 per ha; T+Disc Harrow-Rs 711 per ha; T+Cultivator-Rs 683 per ha; T+Seed Drill-Rs 783 per ha; T+Trolley-Rs 154 per hr. The custom hiring rates were comparatively low in Thane district and high in Pune and Yavatmal districts.

### Average rate of custom hiring of farm power sources

Average rates of custom hiring of Tractor for irrigation purpose was Rs 221 per hr while for threshing purpose, it was Rs 382 per hr. The custom hiring rates of Electric Motor for irrigation purpose was Rs 36 per hr and for threshing purpose, it was Rs 172 per hr. The custom hiring rate of Diesel Engine for irrigation purpose was Rs 79 per hr and for threshing purpose, it was Rs 177 per hr.

### Average rate of custom hiring of implements drawn by animals

The custom hiring rate of *Desi* Plough was Rs 980 per ha; Disc Harrow-Rs 431 per ha; Cultivator-Rs 464 per ha; Seed Drill-Rs 624 per ha. The custom hiring rates of Bakhar was Rs 368 per ha. In Raigarh district, these implements were available at low rates. In Pune and Yavatmal districts, the custom hiring rates were comparatively higher.

### Estimated number of farm power sources per thousand ha of net area sown

Overall, the availability of power sources per thousand ha of net area sown was less. The estimated number of Tractors, Power Tillers, Electric Motors, Diesel Engines and Draught Animals per thousand ha of net area sown, in the selected districts, were 7; 2; 51; 6; and 246 respectively.

### Estimates of farm power sources

The estimate of total number of Tractors in the State was 1,28,415. There were less number of Power Tillers in the State. The estimate of total number of Electric Motors and Diesel Engines was 9,95,296 and 1,02,976 respectively. The estimate of total number of Draught Animals was 43,44,823.

## NEH REGION

Agro Climatic Zone-II : Eastern Himalayan Region

## ARUNACHAL PRADESH

### General Information

There were 13 districts in the State, out of which three districts namely Tawang, West Kamang & East Siang were randomly selected. Overall, 31% selected villages were on the metal road, 16% within distance of 2 km and 53% selected villages were at a distance greater than 2 km from the metal road. The mode of transport from block head quarter to village was bus/taxi/tonga/auto/jeep in 84% selected villages.

The basic amenities viz. Co-operative Society was available in 37%, Telephone in 35%, Post Office in 41%, Dispensary in 45%, Rice Mills in 50%, Input Supply Agency in 23%, Agricultural Machinery Supply Agency in 12% and Marketing Agency in 12% selected villages.

The loan facilities from Bank & Co-operative Society were available in 94% & 68% selected villages respectively. Subsidy for agriculture inputs was available in 99% selected villages.

### Cropping pattern, both agricultural and horticultural

The main crops grown in *kharif* season were Paddy, Maize, Common Millet and Ginger. In *rabi* season, Potato, Wheat, Cabbage and Tomato were the main crops grown.

### Percentage area irrigated and Cropping intensity

In the selected districts, for the NHT category of cultivators, area irrigated & cropping intensity were 47% & 120% respectively. For HT category of cultivators, these figures were 26% & 114% respectively.

### Socio-economic conditions of the farmers

Based on the socio-economic parameters, overall, 3% cultivators fall in poor category, 63% cultivators fall in Low income class, 31% cultivators fall in Low middle class and 3% cultivators fall in High middle class.

### Average rate of custom hiring of tractor with implements

The average rate of custom hiring of Tractor(T)+ Disc Plough, T+MB Plough, T+Disc Harrow, T+Cultivator, T+Trolley, T+Thresher were Rs 271/ha, Rs 308/ha, Rs 278/ha, Rs 300/ha, Rs 158/hr and Rs 300/hr respectively.

**Average rate of custom hiring of farm power sources**  
The average rate of custom hiring for Tractor & Diesel Engine for irrigation purpose was Rs 157 & Rs 150 per hr respectively and custom hiring rate for threshing purpose was Rs 227 & Rs 150 per hr respectively.

### Average rate of custom hiring of implements drawn by animals

The average rate of custom hiring of implements

drawn by animals was: *Desi* Plough: Rs197/ha; Disc Harrow: Rs 300/ha; Cultivator: Rs 287/ha and Soil Turning Plough: Rs 230 per ha.

### Estimate of total number of farm power sources

The estimate of total number of Tractors, Diesel Engines, Draught Animals in the State were 274; 3,564; and 1,09,247 respectively.

## MANIPUR

### General Information

There were 9 districts in the State, out of which 1 district namely Imphal came under random selection. Overall, 45% selected villages were reported on the metal road, 17% within a distance of 2 km and 38% selected villages were at a distance greater than 2 km from the metal road. The mode of transport from block head quarter to village was bus/taxi/tonga/auto/jeep in all the selected villages.

The basic amenities like Drinking water, Electricity, TV/Radio/Newspaper, School, Rice Mills were available in most of the villages while the amenities viz. Co-operative Society was available in 31%, Telephone in 62%, Post Office in 45%, Dispensary in 54%, Input Supply Agency in 20%, Agricultural Machine Supply Agency in 7%, Marketing Agency in 50%, Co-operative Credit Agency in 12% and Bakery in 22% selected villages.

The loan facilities from Bank were available in 18% selected villages and from Co-operative Societies in 17% selected villages. Subsidy for Agriculture Inputs was available in 28% selected villages.

### Cropping pattern, both agricultural and horticultural

Main crops grown in *kharif* season were Paddy and Maize. No crop was grown in the *rabi* season.

### Percentage area irrigated and Cropping intensity

Per cent cropping intensity for the NHT category of cultivators was 104% and for the HT category of cultivators, it was 101%. For HT category of cultivators, percent area irrigated was 3%.

### Socio-economic conditions of the farmers

Based on the socio-economic parameters, overall, only 1% cultivators fall in poor category, 24% cultivators fall in Low income class, 70% cultivators in Low middle class and 5% cultivators fall in High middle class.

**Average rate of custom hiring of tractor with implements**

In Imphal district, the average rate of custom hiring of Tractor(T)+Cultivator, T+Harvester and T+Trolley were Rs 1,019 per ha, Rs 250 per ha and Rs 138 per hr respectively.

**Average rate of custom hiring of farm power sources**

In Imphal district, the average rate of custom hiring of Diesel Engine for irrigation purpose was Rs 76 per hr. The custom hiring rate of Tractor for threshing purpose was Rs 117 per hr.

**Average rate of custom hiring of implements drawn by animals**

In Imphal district, the average rate of custom hiring of implements drawn by animals were, *Desi* Plough: Rs 800 per ha; Cultivator: Rs 904 per ha.

**Estimate of total number of farm power sources**

In Imphal district, the estimate of total number of Tractors, Power Tillers, Diesel Engines and Draught Animals were 267; 74; 23 and 2,835 respectively.

**MEGHALAYA****General Information**

There were 7 districts in the State, out of which two districts namely Jantia Pahar and East Khasi Hills were randomly selected. Pooled over both the selected districts, 51% villages were on the metal road, 14% villages were within distance of 2 km and 35% villages were at a distance greater than 2 km from the metal road. The main mode of transport from block head quarter to village was Bus/Taxi/Tonga/Auto/Jeep.

The basic amenities viz. Drinking water, Electricity, School were available in most of the selected villages. The basic amenities like Co-operative Society was available in 24%, Telephone in 42%, Post Office in 40%, TV/Radio/Newspaper in 67%, Dispensary in 29%, Rice Mill in 29%, Input Supply Agency in 21%, Agricultural Machinery Supply Agency in 13%, Marketing Agency in 21%, Co-operative Credit Agency in 13% and Bakery in 17% selected villages. Other basic amenities were rarely available.

Loan facilities from Bank & Co-operative societies were available in 60% & 62% selected villages respectively. Subsidy for Agricultural inputs was in 75% selected villages.

**Cropping pattern, both agricultural and horticultural**

Main crops grown in *kharif* season were Paddy, Potato and Maize. In *rabi* season, the main crops grown were Potato, Cabbage and Tomato.

**Percentage area irrigated and Cropping intensity**

Overall, the area irrigated & cropping intensity for the NHT category of cultivators was 41% & 138% respectively, while for the HT category of cultivators, it was 53% & 144% respectively.

**Socio-economic conditions of the farmers**

Based on socio-economic parameters, overall, 4% cultivators fall in poor category, 56% cultivators fall in Low income class, 37% cultivators fall in Low middle class and 3% cultivators fall in High middle class.

**Average rate of custom hiring of implements drawn by animals**

Overall, the average rates of custom hiring of the implements drawn by animals were: *Desi* Plough: Rs 2,250 per ha; Soil Turning Plough: Rs 500 per ha; Seed Drill: Rs 2,150 per ha.

**Estimate of total number of farm power sources**

Overall, the estimate of total number of Power Tillers and Draught Animals were 283 and 2,09,619 respectively.

**MIZORAM****General Information**

There were eight districts in the State, out of which district Aizwal came under random selection. In the selected district, out of 40 randomly selected villages, 50% selected villages were on the metal road and rest of 50% selected villages were at a distance greater than 2 km from the metal road. The main mode of transport from block head quarter to village was Bus/Taxi/Tonga/Auto/Jeep in 95% selected villages.

In Aizwal district, the basic amenities like Drinking water, Electricity, TV/Radio/Newspaper, Schools, Rice Mills were available in most of the selected villages. Other amenities viz. Co-operative Societies were available in 27%, Telephone in 60%, Post Office in 71%, Dispensary in 67%, Co-operative Credit Agency in 20% and Bakery in 67% selected villages.

The loan facilities from Bank and Co-operative

Societies were available in 50% and 41% selected villages respectively. Subsidy for Agriculture inputs was available in 38% selected villages.

#### **Cropping pattern, both agricultural and horticultural**

In Aizwal district, the main crops grown in *kharif* season were Paddy, Maize and Ginger. No crop was grown in *Rabiseason*.

#### **Percentage area irrigated and Cropping intensity**

In Aizwal district, for the NHT category of cultivators, the percentage area irrigated and cropping intensity were 8% and 106% respectively.

#### **Socio-economic conditions of the farmers**

In Aizwal district, the average rate of custom hiring of Tractor(T)+Plough, T+Disc Harrow and T+Trolley was Rs 800 per ha, Rs 800 per ha and Rs 350 per ha respectively.

#### **Average rate of custom hiring of implements drawn by animals**

In Aizwal district, the average rate of custom hiring of implements drawn by animals was Cultivator: Rs 300 per ha; Soil Turning Plough: Rs 300 per ha.

#### **Estimate of total number of farm power sources**

In Aizwal district, the estimate of total number of Draught Animals was 588.

## **NAGALAND**

### **General Information**

There were 8 districts in the State, out of which district Mon came under random selection. In Mon district, of the 40 randomly selected villages, 12% villages were on the metal road, 25% villages were within distance of 2 km and 63% villages were at a distance greater than 2 km from the metal road. The main mode of transport from block head quarter to village was Bus/Taxi/Tonga/Auto/Jeep in all the selected villages.

In Mon district, the basic amenities like Electricity, Telephone, Post office, TV/Radio/Newspaper, School, Dispensary, Rice Mills, Input Supply Agency, Agricultural Machinery Supply Agency, Marketing Agency were available in most of the selected villages. Other basic amenities viz. Co-operative Societies were available in 67% selected villages and Drinking water was available in 79% selected villages.

In Mon district, the loan facilities from Banks and Co-operative Societies were available in only 3% selected villages. Subsidy for agriculture inputs was available in 34% selected villages.

#### **Cropping pattern, both agricultural and horticultural**

In Mon district, the main crops grown in *kharif* season were Paddy, Maize and Common Millet. No crop was grown in *rabi* season.

#### **Percentage area irrigated and Cropping intensity**

In Mon district, for the NHT category of cultivators, only 1% of the area was irrigated. Cropping intensity was 116%.

#### **Socio-economic conditions of the farmers**

In Mon district, based on the socio-economic parameters, 13% cultivators fall in poor category, 55% cultivators fall in Low income class, 28% cultivators fall in Low middle class and 4% cultivators fall in High middle class.

## **SIKKIM**

### **General Information**

There were four districts in the State, out of which West Sikkim district came under random selection. In West Sikkim district, only 6% selected villages were on the metal road, 48% selected villages were within a distance of 2 km and 46% selected villages were at a distance greater than 2 km from the metal road. The main mode of transport from block head quarter to village was Bus/Taxi/Tonga/Auto/Jeep in 95% selected villages.

The basic amenities like Drinking water, Electricity were available in most of the selected villages, while other basic amenities viz. Co-operative Societies were available in 45%, Telephones in 53%, Post Offices in 38%, TV/Radio/Newspaper in 63%, Dispensary in 42%, Schools in 76%, Rice Mills in 18%, Input Supply Agency in 50%, Agricultural Machinery Supply Agency in 24%, Marketing Agency in 6% and Cooperative Credit Agency in 35% selected villages.

In West Sikkim district, the loan facilities from Banks and from Co-operative Society were available in all the selected villages.

#### **Cropping pattern, both agricultural and horticultural**

In West Sikkim district, the main crops grown in *kharif* season were Paddy, Maize and Ginger. Main crops grown in *rabi* season were Wheat, Cabbage and Potato.

**Percentage area irrigated and Cropping intensity**

In West Sikkim district, for the NHT category of cultivators, percentage area irrigated & cropping intensity were 32% & 171% respectively.

**Socio-economic conditions of the farmers**

In West Sikkim district, based on socio-economic parameters, 34% cultivators fall in Low income class, 63% cultivators fall in Low middle class and 3% cultivators fall in High middle class.

**Average rate of custom hiring of implements drawn by animals**

In West Sikkim district, the average rate of custom hiring of *Desi* Plough drawn by animals was Rs 1,440 per ha.

**Estimate of total number of farm power sources**

In West Sikkim district, the estimate of the total number of Draught Animals was 2,169.

**TRIPURA****General Information**

There were four districts in the State, out of which West Tripura district came under random selection. Out of the 40 selected villages of West Tripura district, 22% villages were on the metal road, 53% villages were within distance of 2 km and 25% villages were at a distance greater than 2 km from the metal road. The main mode of transport from block head quarter to village was Bus/Taxi/Tonga/Auto/Jeep in all the selected villages.

The basic amenities like Drinking Water, Electricity, TV/Radio/Newspaper, School, Rice Mills were available in most of the selected villages. Other basic amenities viz. Co-operative Societies were available in 67% selected villages, Telephone in 79%, Post Office in 76%, Dispensary in 61%, Input Supply Agency in 38%, Agricultural Machinery Supply Agency in 22%, Marketing Agency in 51% and Co-operative Credit Agency in 60% selected villages.

In West Tripura district, the loan facilities from Bank & Co-operative Societies were available in 78% & 89% selected villages respectively. Subsidy for Agriculture inputs was available in 24% selected villages.

