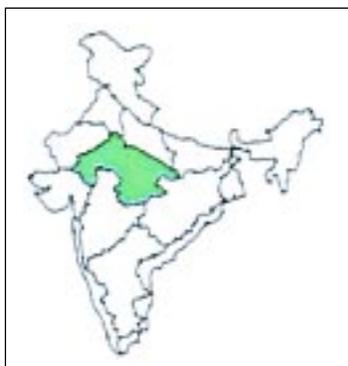


## Long-term Strategies and Programmes for Mechanization of Agriculture in Agro Climatic Zone–VIII : Central Plateau and Hills region

Dr M.M. Pandey

*Project Coordinator, AICRP on Farm Implements and Machinery,  
Central Institute of Agricultural Engineering, Bhopal*

1. NAME OF AGRO CLIMATIC ZONE : Central Plateau and Hills region
2. STATES UNDER THIS ZONE : Madhya Pradesh, Rajasthan and Uttar Pradesh



### 3. SUB-AGRO CLIMATIC ZONES WITH THEIR CHARACTERIZATION

This zone includes 46 districts from three States and is centrally located. It is interspersed with plateau and hill areas. There are vast areas of barren and uncultivable land. Water run-off is excessive. Nearly 15% of the land is not available for cultivation.

#### 3.1 Southern Plains of Rajasthan

This region includes three sub-zones—the South East Humid Plain consisting of the districts of Dungarpur and Banswara, the Southern Humid Plain consisting of Pali and Sirohi and the Transitional Plain consisting of the districts of Bhilwara, Udaipur and Chittaurgarh. Average rainfall in the area is about 550 mm per annum, and the climate is semi-arid. Only 32% of the geographical area is under cultivation. 15% is classified as forests and over 20% is unavailable for cultivation. 29% of the cultivated land is irrigated. Productivity is low.

#### 3.2 Eastern Plains of Rajasthan

This includes three sub-zones. The sub-humid southern plains span over the districts of Bundi and Kota. The semi-arid eastern plains run over the districts of Ajmer, Tonk and Jaipur. The flood prone eastern plains are the districts of Alwar, Bharatpur, Sawai Madhopur and Dholpur.

Although the rainfall, climate and soil condition are similar to the southern plains, a little over half of the geographical area is cultivated.

#### 3.3 Bundelkhand (Uttar Pradesh)

Bundelkhand lies between the Yamuna and the Northern scarp of the Vindhyan plains. The agro climatic sub-zone Bundelkhand (Uttar Pradesh) includes five districts from South-central Uttar Pradesh, viz. Jalaun, Jhansi, Lalitpur, Hamirpur and Banda. It receives about 900 mm of rainfall.

A little over 60% of the area is cultivated, but compared to other parts of Uttar Pradesh, the sub-zone has less developed irrigation facilities. Only about 25% of the cultivated area is irrigated as against a State average of nearly 60%. Soil erosion is high and land productivity is low.

#### 3.4 Bundelkhand (Madhya Pradesh)

The proportion of wastelands is very high at about 37% in this sub-zone. Only about 45% of the land is cultivated; a little over a third of the cultivated area is irrigated. The sub-zone includes the districts of Datia, Chhatrapur and Tikamgarh. The area receives relatively

low rainfall of around 700 mm annually, the climate is dry sub-humid and the soil type is classified as mixed red and black.

#### 3.5 North Hills

Also called Chhatisgarh Hills sub-zone, this consists of Mandla district. It receives relatively higher rainfall, about 1,570 mm per annum. Around 42% of the land is cultivated and a little over a third of it is irrigated. Tribal population is high.

#### 3.6 Kymore Plateau and Satpura Hills

This is a vertical strip running down central Madhya Pradesh including Sidhi, Rewa, Satna, Panna, Jabalpur and Seoni districts. The region has a relatively high proportion of waste and uncultivated lands—about 21%. Another about 22% of the land is under forest cover. Only 37% is cultivated. Irrigation facilities are very poor as only about ten per cent of the cultivated land is irrigated.

#### 3.7 Vindhya Plateau

This is a cluster of six districts—Sehore, Raisen, Bhopal, Vidisha, Sagar and Damoh—located in central Madhya Pradesh. This region is more urbanised and has a larger portion of its area under cultivation as compared to the rest of the zone. 53% of the area is cultivated, however, only 11% of this is irrigated. The region receives about 1,130 mm of rains annually.

#### 3.8 Satpura Plateau

Three districts of southern Madhya Pradesh, viz. Betul, Chhindwara and Narsimhapur with a combined area of about two million hectares form the Satpura Plateau sub-zone. The area receives about 1,120 mm of rains annually and about 36% of the area is under forest cover. Around 52% of the geographical area is tilled, but only about 13% of this is with the assistance of developed irrigation facilities. The area has a high proportion of tribal population.

#### 3.9 Central Narmada Valley

This is Hoshangabad district lying between the Vindhya and Satpura plateau. It rains about 1,300 mm annually and the soil is deep black. 45% of the geographical area is cultivated. Irrigation facilities are limited to around 39% of the cultivated area.

#### 3.10 Gird

Morena, Bhind, Gwalior, Shivpuri and Guna districts of north Madhya Pradesh comprise Gird sub-zone. This

region is rich in alluvial soils but has a large proportion of ravines. Net sown area is low at about 37% of geographical area. Only 36% of the cultivated area is irrigated. Rainfall is limited to only 670 mm.

#### 4. GENERAL TOPOGRAPHY OF THE ZONE

In Madhya Pradesh, in Kymore plateau sub-zone, the topography is undulated and sloppy; in Vindhya Plateau sub-zone, it is plain to undulated; in Central Narmada Valley sub-zone, it is plain; in Gird region, it is plain to undulated; in Bundelkhand region, it is plain with small hillock (5% slope) while in Satpura Plateau sub-zone, it is plain to undulated.

In the Southern-eastern humid plain zone (Rajasthan), the most distinguish feature of Bundi region is a double line of hills running through the districts in the north east and south west directions. This range is characterized by hills and ridges, made up of Vindhyan rock, varying in height between 91 to 547 metres above sea level. North-western part of the district is hilly with hard and stony soil, while south eastern plains have rich black loamy soil. In Kota district, the land slopes gently from south to north and is retained by the Chambal and eastern plains portion. Jhalawar district stands at the edge of Malwa plateau with an area of low hills and shallow plains.

#### 5. OPERATIONAL LAND HOLDING PATTERN BY MAJOR SIZE GROUPS

Operational land holding pattern is