**Cropping pattern, both agricultural and horticultural**

In West Tripura district, the main crops grown in *kharif* season were Paddy, Brinjal and Sesame and the main crops grown in *rabi* season were Paddy, Cabbage and

Tomato.

**Percentage area irrigated and Cropping intensity**

In West Tripura district, for the NHT category of cultivators, percentage area irrigated and cropping intensity were 67% & 165% respectively. For HT category of cultivators, these figures were 73% & 167% respectively.

**Socio-economic conditions of the farmers**

In West Tripura district, based on the socio-economic parameters, 32% cultivators fall in Low income class, 60% cultivators fall in Low middle class and 8% cultivators fall in High middle class.

**Average rate of custom hiring of tractor with implements**

In West Tripura district, the average rates of custom hiring of Tractor(T)+MB Plough, T+Harvester, T+Thresher were Rs 82 per ha, Rs 100 per ha and Rs 64 per hr respectively.

**Average rate of custom hiring of farm power sources**

In West Tripura district, the average rates of custom hiring of Electric Motor and Diesel Engine for irrigation purpose were Rs 74 & Rs 82 per hr. The average rate of custom hiring for each, Tractor and Diesel Engine for threshing purpose was Rs 120 per hr.

**Average rate of custom hiring of implements drawn by animals**

In West Tripura district, the average rate of custom hiring of implements drawn by animals were, *Desi* Plough: Rs 476 per ha; Soil Turning Plough: Rs 500 per ha.

**Estimate of total number of farm power sources**

In West Tripura district, the estimate of total number of Tractors, Power Tillers, Electric Motors, Diesel Engines, Draught Animals were 20; 696; 1,474; 2,122; and 58,702 respectively.

**ORISSA**

**Agro Climatic Zones-VII and IX : Eastern Plateau and Hills  
Eastern Coast Plains and Hills**

**General Information**

There were 30 districts in the State out of which 6

districts namely Angul, Nayagarh, Sonapur, Ganjam, Jagatsinghpur and Khurda had been selected for this study. Orissa State lies on the east coast of India. It is surrounded by Jharkhand on the North, Andhra Pradesh on the South-East, Madhya Pradesh on the West and Bay of Bengal on the East. Sixty-four percent of the working population was dependent on agriculture. Rice, Pulses, Oilseeds, Jute and Mesta, Sugarcane (the main cash crop), Coconut and Turmeric were important crops grown in the State. Orissa contributes one-tenth of the rice production in India. Forest covers constitute nearly 37% of the total area of the State.

The villages in Orissa were widely scattered. 21% villages had block head quarter at a distance up to 5 km, 29% villages had block head quarter at a distance 5–10 km and 50% villages had block head quarter at a distance greater than 10 km. 78% of villages were situated at a distance upto 5 km from metal road and 22% villages had metal road at a distance greater than 5 km. 69% villages had Bus/Taxi/Tempo/Auto/Jeep as main mode of transport, 3% villages had Tonga/Rickshaw as main mode of transport and 2% had Tractor Trolley as main mode of transport. The basic amenities such as Co-operative Society, Commercial Bank, Drinking water, Electricity, Telephone, Post Office, TV/Radio, Dispensary, School and Rice Mill were available in 21%, 10%, 92%, 79%, 54%, 28%, 85%, 15%, 74% and 37% of the selected villages respectively.

Loan/subsidy from Bank was available in 66% selected villages and loan/subsidy from Co-operative Society was available in 73% selected villages. For Agricultural Inputs, subsidy was available in 82% selected villages.

The position of ground water table was satisfactory in the State. 68% villages had water table up to 10 metres, 13% villages had water table between 10–20 metres and rest 19% villages had water table at more than 20 metres.

### Cropping pattern

The major crops grown in *kharif* season was Paddy while in *rabi* season, Green Gram, Paddy, Black Gram and Chickling were grown. No crop was grown in *zaid* season.

### Percentage area irrigated and cropping intensity

The area under irrigation was relatively low in the State. The percentage area irrigated under NHT category of cultivators was 34% and under HT category of cultivators, it was 59%. The cropping intensity under NHT category of cultivators was 135% and under HT category of cultivators, it was 159%.

### Socio-economic conditions of the farmers

Based on socio-economic parameters, it was found that 41% of cultivators fall in Low income class, 54% in Low middle class and 5% in High middle class.

### Land holding pattern

Majority of the cultivators, i.e. about 83% had land holding upto 2 ha, 13% cultivators had 2–4 ha and only 3% cultivators had above 4 ha land holding under NHT category of cultivators, while about 1% cultivators had land in holding size upto 2 ha and 0.3% cultivators had land in each, holding size of 2–4 ha and above 4 ha, under HT category of cultivators.

### Farm Machinery/Equipment/Implements used

The implements like Cultivator, *Desi* Plough, Disc Harrow, Groundnut Digger, Hand Hoe, Leveller, Long Handle Hoe, Puddler, Rice Transplanter, Sickle, Sprayer, Tractor Mounted Reaper, Wheel Hoe, Winnower etc. were used by the cultivators of the State.

Due to lack of proper infrastructure in the State, repair and maintenance facilities of different types of machinery/equipment/implements are inadequate.

### Average rate of custom hiring of Tractor with implements

The average rate of custom hiring of Tractor (T)+Disc Plough was Rs 355 per ha; for T + MB Plough was Rs 588 per ha; T+Disc Harrow was Rs 508 and for T+Cultivator, it was Rs 414 per ha.

### Average rate of custom hiring of farm power sources

The average rate of custom hiring of Tractor used for irrigation purpose was Rs 268 per hr and for threshing purpose, it was Rs 226 per hr. The average rate of custom hiring of Diesel Engine used for irrigation was Rs 73 per hr and for threshing, it was Rs 59 per hr. The average rate of custom hiring of Electric Motor used for irrigation purpose was Rs 67 per hr and for threshing purpose, it was Rs 50 per hr.

### Average rate of custom hiring of Implements drawn by animals

The average rates of custom hiring of *Desi* Plough was Rs 290 per ha and for Cultivator, it was Rs 168 per ha. The average rate of custom hiring of Disc Harrow was Rs 103 per ha.

### Estimated number of farm power sources per thousand ha of net area sown

In the selected districts, the estimated number of

Tractors, Power Tillers, Electric Motors, Diesel Engines and Draught Animals per thousand ha of net area sown was 7, 4, 5, 6, and 1,148 respectively.

### Estimate of total number of farm power sources

The estimate of the total number of Tractors, Power Tillers, Electric Motors, Diesel Engines and Draught Animals in the State was 19,234; 11,453; 18,509; 20,061 and 36,90,503 respectively.

## PONDICHERRY

### Agro Climatic Zone–XI : East Coast Plains and Hills

#### General Information

The Union Territory of Pondicherry comprises Pondicherry, Karaikal, Mahe and Yanam which lie scattered in South India. It is bounded on the East by the Bay of Bengal and on the three sides by Tamil Nadu. About 150 km South of Pondicherry on the East coast lies Karaikal. Mahe is situated on the Malabar Coast on the Western Ghats surrounded by Kerala. It can be reached from Calicut Airport which is 70 km from Mahe. Yanam is situated adjoining the East Godavari district of Andhra Pradesh and is about 200 km from Visakhapatnam airport. It has area 492 sq km having population 9,73,829.

Nearly 45% of the population of the UT was engaged in agriculture and allied pursuits. 90% of the cultivated area was irrigated. Paddy was the predominant crop followed by Pulses. Mahe region contributes to the plantation wealth of this Territory. Crops like Coconut, Arecanut, Condiments and Spices were grown here. Pulses, Groundnut and Chillies were the other rainfed crops grown in Yanam. During 2001–02, 28,068 ha had been cultivated under Paddy.

Irrigation in Pondicherry was mainly through tanks and tube wells. Karaikal district comes under the 'East Coast Plains and Hills'—agro-climatic zone.

According to Livestock Census 1992, number of Tractors and Power Tillers used for agriculture were 505 and 155 while these were 281 and 196 during Livestock Census 1987.

As per 2001 census, the male and female population in Pondicherry was 4,86,705 and 4,87,124 respectively. Sex ratio (females per 1,000 males) was 1,001. Density per km<sup>2</sup> was 2,029. Literacy rate for male and female was 89% and 74% respectively. Consumption of electricity for agricultural purposes during 2000–2001 was 97 million kWh which was 6.91% of total

consumption of electricity in the UT.

In Karaikal district, 72.5% selected villages had distance up to 5 km from block head quarter. Rest of villages had distance more than 5 km from block head quarter.

In Karaikal district, 45% selected villages were connected by metal road while 37% villages had distance between 1–5 km from metal road. Rest villages had distance between 0–1 km from metal road.

In Karaikal district, Bus/Taxi/Tempo/Jeep/Auto/Bullock cart were the main mode of transport used between village and block head quarter in 75% selected villages. Rest of the 25% villages use other modes of transport.

Drinking Water, Electricity, Telephone, TV/Radio/Newspaper and School were available in most of the selected villages, while Dispensary and Post Office were available in about 25% selected villages. Co-operative Society, Input Supply Agency, Agricultural Machinery Agency, Workshop Facility, Co-operative Credit Society, Commercial Bank and Marketing Agency/Mandi were available in very few selected villages.

In selected villages of Karaikal district, loan from Banks and Co-operative societies was either easily available or available with some efforts in 60% and 72% villages respectively, while it was either available with great difficulty or not available in rest of the villages.

Subsidy on Agricultural inputs was either easily available or available with some efforts in about 87% villages while it was available with great difficulty in 7% villages. In rest of the villages, it was not available.

#### Cropping pattern

The main crops grown were Paddy during *kharif* and *rabi* seasons while Black Gram, Cotton, Green Gram were grown during *zaid* season.

#### Percentage area irrigated and cropping intensity

It was observed that almost complete cropped area was irrigated under different holding sizes for NHT category of cultivators as well as for HT category of cultivators.

Cropping intensity was between 161% to 165% for NHT category of cultivators while it was between 141% to 203% for HT category of cultivators for different holding sizes.

#### Socio-economic conditions of the farmers

It was observed that 29%, 63% and 8% cultivators in Karaikal district belong to Low income class; Low

middle class, and High middle class respectively. None of the cultivator belongs to poor class.

### Land holding pattern

Majority of the cultivators, i.e. about 93% had land holding upto 2 ha, 5% cultivators had 2–4 ha and only 0.4% cultivators had above 4 ha land holding under NHT category of cultivators, while about 0.3% cultivators had land each in holding upto 2 ha and holding size of 2–4 ha and 0.5% cultivators had land holding above 4 ha under HT category of cultivators.

### Farm Machinery/Equipment/Implements used

*Desi* Plough, Disc Plough, MB Plough, Leveller, Puddler, Sickle, Hand Hoe, Planter, Seed Drill, Cultivator, Thresher and Tractor mounted reaper were being used by the cultivators for different agricultural operations in the selected district.

### Average rate of custom hiring of tractor with implements

Average rate of custom hiring of Tractor with implements viz. Disc Plough, MB Plough, Disc Harrow and Cultivator were Rs 1,207; Rs 1,250; Rs 1,346 and Rs 857 per ha respectively. Average rate of custom hiring of Tractor with Thresher was Rs 343 per hour. Average rates of custom hiring of Electric Motor and Diesel Engine for irrigation purpose were observed to be Rs 12 and Rs 40 per hour respectively.

Average rate of custom hiring of implements drawn by animals viz. *Desi* Plough, Disc Harrow, Cultivator and Leveller/Clod Breaker were ranging in between Rs 167 to Rs 250 per day.

### Estimated number of farm power sources per thousand ha of net area sown

The estimated number of Tractors, Power Tillers, Electric Motors, and Diesel Engines per thousand ha of net area sown was 11; 1; 222; and 160. Estimated number of Draught Animals, i.e. Bullocks per 1,000 ha of net area sown was 203, 166 and 152 for holding sizes up to 2 ha, 2–4 ha and >4 ha respectively.

### Estimate of total number of farm power sources

The estimates of the number of Tractors and Power Tillers in Karaikal district were 70 and 5 respectively, while over the State, it was 280 and 20 respectively. Estimated number of Electric Motors and Diesel Engines in Karaikal district was 1,385 and 1,000; while it was 5,540 and 4,000 over the State respectively. Estimate of the number of Draught Animals in the district was 1,205

while over the State, it was 4,820.

## PUNJAB

### Agro Climatic Zone–VI : Trans Gangetic Plains Region

#### General information

There were 17 districts in the State out of which four districts namely Gurdaspur, Ludhiana, Mansa and Nawashahar were randomly selected on the basis of mechanization index. Pooled over all the selected districts, 94% selected villages were connected with the metal road, 5% selected villages were at a distance upto 5 km from the metal road and 1% selected villages were at a distance more than 5 km from the metal road. Overall, 54% selected villages were at distance upto 10 km from block head quarter, 40% selected villages were at distance between 10–20 km and 6% selected villages were at distance more than 20 km from the respective block head quarter. Main mode of transport from village to block head quarter was Bus/Taxi/Tonga/Auto/Jeep.

The basic amenities, viz. Electricity, Telephone, School, Drinking water and TV/Radio/Newspaper were available in almost all the selected villages of selected districts. Very few villages had Agricultural Machinery Supply Agency/Workshop Facility/Marketing Agency. The loan facilities from Bank and Cooperative Societies were easily available in 30% and 57% in the selected villages respectively, whereas, it was available with some efforts in 33% and 22% of selected villages respectively. Subsidy on Agricultural Inputs was reported to be available easily or with some efforts in 24% selected villages only. Subsidy on Agricultural Inputs was available in most of the selected villages of Gurdaspur and Mansa districts.

#### Cropping pattern

The main crops grown during *khari* season were Maize, Bajra, Cotton and Paddy while Wheat, Mustard, Sunflower, Potato and Barseem were major crops grown in *rabi* season. In *zaid* season Green gram, Bajra and Jowar were some of the major crops grown in the selected villages. The other crop grown was Sugarcane.

#### Percentage area irrigated and cropping intensity

The percentage area irrigated and cropping intensity under NHT category of cultivators was 99% and 202% respectively, while under HT category of cultivators, these were 100% and 197% respectively.

#### Socio-economic conditions of the farmers

Based on socio-economic parameters, it was observed that 6% cultivators fall under Low income class; 66% in Low middle class and 28% in High middle class.

### **Land holding pattern**

Of all the cultivators, about 43% had land holding upto 2 ha, 13% cultivators had 2–4 ha and only 4% cultivators had above 4 ha land under NHT category of cultivators, while under HT category of cultivators, about 10% cultivators had land in holding size upto 2 ha, 14% cultivators had land holding of 2–4 ha and 16% cultivators had land holding above 4 ha.

### **Farm Machinery/Equipment/Implements used**

The implements like Bund Maker, Cultivator, *Desi* Plough, Disc Harrow, Disc Plough, Hand Hoe, Leveller, Long Handle Hoe, M.B. Plough, Planter, Puddler, Rotavator, Scythe, Seed Drill, Sickle, Sowing (manual metering), Sprayer, Thresher, Tractor Mounted Reaper, Weeder, Wheel Hoe, Combine etc. were used by the cultivators of the State.

Details of different farm machinery and equipment in use, gaps and future requirements according to different crops as well as operations are given in Appendix-A.

### **Average rate of custom hiring of tractor with implements**

The average rate of custom hiring of Tractor with Disc Plough was between Rs 305 per ha to Rs 748 per ha in the selected villages of the selected districts. For Combine, the custom hiring rate was between Rs 639 per hr to Rs 1107 per hr and for Tractor along with Harvester/Thresher, it was between Rs 254 to 738 per hour.

### **Average rate of custom hiring of farm power sources**

The average rate of custom hiring of Electric Motor and Diesel Engine for irrigation was between Rs 16 to Rs 50 per hr in all the selected districts.

### **Average rate of custom hiring of implements drawn by animals**

The average rate of custom hiring of *Desi* Plough/ Disc Harrow drawn by animals was reported to be between Rs 500 to Rs 625 per day in the selected districts.

### **Estimated number of farm power sources per thousand ha of net area sown**

The number of Tractors, Power Tillers, Electric Motors, Diesel Engines and Draught Animals per thousand ha of net area sown were 130; 2; 189; 229 and 245 respectively.

### **Estimate of total number of farm power sources**

The estimate of number of Tractors in the State was 2,83,188. Estimate of number of Power Tillers was 7,838; Electric Motors 5,96,526; Diesel Engines 3,97,665; Draught Animals 6,64,254.

## RAJASTHAN

**Agro Climatic Zones– VI, VIII and XIV** : **Trans Gangetic Plains Region**  
**Central Plateau and Hills Region**  
**Western Dry Region**

### General Information

There were 32 districts in the State, out of which 6 districts were randomly selected. Over all the selected districts, 39% selected villages were on the metal road; 45% selected villages were at a distance upto 5 km, 12% villages at a distance between 5 to 10 km and 4% villages at a distance more than 10 km from metal road. The main mode of transport in all the selected villages of the districts was Bus/Taxi/Tonga/Auto/Jeep except in Kota district, where Tractor Trolley was also used as a mode of transport.

The basic amenities, viz. Electricity, School, Drinking Water and TV/Radio/News Paper were available in almost all the selected villages. Very few selected villages had Agricultural Machinery Supply Agency/Workshop facility.

The loan facilities from Bank and Co-operative Societies were available in all the selected villages of selected districts except Udaipur. In Udaipur district, it was available in about 60% selected villages. Same was the position for the Subsidy for Agricultural Inputs.

### Cropping pattern

The main crops grown in *kharif* season were Jowar, Maize, Black Gram, Green Gram, Soybean, and Groundnut, while in *rabi* season, the main crops were Wheat, Bengal Gram and Mustard.

### Percentage area irrigated and cropping intensity

The percentage area irrigated under NHT category of cultivators was 68% and under HT category of cultivators, it was 81%. The cropping intensity in NHT category of cultivators was 144% and in HT category of cultivators, it was 148%.

### Socio-economic conditions of the farmers

Based on socio-economic parameters, 36% of cultivators fall under Low income class, 54% in Low middle class and 9% in High middle class.

### Land holding pattern

Majority of the cultivators, i.e. about 61% had land holding upto 2 ha, 20% cultivators had 2–4 ha and only 12% cultivators had above 4 ha land holding under NHT

category of cultivators, while about 1.5% cultivators had land in holding size upto 2 ha, 2.1% cultivators had land holding of 2–4 ha and 3.5% cultivators had land holding above 4 ha under HT category of cultivators.

### Farm Machinery/Equipment/Implements used

The implements like Bund Maker, Cultivator, *Desi* Plough, Dibbler, Disc Harrow, Disc Plough, Duster, Hand Hoe, Leveller, Long Handle Hoe, M.B. Plough, Scythe, Seed Drill, Sickle, Sowing (manual metering), Sprayer, Thresher, Tractor Mounted Reaper, Weeder etc. were used by the cultivators of the State.

Details of different farm machinery and equipment in use, gaps and future requirements according to different crops as well as operations are given in Appendix-A.

Due to lack of proper infrastructure in the State, repair and maintenance facilities of different types of machinery/equipment/implements are inadequate.

### Average rate of custom hiring of tractor with implements

The average rate of custom hiring of Tractor (T) with Disc Plough was Rs 547 per ha; T+Disc Harrow: Rs 426 per ha; T+Cultivator: Rs 423 per ha; T+Harvester: Rs 200 per ha and T+Thresher: Rs 248 per ha in the selected villages.

### Average rate of custom hiring of farm power sources

The average rate of custom hiring of Tractor, Electric Motor and Diesel Engine for irrigation purpose was Rs 256, Rs 58 and Rs 53 per hr respectively, while for threshing purpose, corresponding custom hiring rates were Rs 249, Rs 178 and Rs 184 per hr respectively.

### Average rate of custom hiring of implements drawn by animals

The average rate of custom hiring of *Desi* Plough/ Disc Harrow/Cultivator drawn by animals was in between Rs 159 to Rs 593 per day in the selected villages of the State.

### Estimated number of farm power sources per thousand ha of net area sown

In Kota, Chittorgarh, Jalore, Banswara, Sirohi and Udaipur districts, the number of Tractors per thousand ha of net area sown was 19, 28, 65, 56, 36 and 11 respectively. Corresponding figures for Electric Motors were 103, 138, 144, 132, 114 and 71 respectively; for Diesel Engine were 121, 151, 20, 200, 94 and 70 respectively. Number of Draught Animals per thousand ha of net area sown were 486, 606, 68, 5682, 208 and

725 respectively. Over the State, Number of Tractors, Electric Motors, Diesel Engines and Draught Animals per thousand ha of net area sown were 30, 112, 95 and 571 respectively.

#### Estimate of total number of farm power sources

The estimate of the total number of Tractors, Power Tillers, Electric Motors, Diesel Engines and Draught Animals were 1,60,016; 4,436; 6,90,796; 6,69,190 and 44,11,058 respectively.

### TAMIL NADU

**Agro Climatic Zones-X, XI and XII** : **Southern Plateau and Hills Region**  
**East Coast Plains and Hills Region**  
**West Coast Plains and Ghat Region**

#### General Information

There were 30 districts in the State out of which 7 districts, viz. Namakkal, Tiruvanamalai, Coimbatore, Erode, Salem, Tuticorin and Nilgiris were randomly selected. Tamil Nadu is bounded on North by Andhra Pradesh and Karnataka, on West by Kerala, on East by the Bay of Bengal and on South by Indian Ocean. Tamil Nadu has an area 1,30,058 sq. km. Tamil Nadu is the southern most State in the Indian Union located between 8°–12°N latitude and 76° 15' and 80° 5' E longitudes. The economy of the State was predominantly rural with 67% of its population still living in rural areas and depending on agriculture and allied activities. The State can be divided into 4 physiographic regions (i) the Coastal Plains, (ii) Eastern Ghats, (iii) The Central Plateau and (iv) The Western Ghats. The soil in the State of Tamil Nadu falls broadly into 4 major categories viz. (i) Black soil (ii) Red soil (iii) Laterite soil and (iv) Alluvial soil. Of the total area of 12.96 million ha, red soil occupy a major area of 61%, black soil 12%, alluvial soil 24%, and laterite soil 3%. Out of the 6.56 million ha of cultivated area, about 6.7 lakh ha had been affected by soil salinity. The climate of Tamil Nadu was basically tropical. On account of proximity to the sea, it was more equitable than the climate of North India. Tamil Nadu had three distinct rainfall seasons (i) advancing monsoon season-June to September with Southwest winds, (ii) Retreating monsoon season-October to January with North Eastern winds and (iii) Transitional dry season-February to May. The normal annual rainfall in the State during 2000–2001 was 990 mm, while actual rainfall was 803 mm. Occurrence of drought was very frequent.

The day temperature ranges from 29°C (January) to 38°C (May) and night temperature ranges from 19–27°C. In hill regions like the Nilgiris and Kodaikanal, the day temperature varied from 19–24°C and night temperature varied from 8–16°C.

Agriculture was the major occupation in Tamil Nadu. The principal food crops include Paddy, Millets, Jowar, Bajra, Ragi, Maize and Pulses. Commercial crops include Sugarcane, Cotton, Sunflower, Coconut, Cashew, Chillies, Ginger and Groundnut. Plantation crops were Tea, Coffee, Cardamom and Rubber. Major forest produces were Timber, Sandalwood, Pulp wood and Fuel wood. The State occupies a premier position in the production and extensive application of bio-fertilizers.

Of the seven selected districts, five districts, viz. Namakkal, Tiruvanamalai, Coimbatore, Erode, Salem come under the 'Southern Plateau and Hills Region. Tuticorin district comes under the 'East Coast Plains and Hills Regions', while Nilgiris district comes under the 'West Coast Plains and Ghat region'.

As per 2001 census, the male and female population in Tamil Nadu State was 3,12,68,654 and 3,08,42,185 respectively. Sex ratio (females per 1,000 males) was 986. Density was 478 per km<sup>2</sup>. Literacy rates (%) of male and female were 82.33 and 64.55. Consumption of electricity for agricultural purposes during 2000–2001 was 9,312 million kWh which was 27.18% of total consumption of electricity in the State. Farm power availability in Tamil Nadu State during 2001 was 0.90 kW/ha and food grain productivity was 2,262 kg/ha.

Distance of villages from Block head quarter was up to 10 km in case of 58% villages. About 18% villages had distance between 10–15 km. Rest villages had distance more than 15 km.

In the selected districts, more than 57% villages were well connected from metal road. It was also observed that villages were not well connected from metal road in Namakkal, Tiruvanamalai and Tuticorin districts while villages were well connected in other selected districts.

Main mode of transport from village to block head quarter was Bus/Taxi/Tempo/Auto/Jeep in all the selected districts except in Nilgiris district, where mostly villages were connected by Tonga/Rickshaw.

Agricultural Machinery Agency, Marketing Agency and Workshop facilities were available in few villages. Co-operative Society, Co-operative Credit Society and Dispensary were available in about 50% selected villages. Input Supply Agency and Commercial Bank were available in few villages. Basic amenities, viz. Electricity, Telephone, Drinking water, TV/Radio/ Newspaper, School, Post office were available in almost

all the selected villages.

In the selected villages, loan from Banks and Co-operative Societies was either easily available or available with some efforts in about 85% villages while it was either available with great difficulty or not available in rest of the villages.

Subsidy for Agricultural Inputs was either easily available or available with some efforts in about 75% villages while it was available with great difficulty or not available in rest of the villages.

### **Cropping pattern**

In the selected districts, major crops grown were Jowar, Groundnut, Paddy, Black Gram, Cotton, Turmeric, Coconut, Sugarcane, Tapioca, Tea, Coffee etc.

### **Percentage area irrigated and cropping intensity**

Per cent area irrigated was about 32% under NHT category of cultivators, while it was 70% under HT category of cultivators. Cropping intensity was 160% under NHT category of cultivators, while it was 176% under HT category of cultivators.

Percentage area irrigated under NHT category of cultivators was minimum in Nilgiri district while percentage area irrigated was maximum in Coimbatore district. Percentage area irrigated under HT category of cultivators was maximum in Coimbatore district while it was minimum in Tuticorin district.

### **Socio-economic conditions of the farmers**

Based on socio-economic parameters, it was observed that 0.21%, 12.42%, 69.53%, 17.19% and 0.65% cultivators belong to poor, Low income class, Low middle class, High middle class and Rich class respectively.

### **Land holding pattern**

Majority of the cultivators, i.e. about 61% had land holding upto 2 ha, 24% cultivators had 2–4 ha and only 12% cultivators had above 4 ha land under NHT category of cultivators, while about 0.8% cultivators had land in holding size upto 2 ha, 1% cultivators had land holding of 2–4 ha and 2.2% cultivators had land holding above 4 ha under HT category of cultivators.

### **Farm Machinery/Equipment/Implements used**

Hand operated agricultural implements available in the State were Seed-cum-fertilizer drill, Seed Drill, Hand cutter Sickles, Wheel Hoes, Sprayers, Dusters, Threshers. Animal drawn/operated agricultural implements available in the State were Wooden Plough, Soil Stirring

Steel Plough, Soil Turning Steel Plough, Cultivator/Tripal, Disc Harrow, Seed-cum-fertilizer Drill, Seed Drill, Animal drawn Leveller, Wetland Puddler, Olpad Thresher, Animal Cart, Ghanies, Persian Wheel. Other Power machinery, e.g. Leveller, Planter, Sprayers and Dusters, Sugarcane Crusher, Maize Sheller were also available.

Tractor/Power Tillers and attached implements available in the State were Mould Board Plough, Disc Harrow, Seed-cum-fertilizer Drill, Seed Planter, Leveller, Potato Diggers, Trailers, Tractor-operated Combine, Self-propelled Combine, Paddy Thresher, Wheat Thresher, Multi-crop Thresher, Chaff Cutter, Sugarcane Crusher, Reaper.

Details of different farm machinery and equipment in use, gaps and future requirements according to different crops as well as operations are given in Appendix-A.

### **Average rate of custom hiring of tractor with implements**

In selected districts, average rate of custom hiring of Tractor with Cultivator was about Rs 620 per ha, while average rate of custom hiring of Tractor with Disc Plough was about Rs 732 per ha. Average rate of custom hiring of Tractor with Disc Harrow was Rs 427 per ha while it was Rs 331 per ha for Tractor with MB Plough. Tractors, Power Tillers, Diesel Engines, Electric Motors and Draught Animals were not available in the selected villages of Nilgiri district.

The average rate of custom hiring of Tractor for irrigation purpose was about Rs 234 per hr. The average rate of custom hiring of Electric Motor and Diesel Engine for irrigation purpose was Rs 51 and Rs 72 per hr respectively.

Average rate of custom hiring of animal drawn implements, viz. *Desi* Plough/Disc Harrow was between Rs 266 and Rs 405 per day while it was Rs 275 per day for Bakhar.

It was observed that there was lot of variation among average rate of custom hiring of farm power sources with implements in the selected districts.

### **Estimated number of farm power sources per thousand ha of net area sown**

In the selected districts, estimated number of Tractors and Power Tillers per thousand ha of net area sown were 27 and 4 respectively, while Electric Motors and Diesel Engines were 403 and 39 per thousand ha of net area sown respectively. Number of Bullocks per 1,000 ha of net area sown were 337.

Estimated number of power sources per thousand ha

of net area sown was minimum in Tuticorin district, while it was maximum in Coimbatore/Tiruvanamalai districts. There was no power source reported in Nilgiri district.

### Estimate of total number of farm power sources

In Tamil Nadu State, estimates of the number of Tractors, Power Tillers, Electric Motors and Diesel Engines were 61,168; 9,412; 9,95,484 and 99,797 respectively. Estimate of the number of Draught Animals was 10,17,227.

## UTTAR PRADESH

**Agro Climatic Zones-IV, V and VIII** : **Middle Gangetic Plains Region**  
**Upper Gangetic Plains Region**  
**Central Plateau and Hills Region**

### General information

There were 70 districts in the State out of which 13 districts were randomly selected on the basis of farm mechanization index. These districts fall under different agro climatic zones. 7 Selected districts, viz. Mirzapur, Varanasi, Balia, Basti, Gonda, Gorakhpur and Mau fall under Middle Gangetic Plains Region, while 5 selected districts viz. Kanpur Dehat, Baghpat, Barabanki, Bijnor and Muzaffarnagar fall under Upper Gangetic Plains Region and rest 2 selected districts viz. Lalitpur and Lucknow fall under Central Plateau and Hills Region.

Overall, 13-20% selected villages of Bijnor, Gonda, Gorakhpur, Lucknow and Muzaffarnagar, 23-30% selected villages of Mirzapur, Varanasi, Baghpat and Basti, 50% selected villages of Mau and 48% of Balia were within a distance of 5 km from their respective block head quarters. In Lalitpur district, only 5% selected villages were within a distance of 5 km from their respective block head quarters. In Kanpur Dehat and Gonda districts, most of the selected villages were not well connected with the metal road. In other selected districts, more than 90% selected villages were connected with the metal road. Majority of the selected villages of all the selected districts had Bus/Taxi/Tempo/Jeep/Auto as the main mode of transport from the villages to block head quarter. In some of the selected villages of Baghpat, Lucknow and Gorakhpur, Rail was also used as a mode of transport.

The basic amenities like Drinking Water, Electricity, Telephone, Television/Radio/News Paper and Schools were available in almost all the selected villages, while facilities like Co-operative Societies, Input Supply

Agency, Agricultural Machinery Supply Agency, Workshop Facility, Commercial Bank, Post Office, Dispensaries and Bakeries were available at a distance ranging from 5 to 10 km from the selected villages. The facilities like Cold Storage, Dal Mill, Milk Processing Plant, Food Packaging etc. were available at a distance between 20 km to 50 km in 50% selected villages, while in rest of the villages, these were available at a distance more than 50 km.

Loan to the cultivators from Banks and Co-operative Societies for agricultural purposes was available in most of the selected villages but subsidy for Agricultural Inputs was not generally available in the selected villages.

### Cropping pattern

Paddy, Maize, Jowar and Black Gram were the major crops grown in *kharif* season in most of the selected villages. Bajra, Red Gram and Ground nut were also grown in *kharif* season in some of the selected villages of Kanpur Dehat, Mirzapur and Varanasi districts. Wheat, Mustard, Bengal Gram, Pea and Potato were the major crops grown in *rabi* season while Black Gram, Green Gram and Onion were the major crops grown in *zaid* season. Sugarcane and Red Gram were some other major crops grown in most of the selected villages of the State.

### Percentage area irrigated and Cropping Intensity

More than 90% area was under irrigation in the selected villages belonging to NHT category of cultivators as well as HT category of cultivators except in Lalitpur, Mirzapur and Barabanki districts, where it varied from 82% to 86%.

The cropping intensity was 190% to 202% for NHT category of cultivators, while it was 183% to 203% for HT category of cultivators except in the Mirzapur district (where it was 128% for NHT category of cultivators), in Barabanki district (where it was 128% for NHT category of cultivators) and in Muzaffarnagar district (where it was 128% for NHT category of cultivators and 158% for HT category of cultivators).

### Socio-economic conditions of the farmers

Based on socio-economic parameters, overall, 22% cultivators of the selected villages belong to Low-income class. A majority of 63% cultivators belong to Low middle class while 15% belong to High middle class.

### Land holding pattern

Majority of the cultivators i.e. about 61% had land holding upto 2 ha, 20% cultivators had 2-4 ha and only

13% cultivators had above 4 ha land holding under NHT category of cultivators, while about 1.2% cultivators had land in holding size upto 2 ha, 2.2% cultivators had land holding of 2–4 ha and 2.5% cultivators had land holding above 4 ha under HT category of cultivators.

### Farm Machinery/Equipment/Implements used

The implements used by the cultivators in the selected districts of the State were Seed-cum-Fertilizer Drill, Seed Drill, Sickle, Hand Hoe, Long Handle Hoe, Wheel Hoe, Sprayer, Dusters, Thresher, Wooden Plough, Cultivator, Disc Harrow, Animal drawn Leveller, Puddler, Thresher, Leveller, Planter, Sprayers and Dusters, Sugarcane Crusher, Maize Sheller. Tractor attached implements available in the State were MB Plough, Disc Harrow, Seed-cum-Fertilizer Drill, Seed Planter, Leveller, Potato Diggers, Combine, Self-propelled Combine, Paddy Thresher, Wheat Thresher, Multi-Crop Thresher, Chaff Cutter, Sugarcane Crusher, Reaper etc.

Details of different farm machinery and equipment in use, gaps and future requirements according to different crops as well as operations are given in Appendix-A.

### Average rate of custom hiring of tractor with implements

The overall average custom hiring rates of Tractor with Disc Plough, M.B. Plough, Disc Harrow were Rs. 694, Rs. 764, and Rs. 758 respectively, while these rates were Rs. 590 and Rs. 549 for the Tractor with Cultivator and Seed Drill respectively. The Combine was used in the districts of Balia, Bijnor, Gonda, Gorakhpur and Mau and overall average custom hiring rate of Combine was Rs. 1,154. The average custom hiring rates of Tractor with Harvester & Thresher were Rs. 308 and Rs. 217 respectively. Average rates of custom hiring were higher in the selected villages of Varanasi, Baghpat, Gorakhpur and Muzaffarnagar districts as compared to other selected districts.

### Average rate of custom hiring of farm power sources

Average rate of custom hiring of Tractor for irrigation and threshing purposes varied from Rs 60 to Rs 200 per hr and Rs 137 to Rs 240 per hr respectively. The rates for custom hiring of Electric Motor for irrigation & threshing varied from Rs 15 to Rs 83 per hr and Rs 30 to Rs 150 per hr respectively. Custom hiring rates for Diesel Engine for irrigation were lowest at Rs 38 per hr in the selected villages of Balia and Varanasi districts and

highest at Rs 64 per hr in the selected villages of Lucknow district.

### Average rate of custom hiring of implements drawn by animals

Average rate of custom hiring of implements drawn by animals were: *Desi* Plough: Rs. 660 per ha; Disc Harrow: Rs. 749 per ha; and Cultivator: Rs. 669 per ha.

### Estimated number of farm power sources per thousand ha of net area sown

Estimated number of Tractors per thousand ha of net area sown was 18 in the selected villages of Mirzapur district, while it was 152 in Baghpat district. Estimated number of Diesel Engines per thousand ha of net area sown was 37 in Mirzapur district and 384 in Basti district. Estimated Number of Draught Animals per thousand ha of net area sown was 80 in the Balia district and 1,011 in the Bijnor district. In some of the selected villages of Varanasi, Mau and Kanpur Dehat, Power Tillers were also used, but its number is negligible.

### Estimate of total number of farm power sources

The estimate of number of Tractors was highest 24,870 in Bijnor district and the lowest 2,252 in Lucknow district. This figure was 7,03,416 for the entire State. The estimates of number of Electric Motors were 29,652 for Bijnor district, 24,353 for Varanasi district, 345 for Barabanki district and 433 for Gorakhpur district. The estimates of number of Diesel Engines were 96,051 in Bijnor district, 88,184 in Gorakhpur district, 13,073 in Lucknow district and 13,298 in Baghpat district. It was 29,34,393 for the entire State. Estimate of number of Draught Animals was 3,80,698 in Bijnor district and 17,026 in Balia district.

For the Uttar Pradesh State, the estimates of number of Tractors, Power Tillers, Electric Motors, Diesel Engines and Draught Animals were 7,03,416; 8,112; 7,19,705; 29,34,393 and 62,74,392 respectively.

## UTTARANCHAL

**Agro Climatic Zone-I : Western Himalayan Region**

### General Information

There were 13 districts in the State out of which 3 districts, viz. Almora, Bageshwar and Nainital came under random selection from among the list of selected districts under erstwhile Uttar Pradesh State. The State is located in the foothills of the Himalayas. The State has international boundaries with China (Tibet) in the North and Nepal in the East. On its North West lies Himachal Pradesh while on the South is Uttar Pradesh.

57 Uttaranchal is a hilly State that provides favourable environment for raising almost all type of agriculture

and horticultural crops. The mechanization in hilly tracts was badly affected by stepped, small and irregular fields, and undulating topography. In Uttaranchal State, number of Tractors and Power Tillers used for agriculture were 19,300 and 7,300 respectively according to Livestock Census 2003. In Uttaranchal State, estimated number of Tractors and Power Tillers per thousand ha of total cropped area were 14.363 and 5.433 respectively during 2002–2003.

The Uttaranchal State is situated between 28.42° and 31.28° North latitude and 177.35°–81.5° East longitude. Rice-Wheat was a major crop rotation. Most of the farmers had very small land holdings. Bullocks were the major source of farm power. *Desi* Plough, Puddlers and Levellers were the main animal drawn equipment. Sickles and Hand Hoes were the main hand operational tools which were used for removal of weeds and harvesting of crops respectively.

About 90% of the population of Uttaranchal state depends on agriculture. Total area of the State was 55,92,361 sq km, out of this area, 34,98,447 sq km was covered with forest, only 7,84,117 sq km area was used for agriculture and total irrigated area was 3,39,769 sq km and it was divided into two division, viz. Garhwal and Kumaon. Two districts of Uttaranchal, viz. Udham Singh Nagar and Haridwar located in the foothill of Himalayas, where farming conditions were similar to Indo-Gangetic plains. Also some parts of Nainital and Dehra Dun were having plain like conditions and similar crops were grown as in plain regions but the soil had gravels in it and needs different type of equipment for inter-culture operations. In all, the State has 11 districts in hills and two districts in plain region.

Agricultural land under irrigation was 5,19,806 ha during the year 1994–95 which was 56% of the total agricultural land. The state had excellent potential for hydro-power generation. Out of 15,669 villages, 12,315 villages had been electrified. The total length of metal roads in Uttaranchal was 16,652 km.

As per 2001 census, the male and female population in Uttaranchal state was 43,16,401 and 41,63,161 respectively. Sex ratio (females per 1,000 males) was 964. Density per km<sup>2</sup> was 159. Literacy rates (%) of male and female were 84.01 and 60.26. Farm power availability in Uttaranchal State during 2001 was 1.60 kW/ha and food grain productivity was 1,712 kg/ha. Rainfall in the State during 2000–2001 was 1,778.7 mm and normal rain fall was 1,667.9 mm. The plain soils were alluvial in nature as they were deposited by rivers and rivulets. These were loam to sandy loam in texture. The major soil group in hill soils was (i) Brown Forest

soils (ii) Sub-montane soils (iii) Mountain meadow soils (iv) Skeletal soil (v) Red loam soil.

About 60% selected villages were located at distance more than 10 km from block headquarter, while 23% villages were at distance between 5–10 km from block head quarter. Rest of villages were at distance of up to 5 km from block headquarter.

Only 12% selected villages were connected by metal road. Distance of villages from metal road was more than 5 km in case of 26% villages, while it was 1-5 km in case of 45% villages.

All the selected villages were well connected with block head quarter.

Drinking Water, Electricity, School and TV/Radio/ Newspaper were available in almost all the selected villages while Dispensary, Telephone and Post Office were available in about 50% selected villages. It was observed that Agricultural Machinery Supply Agency, Workshop Facility, Marketing Agency, Input Supply Agency and Co-operative Credit Society were available only in few selected villages.

Loan from Banks and Co-operative Societies was either easily available or available with some efforts in most of the selected villages.

### Cropping pattern

Main crops grown during *kharif* season were Paddy, Jowar, Maize, Bajra, Millet, Soybean etc. while during *rabi* season these were Wheat, Barley, Mustard, Lentil etc. During *zaid* season, Potato, Cucumber, Pumpkin, Onion, Bhatt (black soybean), Gaihat etc. were grown. Other crops grown were Sugarcane and Ginger.

### Percentage area irrigated and cropping intensity

It was observed that in case of cultivators, having holding size more than 2 ha, per cent cropping intensity was more in comparison to holding size up to 2 ha. 100% area was irrigated in holding sizes of more than 4 ha. In rest holding sizes, it was less.

### Socio-economic conditions of the farmers

Based on socio-economic parameters, it was observed that 33% cultivators fall under Low income class, 59% fall under Low middle class, and 8% cultivators fall under High middle class.

### Land holding pattern

Majority of the cultivators i.e. about 96% had land holding upto 2 ha, 2% cultivators had 2–4 ha and only 0.2% cultivators had above 4 ha land holding under NHT category of cultivators, while under HT category

of cultivators, about 0.4% cultivators had land in holding size upto 2 ha, 0.5% cultivators had land holding of 2–4 ha and 0.8% cultivators had land holding above 4 ha.

### Farm Machinery/Equipment/Implements used

The implements viz. *Desi* Plough, Disc Harrow, Hand Hoe, Leveller, Long Handle Hoe, Rotavator, Scythe, Seed Drill, Sickle, Sprayer, Thresher, Tractor Mounted Reaper, Winnowing etc. were used for performing various agricultural operations by the cultivators.

Details of different improved implements suggested for introduction in the State are given in Appendix-A.

Due to lack of proper infrastructure in the State, repair and maintenance facilities of different types of machinery/equipment/implements are inadequate.

### Average rate of custom hiring of tractor with implements

It was observed that in Nainital district, average rate of custom hiring of Tractor with Disc Plough/Cultivator/Disc Harrow/MB Plough was about Rs 400 per ha, while average rate of custom hiring of Electric Motor and Diesel Engine for irrigation purpose was about Rs 23 per hour.

Average rate of custom hiring of implements drawn by animals, viz. *Desi* Plough, Soil Turning Plough and Disc Harrow was about Rs 200 per day.

### Estimated number of farm power sources per

### thousand ha of net area sown

No power source except Draught Animals were observed in Almora and Bageshwar districts. Estimated number of Draught Animals per 1,000 ha of net area sown was 1,527 in all the three selected districts. In Nainital district, estimated number of Tractors per 1,000 ha of net area sown was 39 and estimated number of Electric Motors and Diesel Engines per 1,000 ha of net area sown were 3 and 19 respectively.

### Estimate of total number of farm power sources

Estimates of total number of Tractors, Electric Motors and Diesel Engines for Nainital district were 2,943; 252 and 1,429 respectively. Estimate of the number of Draught Animals for the State was 10,16,900.

Sl. No.	Agro Climatic Regions/Zones	States represented	Name of Expert
I.	Western Himalayan region	Himachal Pradesh, Jammu and Kashmir, Uttaranchal	Dr A Alam
II.	Eastern Himalayan region	Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, West Bengal	Dr A Alam
III.	Lower Gangetic Plains region	West Bengal	Dr NPS Sirohi
IV.	Middle Gangetic Plains region	Uttar Pradesh, Bihar	Dr NSL Srivastava
V.	Upper Gangetic Plains region	Uttar Pradesh	Dr NSL Srivastava
VI.	Trans Gangetic Plains region	Chandigarh, Delhi, Haryana, Punjab, Rajasthan	Dr SR Verma
VII.	Eastern Plateau and Hills region	Jharkhand, Chhattisgarh, Maharashtra, Orissa, West Bengal	Dr MM Pandey
VIII.	Central Plateau and Hills region	Madhya Pradesh, Rajasthan, Uttar Pradesh	Dr MM Pandey
IX.	Western Plateau and Hills region	Madhya Pradesh, Maharashtra	Dr MM Pandey
X.	Southern Plateau and Hills region	Andhra Pradesh, Karnataka, Tamil Nadu	Dr SJK Annamalai
XI.	East Coast Plains and Hills region	Tamil Nadu, Andhra Pradesh, Pondicherry, Orissa	Dr SJK Annamalai
XII.	West Coast Plains and Ghat region	Goa, Karnataka, Kerala, Maharashtra, Tamil Nadu	Dr SJK Annamalai
XIII.	Gujarat Plains and Hills region	Gujarat, Daman and Diu, Dadra and Nagar Haveli	Dr BS Pathak
XIV.	Western Dry region	Rajasthan	Dr BS Pathak
XV.	Island region	Andaman and Nicobar Islands, Lakshadweep	Dr A Alam

## WEST BENGAL

**Agro Climatic Zones–II, III and VII** : **Eastern Himalayan Region**  
**Lower Gangetic Plains Region**  
**Eastern Plateau and Hills Region**

### General Information

There were 18 districts in the State out of which four districts, viz. Bankura, Bardhaman, Hooghly and Midinipur were randomly selected. Agriculture plays a pivotal role in the State's income and nearly three out of four persons were directly or indirectly involved in agriculture. West Bengal was the leading producer of Paddy and second largest producer of potato in the country. In addition, it also grows Wheat, Pulses, Sesame, Groundnut, Jute, Sugarcane and Mustard.

The State, as a whole, had the humid climate. On the basis of soil composition, the State can broadly be classified into (i) Brown hill soil (ii) Terai soil (iii) Red soil (iv) Laterite soil (v) Alluvial soil (vi) Coastal soil.

As per 2001 census, the male and female population in West Bengal State was 4,14,87,694 and 3,87,33,477 respectively. Sex ratio (females per 1,000 males) was 934. It was most thickly populated State with a population density of 904 per sq km in 2001. Total generation of power in the State was 12,208.96 MU in 2000–01 (up to November, 2000). The total number of moujas electrified during 2000–01 (up to October, 2000) was 29,609 and the total number of pump sets energized was 1,10,079. Under the Kutir Jyoti and Lokdeep schemes, 1,21,745 households were electrified up to 31 October, 2000.

Consumption of electricity for agricultural purposes during 2000–2001 was 999 million kWh which was 6.68% of total consumption of electricity in West Bengal State. Farm power availability in West Bengal State during 2001 was 1.25 kW/ha and food grain productivity was 2,217 kg/ha.

Distance of villages from block head quarter was up to 10 km in about 51% selected villages while it was more than 20 km in 13% selected districts.

In the selected districts, most of the villages had distance between 0–5 km from metal road.

In the selected districts, most of villages were well connected with block head quarter and had Bus/Taxi/Temp/Auto/Jeep as main mode of transport.

Drinking Water facilities was available in about 96% selected villages. Electricity was available in about 80%

of the selected villages while Telephone facility was available in 68% selected villages. Dispensary was available in only 48% selected villages, while TV/Radio/Newspaper was available in about 89% selected villages. About 81% selected villages had Schools and about 42% selected villages had Post Offices. Commercial Bank, Co-operative Society, Agricultural Machinery Supply Agency and Workshop facilities were available in very few villages.

In selected villages, loan from Banks and Co-operative Societies was either easily available or available with some efforts in about 60% villages. In rest villages, it was either available with great difficulty or not available. Subsidy for Agricultural Inputs were either easily available or available with some efforts in 62% villages. In rest villages, it was either available with great difficulty or not available.

### Cropping pattern

The main crops grown during *kharif* season was Paddy while Mustard, Wheat, Potato, Boro Paddy were grown during *rabi* season. Til, Boro Paddy, Jute, Betal leaves were grown during *zaid* season. Other crops, viz. Mango, Sugarcane were also grown.

### Percentage area irrigated and cropping intensity

Under NHT category of cultivators, 49% area was irrigated, while under HT category of cultivators, it was 85%. Cropping intensity under NHT category of cultivators was 135% while under HT category of cultivators, it was 121%.

### Socio-economic conditions of the farmers

Based on socio-economic parameters, it was observed that 43% cultivators fall under Low income class; 52% cultivators fall under Low middle class; about 5% cultivators fall under High middle class.

### Land holding pattern

Majority of the cultivators, i.e. about 86% had land holding upto 2 ha, 9% cultivators had 2–4 ha and only 2% cultivators had above 4 ha land holding under NHT category of cultivators, while about 1% cultivators had land in holding size upto 2 ha, 1.1% cultivators had land holding of 2–4 ha and 0.8% cultivators had land holding above 4 ha under HT category of cultivators.

### Farm Machinery/Equipment/Implements used

The implements used by the cultivators for performing various agricultural operations were Cultivator, *Desi* Plough, Disc Plough, Hand Hoe, Leveller, Long Handle

Hoe, MB Plough, Pedal Operated Rice Thresher, Puddler, Rotavator, Scythe, Seed Drill, Sickle, Sprayer, Thresher, etc.

Details of different farm machinery and equipment in use, gaps and future requirements according to different crops as well as operations are given in Appendix-A.

Due to lack of proper infrastructure in the State, repair and maintenance facilities of different types of machinery/equipment/implements are inadequate.

#### **Average rate of custom hiring of tractor with implements**

Average rate of custom hiring of Tractor with Cultivator was Rs 560 per ha. Average rate of custom hiring of Combine was Rs 245 per hr. Average rate of custom hiring of Tractor with Disc Plough was Rs 850 per ha, while it was Rs 600 per ha for Tractor with MB Plough. The average rate of custom hiring of Tractor for irrigation purpose was about Rs 200 per ha. The average rate of custom hiring of Electric Motor and Diesel Engine for irrigation purpose was Rs 27 and Rs 58 per hr respectively. Average rate of custom hiring of animal drawn implements, viz. *Desi* Pough/Disc Harrow/Cultivator/Soil Turning Plough and Planking was Rs 115 per day.

#### **Estimated number of farm power sources per thousand ha of net area sown**

In the selected districts, estimated number of Tractors and Power Tillers per thousand ha of net area sown were 13 and 32 respectively. Estimated number of Electric Motors and Diesel Engines per thousand ha of net area sown was 85 and 733 respectively. Estimated number of Draught Animals per thousand ha of net area sown was 96.

#### **Estimate of total number of farm power sources**

In West Bengal, the estimates of total number of power sources viz Tractors, Power Tillers, Electric Motors, Diesel Engines and Draught Animals were 88,279; 2,59,352; 10,08,423; 95,21,488 and 9,08,912 respectively.

### **3.3.3 Phase-III: Organisation of Workshop and Preparation of Project Report**

During Phase-III, the results obtained after statistical analysis of digital data collected through the Large Scale Survey, were sent to the concerned mechanization experts so as to facilitate them in preparing the mechanization strategy papers for different agro climatic

zones/States.

#### **3.3.3.1 Experts for Preparation of Strategy Papers for Different Agro Climatic Zones/States**

For identification of experts relating to preparation of strategy papers pertaining to formulation of mechanization strategies, etc., a meeting of the Project Management Committee was held at the Institute on July 29, 2003 under the chairmanship of Dr BS Pathak, Director, SPRERI, Vallabh Vidyanagar, Gujarat. The experts identified for the preparation of strategy papers along with the allocated ACZs/States were as follows:

### 3.3.3.2 Organisation of National Workshop

#### 3.3.3.2.1 Presentation of Final Report

A meeting relating to presentation of final report pertaining to the study was held at IASRI, under the chairmanship of Shri Champak Chatterji, Additional Secretary, DOAC, Ministry of Agriculture, Govt. of India, on January 05, 2005 at 11.00 AM. The proceedings of the meeting are as follows:

Dr SD Sharma, Director, IASRI welcomed the Chairman and requested the participants to introduce themselves. Dr HVL Bathla, Head, Sample Survey Division welcomed the Chairman, invited experts, DOAC officials and the institute scientists present in the meeting. Chairman in his opening remarks observed that during 2004–05, about 100 districts in the country experienced drought for which assistance in the form of cash and foodgrains provided was to the tune of Rs 13,000 crore which is quite large in comparison to the budgetary provisions of DOAC. As such the drought conditions are very important to be considered for mitigation through mechanization. He mentioned about the new initiatives taken by the Ministry of Agriculture like, (i) Emphasis to enhance production and productivity under dryland farming conditions, (ii) Launching of National Horticulture Mission from 2005 and (iii) Bamboo development programme. Thereafter, Dr KK Tyagi, Principal Investigator presented the final report highlighting various issues and recommendations on the following points: the returns from investments; institutional frame work; operational holdings; limited range of equipment; resource conservation; quality of farm machinery; new developments; backward agriculture; banking norms; animal draught power; assured supply of power and fuels; repair and maintenance of agricultural equipment; health and safety and agricultural mechanization data. He also covered the background for initiating the study, the need for farm mechanization and main objectives of the study. He further informed that in the first phase, a seminar-cum-group discussion was organised for deliberating various issues related to the study and experts for preparation of ten status papers on various topics were identified. In the second phase, a large scale survey was conducted in 120 randomly selected districts of the country. He apprised about the sampling design and other details of the survey and the difficulties experienced. He mentioned about the 15 Agro Climatic Zones (ACZs) and the States lying within these zones, some of the state boundaries cutting across in more than one ACZ. In the third phase, experts in the field of agricultural engineering were

identified for preparation of mechanization strategies for each of the ACZs/States as well as at the national-level.

Thereafter, the report was discussed in detail and the comments/observations of different experts are as below:

#### Dr BS Pathak

- So far the agricultural mechanization programmers were being guided by the perception of the farmers. He appreciated that Ministry of Agriculture has decided for the study in question to work out strategies and programmes for appropriate agricultural mechanization in different agro climatic zones/States.
- Multi farm use of Tractors is happening in the country. However, the benefits of introduction of Tractors, have not spread in all the States. He further emphasized that necessity for strategies should be worked out at the national as well as state levels.
- In the past, Ministry of Agriculture had brought out a draft document on ‘National Policy on Agricultural Mechanisation’ which needs to be updated and finalized in the present scenario for its implementation.
- The infrastructural strength at the field level is more important for implementation of the programmes and policies at national level as well as the level of States. This infrastructural arrangement should also be supported through institutional arrangement at both the levels.
- The cost of cultivation has been more because of the poor management of the available infrastructural arrangement for agricultural mechanization for which institutional services on regular basis need to be used.
- He was of the view that for effective implementation of the farm mechanization programmes in the States, a more pragmatic strategy and other related details need to be worked out by each State.
- He suggested that the workshop need to be conducted for sensitizing the State as well as union administrative machinery on issues of agricultural mechanization for working out implementable programmes and their follow-up to know the efficiency of implementation and required changes in the programmes, if any etc. on regional basis.

#### Dr A Alam

- Exercise done in this project needs to be translated into ground-action.
- The development of agricultural mechanization in the country has been declining. Even the socialist States like Kerala and West Bengal have started the introduction of Power Tillers and other agricultural equipment in their States.
- As regards low cost of Chinese farm machinery and equipment, he pointed out that the China has State promoted activities whereas Chinese equipment are not durable and efficient as compared to the indigenous ones. However, so far as Chinese Rice Transplanter is concerned, the same has been evaluated by ICAR and has been adopted in the country on selective basis. He was of the view that agricultural mechanization cannot be outsourced as it may have negative effect.
- In order to enhance the agricultural mechanization, the states need to have stronger extension network. As of now, the infrastructure for agricultural mechanization is very poor. He quoted the example of annual investment to the tune of Rs 50,000 crores for agricultural machinery as compared to Rs 24,000 crores combined annual investment on fertilizers, certified seeds and plant protection chemicals. Wherein the fertilizer and pesticide industry have a much stronger infrastructure than the agricultural mechanization. Ministry of Agriculture should pilot specific extension programmes for agricultural mechanization in terms of expertise at its own level as well as at the level of States in the form of State Directorates of Agricultural Engineering with requisite support of technical manpower. He stressed that skill oriented extension personnel are needed for making these activities more effective.

#### Dr NSL Srivastava

- Power input is not adequate.
- Investment in the farm machinery is quite heavy which can be seen in terms of investments at national level. Therefore, the selection of right type of prime mover and agricultural machinery is more important because a machine once purchased will have to be used by the farmer over a period of 8–10 years. On the other side, at the State level, there is no infrastructure wherefrom farmers can get proper guidance for selection of right type of equipment.
- He emphasized the need for investment

proportional strengthening of infrastructure at the Central and State levels with reference to the total investments in the sector.

- He informed that the traditional user of Draught Animal Power (DAP) has gone down and its annual use in the farming is limited to 230–240 hours only. Therefore, large scale promotion of custom hiring of agricultural machinery is very important for effective implementation of farm mechanization programmes.
- The importance of Front Line Demonstrations (FLDs) was emphasised for effective utilisation of agricultural machinery and equipment. He quoted the example of a State which demanded one unit of Zero-till-Seed-cum-Fertiliser Drill in the FLD programme, which clearly shows the complete absence of infrastructure at the State level for taking up FLD programmes. The allocations for the FLD programme are too meager and need enhancement.
- As regards availability of trained manpower for reaping the benefits of agricultural mechanization, it may be seen that practically there is no facility with the States for such training. For this purpose, manufacturers also need to be involved for training agricultural machinery users on large scale.
- Emphasis need to be given for on-farm post harvest technologies at the village level with a view to reduce losses which are to the tune of 30–50% in perishable crops.
- He also emphasised need for building a data base on agricultural mechanization.
- He pointed out that emphasis need to be given in the area of crop residue management for which whole set of equipment need to be developed/propagated.

#### Dr SR Verma

- Interaction with the States may involve manufacturers and users for suggesting agricultural mechanization programmes. Some of the States have Implement Manufacturers Associations. Such arrangement should be followed in each State.
- In order to encourage more manufacturers to take up the production of any agricultural machines/equipment, it is necessary that standardization of equipment and components is done along with the production and marketing strategies which will attract a large number of manufacturers. He

gave the example of Combine Harvesters, for which, all critical components and development of vender arrangements have gone to a level that today we have more than 100 small scale Combine Harvester manufacturers which in the year 1970–71 was a big challenge to the Indian industry.

- Similar happenings are taking place in the case of manufacture of tractors. The recent example is of Combine Harvesters manufacturers who have also taken up the manufacturing of tractors.
- Agricultural mechanization is dynamic and there is a need for a cell for promoting all strategies and programmes on regional as well as time bound basis. He cited the example of the State of Punjab which is highly mechanised and facing the problems of decline in the ground water level and soil health etc. which call for diversification in cropping programmes leading to change in the farm mechanization requirements to avoid possible hydraulic draught in the state in near future.
- He emphasized the need for training requirements for tractor operators and other agricultural machinery users. The contributions of the Farm Machinery Training and Testing Institutes (FMTTIs) training of over 80,000 personnel, since their inception is too meagre considering the total number of tractors in the country which is around 30 lakh at present. This calls for larger involvement of manufacturers and other agencies for human resource development.
- He referred to the CESS Fund being generated on tractors by imposing special excise duty and the utilization of this CESS Fund for creation of research facilities in the area of tractors and agricultural mechanization in general. He proposed that a “Tractor Engineering Institute” need to be set up in the country for improving the quality and utilisation of tractors in the country with a view to reducing the cost of cultivation and enhancing the productivity.
- Development of mechanization relating to horticultural sector need to be given priority.
- With a view to improve infrastructure for mechanization in the country, he emphasized over the necessity of a study on the available infrastructure for agricultural mechanization in reference to other developed countries.
- In developed countries, the Agricultural Machinery Manufacturer’s Associations support

national level institutions. The Tractor Manufacturers Association (TMA) should also support agricultural machinery institutions in the country having sphere of work in related areas.

- He emphasized the formulation of a national policy on agricultural mechanization for which the draft is already prepared and need to be updated in the present scenario.

#### **Dr MM Pandey**

- Adequate R&D infrastructure in ICAR is available through its Institutes; Project Directorates; National Research Centres; Krishi Vigyan Kendras and number of centres of various AICRPs spread all over the country.
- Popularization of agricultural machinery is not adequate. For a regular feed back, the involvement of the State Governments, SAICs and manufacturers is needed.
- A Directory containing the information on all type of implements and manufacturers has been prepared by the ICAR.
- It is necessary that standard components are used for manufacture of agricultural machinery in order to make available low cost equipment as only low cost equipment can give higher returns to the farmers.
- Proper resource management and contract farming concept is the need of the hour.
- Improvement in the manufacturing and production of quality equipment is necessary.
- Custom hiring of agricultural equipment should be encouraged.

#### **Dr Nawab Ali**

- Timely operations result in reduction in the cost of production, increase in yield and high returns to the farmers.
- A national level workshop on agricultural mechanization has been proposed at Central Institute of Agricultural Engineering (CIAE), in collaboration with Central Farm Machinery Training and Testing Institute (CFMTTI), Budni in the near future.
- Department of Agriculture and Cooperation should persuade all the State Governments to have Agricultural Engineering Directorates. Manufacturing facilities for different types of agricultural equipment are required to be augmented locally through these Directorates, keeping in view the location, soil and crop specific

requirements.

- The Agricultural Engineering Directorates in each State should be involved in undertaking programmes related with small scale industry sector.
- Each State should have an association of agricultural machinery manufacturers.

#### **Dr Pitam Chandra**

- Besides agricultural mechanization, the mechanization in fisheries and livestock sector should also be given due consideration.

#### **Sh RS Dass**

- The information on agricultural mechanization needs to be updated, as per the latest Livestock Census and estimated population based on earlier Livestock Censuses be given in the study report.
- The study should elaborate strategies to be laid down and prioritize them on the basis of the block of five years.
- The Appendices should be updated and properly referred in the main document.
- The Agricultural Mechanization Policy document will be reviewed after the findings of the report are finalised.

#### **In the end, Chairman observed that**

- Detailed discussions with State Governments on policy issues and implementation of programmes related to the strategies recommended for mechanization of agro climatic zones/States should be done at the earliest. For this purpose, IASRI in association with DOAC should organise a two-days workshop involving mechanization experts and state level officials.
- He pointed out that the issue of displacement of labour due to mechanization need to be discussed in depth.
- Labour productivity in India is low which calls for mechanization in agriculture.
- Avenues of non-farm employment through mechanised agriculture for which a study made in West Bengal may be referred.
- Intensive focus need to be given for hill and north eastern regions including other low productivity areas as a National Priority.
- He mentioned that China has opened second channel for mechanization by providing low cost equipment which may not be sturdy but would certainly attract the users. China has also

recognized use of Tractors, Power Tillers etc. as a mean of rural transport. Cost-benefit analysis need to be worked out for adopting Chinese make of agricultural machinery and equipment.

- He was of the view that the final report on the study being of national importance, should be released on some specific day related to mechanization which could refer to the introduction of first tractor in the country or any other important event related to mechanization.
- Ministry of Agriculture has identified Southern Region Farm Machinery Training and Testing Institute (SRFMTTI), Garladinne, District Anantpur (Andhra Pradesh) as a “Centre of demonstration for mechanization in dryland farming”. This being otherwise important that the district of Anantapur had maximum number of suicide cases of farmers in the rural areas and Bangalore was highest in urban areas.
- On the issue of reliability of livestock census and the delays taking place in regular publishing of the census data including data on agricultural mechanization, he was of the view to entrust study to some professional institute like NSSO for timely agricultural census which may form base for policy decisions. He was of the opinion that data base is an important source for bringing out new programmes including policy decisions etc. and the quality of data need to be ensured apart from its timeliness.
- The gap analysis is important for deciding the strategies for agricultural mechanization and making of policies and programmes etc.
- He suggested for combined efforts on the part of ICAR and DOAC for effective implementation of the strategies and programmes on agricultural mechanization. He pointed out that the study shows enhancement of mechanization in terms of number of tractors per one thousand ha which may not alone be indicative of farm mechanization indices and need a more composite approach taking into account agricultural machinery and equipment other than tractors.
- He pointed out that the role of Self Help Groups (SHGs) in propagation of agricultural mechanization should be worked out to make agriculture a profitable venture.
- He was of the view that like other associations, i.e. Fertilizer Association of India, the Tractor Manufacturers Association should also organize a National Workshop annually to discuss the

Group No.	Agro-climatic regions/zones	States represented	Venue
I.	I. Western Himalayan region II. Eastern Himalayan region XV. Island region	Himachal Pradesh, Jammu and Kashmir, Uttaranchal, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, Andaman and Nicobar Islands, Lakshdweep	Symposia Hall, NASC
II.	III. Lower Gangetic Plains region VII. Eastern Plateau and Hills region VIII. Central Plateau and Hills region IX. Western Plateau and Hills region	Jharkhand, Chattisgarh, Orissa, West Bengal, Madhya Pradesh, Rajasthan	Committee Room No. 2 NAAS
III.	IV. Middle Gangetic Plains region V. Upper Gangetic Plains region	Uttar Pradesh, Bihar	Committee Room No. 3 NAAS
IV.	VI. Trans Gangetic Plains region XIII. Gujarat Plains and Hills region XIV. Western Dry region	Chandigarh, Delhi, Haryana, Punjab, Rajasthan, Gujarat, Daman and Diu, Dadra and Nagar Haveli	Lecture Hall NAAS
V.	X. Southern Plateau and Hills region XI. East Coast Plains and Hills region XII. West Coast Plains and Hills region	Andhra Pradesh, Karnataka, Tamil Nadu, Pondicherry, Orissa, Goa, Karnataka, Kerala, Maharashtra	Committee Room No. 1 NAAS

Note: Each Group will also include Officers from respective State Governments, Officials of State Agro Industrial Corporations, FMTTI, DOAC, Participants from Private Organizations.

issues relating to agricultural mechanization where each State Govt. could spell out their programmes for agricultural mechanization.

Dr KK Tyagi proposed vote of thanks to the Chair and others present.

### 3.3.3.2.2 Organisation of National Workshop on Long-term Mechanization Strategies

As per the recommendation of the meeting held under the chairmanship of Shri Champak Chatterji, Additional Secretary, DOAC, Ministry of Agriculture, Government of India, on January 05, 2005, a 2-days National Workshop to discuss and finalize the long term mechanization strategies formulated under the project, with the representatives of the State Governments and other user organizations as well as stakeholders, was organized by the IASRI, New Delhi during April 15–16, 2005. The venue of the Workshop was National Agriculture Science Centre Complex, Pusa, New Delhi. The Workshop was inaugurated on April 15, 2005 by Ms Radha Singh, Secretary, Department of Agriculture & Co-operation, Ministry of Agriculture, Government of India and presided over by Dr Mangala Rai, Secretary, Department of Agricultural Research & Education, Ministry of Agriculture, Government of India and Director General, ICAR, during the Inaugural Session.

The proceedings of the National Workshop are as follows:

#### Inaugural Session

At the outset, Dr SD Sharma, Director, IASRI welcomed the Chief Guest, Ms Radha Singh, Dr Mangala Rai, Sh. Champak Chatterji, Dr Nawab Ali, Dy. Director General (Engg.), ICAR, Sh. Prem Narain, Joint Secretary (Machinery), Deptt of Agriculture & Cooperation, the Farm Mechanization Experts and other invited dignitaries.

Sh. Prem Narain, Joint Secretary (Machinery) briefly reviewed the progress of Agricultural Mechanization in India and focussed on the need to extend the benefits of the technology to vast majority of farmers who are still not able to make use of improved agricultural equipment and power sources.

Dr KK Tyagi, Principal Scientist and Principal Investigator gave a brief report on the methodology adopted in the study for the conduct of large-scale survey and formulation of long-term mechanization strategies.

Ms Radha Singh, Secretary, DOAC, Ministry of Agriculture and Chief Guest in her address referred to the millennium study report, recently completed by the Ministry of Agriculture. She observed that the role of Mechanization so far is not significant and is required to be up-scaled. She observed that mechanization in good

number of States is slow as well as uneven.

For appropriate growth of mechanization, the farmers need to be convinced and educated. Policies at central as well as regional levels need to be formulated for sustainability of agriculture. Indian agriculture need to be provided with efficient agricultural Machinery through replacement of old and inefficient one. The annual investment on agricultural Machinery is to the tune of Rs 50,000 crores, which is more than the combined investment on other inputs such as seed, fertilizers and agro-chemicals. She emphasized over the need to ensure adequate returns of the huge investment in farm mechanization. The country needs to exploit the massive investment being made on agricultural Machinery. The extension machinery of the public sector had till now focussed only on production issues which need to be restructured to meet the needs of mechanization of the country. The private sector should also facilitate extension of agricultural Machinery through their dealership network.

She further emphasized over the quality of agricultural Machinery being manufactured in the country which should be of high quality so as to compete with the international market. For quality and healthy competition, few agricultural machines have been decentralized by the Central Government and the industries should take advantage of it in view of the shrinking land holding size.

The custom hiring/group ownership is the appropriate model for expansion of adequate use of agricultural Machinery in the country. She also mentioned that the fear of mechanization displacing labour has gone and people are now convinced that mechanization leads to off-farm employment as well as more employment through higher productivity.

Dr Mangala Rai, Secretary, DARE and Director General, ICAR in his presidential remarks stressed on the need for better management of crops and other agricultural biomass which is now destroyed through uncontrolled burning after harvest, resulting in loss of valuable organic matter and creation of serious air pollution. He suggested that the development of technology through which the crop residues could be put to dual use namely generation of energy without destroying the organic matter which should be returned to the soil. He observed that assured supply of good quality energy to the rural sector was a pre-requirement to sustain agriculture.

He recommended the establishment of improved farm equipment demonstration units at block-level and proper training and support to the rural artisans so that they

acquire the needed skills for the repair and maintenance of improved agricultural implements.

Dr HVL Bathla, Principal Scientist & Head, Division of Sample Survey proposed vote of thanks to the Chair, Chief Guest, Senior Officials of the DOAC, Ministry of Agriculture, invited Farm Mechanization Experts and other invited dignitaries present in the Inaugural Session.

Thereafter, the entire deliberations of the Workshop were planned in three Technical Sessions as below:

### **Technical Session-I: Presentation on the Recommendations of National level Mechanization Strategies**

The issues and recommendations relating to long term mechanization strategies at the National Level formulated by the mechanization experts were presented in detail by Dr KK Tyagi, Principal Scientist and Principal Investigator. The session was chaired by Sh Champak Chatterji, Additional Secretary, DOAC, Ministry of Agriculture, GOI. After the presentations, there was discussion in the house and the following points emerged:

#### **General Observations**

- Pace of mechanization is slow and needs to be expedited.
- There is very little knowledge about the matching implements. It should be very properly propagated among the farmers.
- Improved management of farm machinery should be taken care of.
- Value addition and on-farm processing to be taken care of.
- Irrigation should be given lot of support—drip and sprinkler.
- Improved Agricultural residues management should get top priority.
- Machines for compost making should also be designed.
- Plant establishment machines need to be promoted by popularizing seed-cum-fertilizer drill and zero till drill.
- Machine for picking of mushroom should be developed.

#### **Animal Energy**

- Animals have energy conservation and environment friendly role and mostly used by the small and marginal farmers, therefore, it need be promoted where tractorization cannot be done.
- Need to strengthen research, development and extension in the field of improved animal drawn

equipment for such areas where mechanical power sources are not suitable.

- Therefore improved and matching implements need be provided to farmers for efficient utilisation of animal power along with yokes for increased utilisation, animals with bull gears may be used for post harvest operations using machines upto 1 hp.
- For promoting non-motorised transport, improved animal carts and hardened hoof shoe may be popularized for hooped animals.

#### Human Engineering and Safety in Agriculture

- As more and more farm machines are going to be used in future times to come, there may be accidents due to machines/other sources while carrying out various farm operations. It is therefore recommended that compensation scheme for agricultural accident victims may be initiated in all the States, as that at Punjab and Haryana, through agricultural marketing boards. It will help to rehabilitate the accident victims/their families.
- Designing of equipment taking into account the Health and Safety considerations should be done.

#### Women labour

- Design and development of tools and equipment suitable for farm women.
- Training to farm women to upgrade their skills in the operation of farm machines/equipment.

#### Custom hiring

- Custom hiring - support for operation and maintenance should be provided through State Engineering Workshops and Institutions like CIAE, Bhopal etc.

#### Irrigation and Drainage

- Irrigation operation contributes about 50% of the energy going into agriculture. Accordingly, irrigation equipment, e.g. pump sets etc. should be designed according to the ground water level in the respective areas.
- Machinery for agricultural drainage must be planned for future.
- More efficient equipment for irrigation and drainage should be developed.

Thereafter, In Technical Session-II, all the participants were divided into 5 Groups as shown in the above Table.

Within each Group, the concerned mechanization expert presented the long term mechanization strategies

for the respective ACZs/States. There was discussion at length and the recommendations of different groups are as follows:

#### RECOMMENDATIONS OF GROUP-I

- Chairman** : Dr BS Pathak, Director, SPRERI, Vallabh Vidyanagar (Gujarat)
- Presented by** : Dr K K Satapathy, Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Barapani (Meghalaya)

#### Recommendations

1. For Jammu and Kashmir region, there should be more Centres of AICRP on Farm Implements and Machinery. Presently there are only two SAUs namely Sher-e-Kashmir University of Agricultural Sciences and Technology, one located at Srinagar and another one at Jammu.
2. Light weight good quality Power Tillers are specially needed for this region.
3. In North Eastern Hilly (NEH) region, there may be processing units for Pineapple crop like HPMC in Himachal Pradesh State.
4. More interaction is needed between farm equipment manufacturers, farmers and agricultural engineers.
5. There may be machines for execution of rose water essence.
6. Equipment must be standardized so that its spare parts may be replaced easily, if need be.
7. Post harvest machines like processing/pruning etc. are also needed.
8. Developed equipment should be promoted.
9. Local manufacturer may be encouraged for manufacturing good quality equipment.
10. Insurance for agricultural machinery should be done.
11. Subsidy should be given on newly introduced machines and tested agricultural machinery. All agricultural machines should be exempted from taxes etc.

#### RECOMMENDATIONS OF GROUP-II

**Chairman** : **Dr MM Pandey,**  
**Project Coordinator,**  
**AICRP on FIM,**  
**CIAE, Bhopal**  
**(Madhya Pradesh)**

**Presenter(s)** : (i) **Dr MM Pandey,**  
**Project Coordinator,**  
**AICRP on FIM,**  
**CIAE, Bhopal and**  
(ii) **Dr NPS Sirohi,**  
**Principal Scientist and**  
**Scientist Incharge,**  
**Indo-Israel Project,**  
**IARI, New Delhi**

### Recommendations

1. Recommendations will be referred to respective State Governments for their comments and monitorable action plan within a reasonable time frame.
2. A list of improved implements has been suggested. State Governments shall prepare a phased action plan for introduction and commercialization of these implements. The action plan shall include the Front Line Demonstration of selected implements.
3. State Governments shall prioritize the farm equipment for their introduction and commercial production in a phased manner.
4. Based on the priority, State Governments may determine equipment for providing subsidy.
5. Front Line Demonstration scheme of improved farm implements should be strengthened with larger financial assistance from the Ministry of Agriculture, Government of India.
6. All State Governments should have Directorate of Agricultural Engineering with adequate extension infrastructure for taking up farm mechanization programme.
7. Regular interface on farm mechanization should be held at least half yearly with participation of officials from the Ministry, State Departments/R&D Institutes/SAU's/CIAE/Manufacturers Associations.
8. A system should be evolved for collection and updating of farm mechanization data such as number of machines in use, manufacturing units and supply of equipment to the farmers.
9. State Governments should take up entrepreneurship developments for custom hiring of high capacity and costly equipment. The Central

Government may provide financial assistance for establishment of such entrepreneurs.

10. Higher subsidies to the farmers of weaker section for purchasing of improved farm machinery should be provided by Central Government.
11. The State Governments should evolve a policy to encourage local manufacture of improved equipment through one time grant or other financial assistance.
12. Regular orientation programmes should be conducted by ICAR Institutes/SAU's for extension engineers on recent developments.
13. ICAR Institutes, Manufacturers Associations, SAUs and State Departments of Agriculture in each State should evolve a system for obtaining feedback on new farm equipment being introduced for their design refinement and also to assess the need for new equipment required by the farmers. Organization of bi-annual meeting suggested may be used to serve these two objectives.

### RECOMMENDATIONS OF GROUP-III

**Chairman** : **Er CB Singh,**  
**Joint Director (Agril Engg)**  
**(Govt. of Uttar Pradesh)**

**Co-Chairman** : **Er LB Prasad**  
**Joint Director (Agril Engg)**  
**(Govt. of Bihar)**

**Presented by** : **Dr NSL Srivastava,**  
**Joint Director, SPRERI,**  
**Vallabh Vidyanagar (Gujarat)**

### Recommendations

1. It was observed that the analysis of issues and identifications of gaps have been done nicely and the mechanization strategies recommended are most appropriate and implementable.
2. A High Power Committee may be appointed at the State Level to look into the recommendations and prepare Time Bound Action Plans for the implementation of recommendations.
3. A Cell should be created at the State Level for Monitoring of the Progress of Execution of Action Plan.
4. The recommendations should be segregated into different heads related to R&D, Extension, Training, Manufacturing, Policy Issues etc.

### RECOMMENDATIONS OF GROUP-IV

**Chairman** : Dr BS Pathak,  
Director, SPRERI,  
Vallabh Vidyanagar (Gujarat)

**Presented by** : (i) Dr SR Verma, Ex-Dean,  
PAU, Ludhiana (Punjab)  
and  
(ii) Dr BS Pathak,  
Director, SPRERI,  
Vallabh Vidyanagar  
(Gujarat)

### Recommendations

**Easy Credit Policy for Custom Hiring/Farmers:** For promotion of farm mechanization, custom hiring/co-operative operation of farm machinery should be encouraged and land mortgage requirement should be removed but hypothecation of machinery and interest free credit for five years and for non-plan funds of assets for five years be provided.

**Subsidy on Farm Machinery:** Subsidy should be given on newly introduced machines and tested agricultural machinery. All agricultural machines should be exempted from VAT/CST and other taxes etc.

**Establishment of Farmers Co-operative/ Association/Club:** For promoting/adoption of newly developed farm machinery, co-operative club/association etc. should be promoted. Front line demonstration/proper selection/camps etc. should be organized through governmental agencies/SAUs/KVKs etc. to promote collective and enhanced annual use of such machinery.

**Diversified Agriculture Long-term Projects:** The farmers willing to adopt farm mechanization in different projects should be encouraged through formulation of projects with easy credit with zero per cent interest rate for a period of five years on the pattern of industry.

**Specialized R&D Centers for Combine Harvester/ Farm Machinery:** R&D centres for combine and farm machinery be located in clusters where such machineries being manufactured. This will help in improving manufacturing and standardization of such machines.

**Establishment of Regional/State Entrepreneur Development Centers (EDC):** In order to promote custom hiring of farm machinery/establishment of agro-business centres/agro-processing centres etc. EDCs should be established on regional basis to promote vocationalization and rural employment.

**Enforcement of BIS code:** There should be an agency at the central level which enforces the strict compliance of BIS codes by random sampling technique to save the farmers from poor quality farm machines.

**Establishment of Agricultural Machinery Export Promotion Cell:** This cell will help the industry in locating consumption centres around the world so that the farm machinery being manufactured in India could be gainfully exported to third world countries.

**Integrated Agricultural Approach:** There is a need to develop Integrated Agriculture mechanization approach to give due consideration to agriculture, animal husbandry, fishery, horticulture and vegetable production systems.

**Establishment of Farm Machinery Front Line Demonstration Centers-cum-Custom Hiring Units:** These centres will promote efficient use of newly developed and recommended farm machineries through FLD programme. At later stages, these machinery can also be provided on custom hiring basis to the farmers for further promotion.

**Establishment of Directorate of Agricultural Engineering in all States:** The area of agricultural engineering includes farm mechanization, post harvest handling, agro-processing, soil conservation, soil health care, water quality and alternative energy resources. At present different agencies are handling this task. These activities should be clubbed together and handled by the Department of Agricultural Engineering.

**Agricultural Machinery Manufacturing Processing Modernization Centers:** Presently the infrastructure available with the farm machinery manufacturers/harvesting combine manufacturers is of obsolete nature. This centre will help in upgrading and modernisation of manufacturing processes on consultancy basis.

**Composite Testing of Diesel Engines for Agricultural Use:** Presently, ARAI and CMVRI are testing the engines under construction machinery. However, this testing should also include the requirements necessary for agricultural purposes and a composite certificate should be given.

**Strengthening research and development for farm mechanization and allied sectors.**

1. Mechanization of agricultural operation for various agricultural crops other than wheat and paddy for diversification of agriculture.
2. Fodder mechanization for promoting dairying industry.
3. Mechanization of horticulture and fodder crops.
4. Mandi mechanization and bulk handling.
5. R&D on alternate fuels and renewable energy sources.
6. Mechanization of residue management operations.
7. Establishment of water harvesting, water conservation, and water quality testing aspects for

development of water resources and water use efficiency.

8. Development of mechanization technology for dry land agriculture.
9. Establishment of regional institutes for developing farm machinery management data to make optimal utilization of capital resources of farm machinery.
10. Establishment of a centre for ergonomics, safety and health hazards in agriculture.
11. Establishing regional prototype production centres for rapid transfer of technology and industrial liaisoning.
12. Industrial Extension Service for farm machine industry.
13. Establishment of IT based centre-cum-market intelligence system.
14. Establishment of Central Institute of Tractor Engineering.
15. Farm Machinery Training Centre for operators of tractors/bulldozers/combindes and other sophisticated farm machinery.

#### RECOMMENDATIONS OF GROUP-V

- Chairman** : **Dr LP Gite,**  
**Project Coordinator,**  
**AICRP on HESA,**  
**CIAE, Bhopal (MP)**
- Co-Chairman** : **Sh N Krishana Reddy,**  
**Dy Director, Agriculture,**  
**(Andhra Pradesh)**
- Presented by** : **Dr SJK Annamalai,**  
**Principal Scientist & Head,**  
**CIAE Industrial Extension**  
**Project,**  
**TNAU, Coimbatore**  
**(Tamil Nadu)**

The three zones X, XI and XII cover the Peninsular India comprising Tamil Nadu, Karnataka, Andhra Pradesh, Union Territory of Pondicherry, Coastal Orissa, Goa and Coastal Maharashtra (Konkan region). The group comprising representatives of State Governments of Kerala, Karnataka and Andhra Pradesh, SAIC from Kerala and Konkan Krishi Vidyalaya, Dapoli Maharashtra and experts from CIAE, Bhopal discussed in detail the long term mechanization strategy proposals and following recommendations have been made.

#### 1. General Recommendations for Zones-X, XI

#### and XII

- 1.1 Selective mechanization of rainfed farming areas to achieve higher productivity may be implemented.
- 1.2 Mechanization of irrigated agriculture of cash and food crops with precision equipment and state of art technologies for increased productivity through higher yields and reduced field losses may be promoted.
- 1.3 The farm power availability in the zone may be increased to meet additional demand by improving the tractor, power tiller and other mechanical and electrical power sources.
- 1.4 Ergonomically improved tools and gadgets for farming operations may be advocated to reduce the drudgery and to provide better environment for agricultural labour for higher work efficiency.
- 1.5 As half of the agricultural workforce is women, it is essential that women friendly tools and equipment may be developed and promoted, keeping their ergonomical considerations to improve their efficiency, reduce drudgery and also minimize the occupational health problems.
- 1.6 Tools and equipment are needed to be developed and promoted for horticultural mechanization.
- 1.7 The farm mechanization package for different crops may have three components, namely small equipment/tools on ownership basis for small farm; large farm equipment on custom hiring basis to be operated by farmers/service entrepreneurs in all types of farms, and farm equipment to be shared by participating farmers under group farming or contract farming system.
- 1.8 The agricultural engineering wings in the State Departments of Agriculture are to be strengthened and revived with specific mandate for extension of agricultural mechanization at micro level.
- 1.9 Separate Directorates of Agriculture Engineering may be created in the States to focus the thrust on farm mechanization.
- 1.10 Women labour may be provided skill upgradation training so as to enable them to operate the farm machinery with safety and comfort.
- 1.11 Agricultural Mechanization Training Centres may be established in each SAU/State to provide continuous training to extension engineers, farmers, manufacturers, artisans, etc with emphasis for on-farm trainings at block level.
- 1.12 Farm Machinery Testing Centres may be set up at each state to enable the manufacturers to get their equipment tested before commercialization.

- 1.13 Technology Park/Display Centres/Model Mechanization farms may be created in each district headquarters where the mechanization technologies suitable for that area may be displayed and demonstrated. State Government owned farms may be made as Model farms for mechanization.
- 1.14 Front Line Demonstrations (FLDs) of power equipment may be strengthened at micro level/ cluster of villages with adequate funding to create more awareness.
- 1.15 Crop residue management equipment/machinery would be the future requirement of these zones and they need to be advocated.
- 1.16 Efficient post harvest management technologies/ equipment for on-farm/community level primary processing may be promoted for adoption.
- 1.17 Low cost/appropriate storage facilities developed for perishable and semi-perishables may be established on a cooperative/Self Help Group Entrepreneurship basis with technical and financial back up from the concerned government departments. Such facilities should enable farmers for transit storage of their produce on high charges basis.
- 1.18 Laboratories for testing the quality of farm produce and value added products in compliance with International Standards may be set up at district level similar to the Pesticide Testing and Seed Testing laboratories of the State Departments of Agriculture.
- 1.19 Farmers may be educated through Awareness and Training programmes about the need to improve the quality of their produce at primary processing stage.
- 1.20 Green house and surface covered agriculture technologies may be promoted in floriculture and vegetable crops as commercial ventures under Self Help Group system with financial and technical support from Government.
- 1.21 **Mission for land water conservation:** Area and drip and sprinkler irrigation may be expanded. In water starved areas and in horticultural farms, watershed management programmes under a special mission for land water conservation may be given a special thrust. Drainage equipment in water stagnation areas may be promoted.
- 1.22 **State Agricultural Mechanization Board:** Agricultural Mechanization Boards may be set up at State level with State Government Agriculture Minister as Chairman with adequate powers. The State Mechanization Board would serve as a nodal agency for implementation of mechanization policy by establishing linkages with all development/financial/HRD/Technology/ Insurance Institutions and shall constantly monitor the progress of mechanization in the State and shall also interact with policy makers, manufacturers, research and extension agencies for eliciting feedback, for correction in problem pockets as well as for future R&D development based on farmers' need. A special Agricultural Mechanization Development Agency similar to DRDA, under the State Mechanization may be established at each district for implementing and monitoring farm mechanization policy at micro level.
- 1.23 **Credit facilities for agricultural machinery:** Credit policies of financial institutions may be liberalized for long term investment on agricultural machinery. The purchase of agricultural machinery may be made easier by hypothecation of the machinery itself. The interest rates and procedures for advancing loans may be rationalized.
- 1.24 (i) **Insurance Schemes for agricultural machinery:** Insurance schemes at rationalized premium rates may be introduced for agricultural machinery against accident, fire, theft/loss and damages due to natural calamities. Utilization of agricultural machinery would have set back due to crop failures/draught etc and the insurance schemes may cover such aspects also.
- (ii) Victims of accidents involving agricultural machinery may be provided adequate compensation.
- 1.25 **Farm Machinery Clinics and Primary Processing Centres:** Farm Machinery Clinics coupled with Primary Processing Centres may be established at block level. These clinics shall be run by rural entrepreneurs/Self Help Groups under the guidance of District level Mechanization Agencies. The farm machinery clinics shall offer custom hiring services for the machinery suitable for the concerned block with all servicing and repairing facilities. The operators/mechanics may be selected from village youth and provided adequate skill upgradation and training. The seed money for these Farm Machinery Clinics may be provided from the Farm Mechanization Revolving Fund which may be created by each

State Government and the loan has to be refunded by the group within reasonable period. The Primary Processing Centres would be run by Women Self Help Groups in that Village.

- 1.26 **Custom Hiring:** Custom hiring of large equipment in small and marginal farms may be further promoted by providing certain incentives to the custom hire operators.
- 1.27 **Sustainability of small manufacturers:** Sustainability of small manufacturers of agricultural machinery/implements may be ensured by strengthening their marketing system.
- 1.28 **Quality of manufacture:** Quality of agricultural machinery manufacturing must be enforced strictly by appropriate regulations. The buyers/users must also be made quality conscious by creating awareness.
- 1.29 **Common quality enhancement facilities for manufacture:** Common facilities for testing of the quality of materials used in manufacture and specialized manufacturing technologies like heat treatment etc may be created in areas where small manufacturers are concentrated to enable them to avail these facilities on chargeable basis.
- 1.30 **Bio-Energy Park:** Bio-energy parks may be created in potential rural areas as a model for processing bio fuels from Jatropha and other plant products and making these bio-fuels available for use in agricultural prime movers in the same areas. These projects may be subsidized initially.
- 1.31 **Role of Participatory Extension Agencies:** Participatory Extension Agencies, both private and NGOs may be encouraged in popularization of agricultural machinery for their commercialization.
- 1.32 **Role of Information Technology:** Information Technology Kiosks may be expanded in a big way by establishing them at micro-level in cluster of villages to enable farmers access for the state of art technology in farm mechanization as well as all other production and post production interventions in agriculture.
- 1.33 **Computerized data bank and collection of data:** Enumeration of farm mechanization data may be carried out by technical personnel for more accuracy and a computerized data bank district wise may be set up to record all relevant data on sale of different types of agricultural machinery in the district and such data may be compiled annually and made available for formulation of future strategies and for analyzing impact of

mechanization programmes.

## 2. **SPECIFIC RECOMMENDATIONS FOR ZONE-X—SOUTHERN PLATEAU**

- 2.1 Package of mechanization equipment for this zone has been identified and listed crop wise.
- 2.2 Draft animal power in the farms will have to be better utilized with ergonomically designed harnesses and yokes and improved implements like seed-cum-fertilizer drills, planters, multi row interculture implements and the farmers may be provided subsidies for adoption of the improved implements.
- 2.3 Emphasis may be given for introducing multi-crop equipment like medium range multi-crop axial flow thresher for rainfed crops, multi-crop reapers, power weeders and roto-tillers.
- 2.4 **Paddy:** The rice belt in Karnataka region and the western and north western zones in Tamil Nadu may be fully mechanized as follows:
  - (i) Shallow puddling may be advocated for mechanization of seeding/transplanting and improved puddlers and Power Tiller operated rotavators are recommended.
  - (ii) Land levelling equipment may be promoted.
  - (iii) Direct seeding of paddy both in low lands and dry uplands with drum seeders.
  - (iv) Manual and power operated transplanters may be promoted.
  - (v) Community level adoption of raising of mat type rice seedling nursery for mechanical transplanting may be promoted.
  - (vi) Distribution of farm equipment may be further increased under Integrated Cereals Development Programmes of the State Governments.
  - (vii) The small and medium size obsolete rice in this zone may be modernized.
- 2.5 **Sugarcane:** Sugarcane cutter planter (tractor drawn) and sugarcane harvester may be introduced under custom hiring schemes through the sugar mills in this zone. Power weeders for intercultural operations and earthing up equipment may be induced under subsidy schemes.
- 2.6 **Groundnut:** Tractor drawn groundnut harvester and groundnut wet pod thresher may be popularized.
- 2.7 **Cotton:** Power weeders for intercultural operations and standard/improved spraying equipment for plant protection operations may be popularized for adoption.
- 2.8 **Horticultural crops:** Broad bed forming

equipment and vegetable planters may be introduced. Horticultural hand tools and gadgets may be adopted by horticultural farmers.

- 2.9 **Chisel Plough:** In medium and light soils, Chisel Plough (tractor drawn) may be introduced for better conservation of water.
- 2.10 **Power Tillers:** Use of Power Tillers may be introduced for channel forming and trench making, seeding and tillage operations.
- 2.11 Power availability in Telengana and Rayalaseema regions of Andhra Pradesh may be increased by introduction of more tractors.

### 3. SPECIFIC RECOMMENDATIONS FOR ZONE—XI—EASTERN COAST PLAINS

- 3.1 Mechanization package for this zone has been identified crop-wise.
- 3.2 In coastal Orissa, improved animal drawn implements like puddlers, improved pneumatic wheel animal carts and improved harnesses and yokes may be provided at subsidized cost to poor and small farmers.
- 3.3 Growth of mechanization is very low in Orissa and it needs special thrust with special mechanization programmes through introduction of power tillers and tractors.
- 3.4 Entrepreneurs/manufacturers may be encouraged to take up farm equipment manufacture in this zone.
- 3.5 Disaster/calamity management measures in cyclone prone regions to prevent losses/damage to human, animals and crops may be further strengthened and long term planning is required.
- 3.6 In the delta regions, implementation of water management measures to effectively use scarcely available water in deficient periods is recommended.
- 3.7 The tail end areas in the delta regions are heavy deep soils and mechanizing such regions is a difficult task. Suitable equipment for heavy deep soils in wet conditions may be developed by R&D institutions.
- 3.8 Harvesting of *kharif* paddy coincides with North East monsoon. High capacity threshers may be introduced for quickly threshing the rain water soaked paddy and hot air dryers for reducing the moisture in the grain to safer level to prevent the paddy from germination and microbial infestation are essentially required to reduce huge losses.
- 3.9 Small and medium rice mills which are obsolete are to be modernized with improved hullers and

polishers.

- 3.10 Small farm equipment like drum seeders for paddy, manual transplanters, manual weeders are to be adopted by small and marginal farmers on ownership basis, self propelled transplanters and combine harvesters for paddy, sugarcane harvesters and tractor drawn planters on custom hiring basis may be advocated.
- 3.11 Weeder, off barer and earthing up equipment attached to Power Tiller or small four wheel tractors for sugarcane crop may be promoted in sugarcane areas in Orissa and Tamil Nadu.
- 3.12 Coconut processing complexes may be established at least one for each state in this zone to make value added products.
- 3.13 Fruit processing industries may be further promoted by establishing more mango pulp and other value added product industries, cashew nut processing industries. The existing cashew processing industries may be modernized. The palm oil extraction industry in Andhra Pradesh may be further promoted and the quality of palm oil extracted may be upgraded to edible grade by having efficient fruit bunches collection mechanism to avoid delays in the start of processing.
- 3.14 With development of brackish and fresh water aquaculture in the zone, more fish processing industries may be set up. Manufacturers of aquaculture farming equipment may be promoted for mechanizing fish farming operations.

### 4. SPECIFIC RECOMMENDATIONS FOR ZONE—XII—WEST COAST PLAINS AND HILL REGION

- 4.1 Being a high rain fall zone, the cropping intensity has to be increased for improving overall production. Hence, intensifying the mechanization programmes at block level would have for reaching benefits.
- 4.2 Package of equipment for mechanization for this zone has been identified and listed.
- 4.3 Custom hiring of equipment may be further encouraged by providing incentives/subsidies to entrepreneurs to reduce custom hire charges for machinery to attract small farmers.
- 4.4 Co-operative system of farming like group farming system in Kerala may be introduced in other states in the zone.
- 4.5 Agricultural machinery repairing and servicing facilities may be created at block level by

- encouraging village youth to start such centres.
- 4.6 Manufacturing activities may be promoted by extending soft loans, subsidies and special incentives to entrepreneurs in this zone.
  - 4.7 Tractors, Power Tillers, power weeders and other machinery for rice farming, namely manual drum seeder, manual and self-propelled rice transplanters, cono weeders, small threshers, winnowers and combines may be introduced in the potential areas.
  - 4.8 For problem areas in Kerala, namely low lying locations like Kole and Kuttanad areas, low head, high discharge, low cost improved energy efficient axial flow pumps may be provided at subsidized cost to farmers to pump out the flood waters from the fields to save their crop during heavy monsoon rains.
  - 4.9 Tractors and rotavator attachments may be provided in Central and Northern Kerala, Coastal Karnataka and Konkan Maharashtra on a massive scale to increase power availability in the zone.
  - 4.10 Shallow puddling with rotavators and mechanized levelling the fields may be propagated for mechanized transplantation.
  - 4.11 Power Tillers with attachment implements may be further promoted in Goa, coconut and mango orchards in Konkan Maharashtra, Coastal Karnataka and southern parts of Kerala.
  - 4.12 Improved drum seeder for direct sowing of paddy in Goa, Coastal Karnataka and Kerala may be aggressively popularized.
  - 4.13 Manual transplanters/power operated transplanters may be supplied with subsidy farmers in Kerala, Coastal Karnataka and Konkan region of Maharashtra.
  - 4.14 The State Governments may subsidise supply inputs for mat-type rice seedling nursery raising at village level to enterprising nursery farmers in the villages.
  - 4.15 Introduction of combine harvesters may be suggested in Konkan region, Coastal Karnataka and Central and Northern Kerala.
  - 4.16 Tall tree sprayers and orchard sprayers for coconut, arecanut, mango and cashew nut may be advocated.
  - 4.17 Chisel Plough may be introduced in upland areas of Goa, middle upland areas in Kerala and upland areas in Konkan Maharashtra for retention of rain water in the subsurface by reducing surface run off from the fields.
  - 4.18 Improved post harvest management practices in spices and plantation crops may be intensified by adopting improved low cost dryers for copra, arecanut and pepper, improved drying system for small cardamom and popularization of value addition of products from coconut like coconut water preservation, snow ball coconut, coconut chips, etc.
  - 4.19 Coconut processing complexes may be established in Konkan Maharashtra for value added products from coconut and their by products. Coconut husk utilization units may be established in the Konkan region.
  - 4.20 Rice processing mills may be established in Kerala and Coastal Karnataka.
  - 4.21 The by product industries for coconut, cashew nut shell liquid, etc. in Kerala and Karnataka may be improved with modernization.
  - 4.22 Processing industries for mango and cashew may be set up in Konkan region of Maharashtra.
  - 4.23 Non-destructive qualitative analytical equipment for assessing quality of export grade mango may be developed for Konkan region.
  - 4.24 Mechanized cashew nut shellers may be developed for avoiding the manual handling of the CNSL oozing from cashew shells.
  - 4.25 Coconut tree harvesting equipment with safety provisions may be developed for this region.
  - 4.26 Energy towers—small wind mills may be established in hilly regions to tap the wind energy for generation of power to supplement the energy needs in the plantations.

### **Technical Session–III: Presentation of mechanization strategies/recommendations by different groups**

In the Technical Session–III recommendations on mechanization strategies by different Groups were presented on 16th April, 2005 at 10.00 AM. The session was chaired by Sh Prem Narain, Joint Secretary, DOAC, Ministry of Agriculture, Govt of India. Other dignitaries present on the dais were Dr BS Pathak, Director, SPRERI, Vallabh Vidyanagar, Dr Nawab Ali, Dy DG (Engg), Dr SD Sharma, Director, IASRI.

The chairman requested the award winning farmers to express their views based on their vast experiences. The views expressed are as below:

Sh Khushal Pal Singh Sirohi from Village: Chandan, District: Kaithal, State: Haryana observed that the main concern in the Workshop should be to reduce the labour cost by adoption of mechanization and in turn to reduce the total expenditure incurred by the farmers in

cultivating various crops. The cost of the agricultural machinery/implements are very high. There is no subsidy on the machines/farm implements. The bank loan is not easily available for purchasing them and even if it is available, it is at higher rate of interest. He mentioned that the loan for other industries is easily available and at a lower rate of interest and even during the first one/two years they are not to pay any instalment. The policies regarding loan and subsidy should be such so as to suit the farmers need. Landless farmers should also be given loan to purchase machines and equipment for custom hiring purposes which in turn will reduce unemployment. There must be some mechanism of standardizing the newly developed machines so as to build up the confidence of the farmers in adopting these.

In agriculture, almost all the family members of the farmers are involved in agricultural related work which is not accounted in input costs. There is no centre for training women labour. Field level demonstrations for the newly developed machines should be given on the farmers field itself. Appropriate training for operating these machines, etc. should also be given by a trained

person.

He told that water charges for agriculture and fisheries are different, which should not be the case and as such uniform yardsticks may be followed. He told that he has done some work relating to Rose-Oil Extraction, which is being exported. In this direction, not much R&D work seems to have been done. Efforts must be made for proper research in this area.

Another award winning farmer Sh Randhir Singh Sheokand, from Village: Jajanpur, Distt. Kaithal, Haryana observed that instead of agro climatic zones, crop zones should be made so that the concentration of the required machinery/equipment may be easily and timely available. He observed that the sprinkler must be made available for gardening also. He further observed that group of farmers in different areas be formed and should be sent to the developed countries to experience the type of development in agriculture there, so as to enhance their skills and adopt these practices accordingly.

Thereafter, another award winning farmer Shri Bahadur Singh Verma from Village: Kailar, Distt. Solan, Himachal Pradesh observed that in hilly areas, the cultivation is step cultivation, for which different types of light weight agricultural machinery/implements are required. Machines especially for digging pits are required. Waste land can be converted into fertile land, vegetables can be grown and crops can be prolonged for six months, to reduce the losses. There is a problem of wild animals like Monkey, Pig, Bear, Bhalu and accordingly protection against these animals must be provided.

Thereafter, the Chairman invited the chairmen of the five Groups to present the recommendations finalized by respective groups.

Representatives from J&K State observed that 50% subsidy for machines should be given. Special machines for the hill area are required. Insurance of crops against natural calamity, damage to crop etc. should be made available to the farmers.

Farmer who can not pay back loans, should be discouraged to purchase machines, e.g. tractor etc. and encouraged for custom hiring of machines and measures for making available such facilities should be taken. Adequate funds and effective infrastructure should be made available to State Agro industries Corporations (SAICs) for providing machines on custom hiring basis and field level demonstrations of the machines should be done in different pockets. In J&K State, the Agricultural Machinery wing is not independent. Chairman observed that best possible services at optimum cost should be made available. It was observed that the small scale industries are not manufacturing machines/implements of standard quality and as such

76 they should not be encouraged for manufacturing machines/implements. The other view was that in spite of withdrawing manufacturing activity of machines/implements from small scale industries sector, the emphasis should be on proper quality which must be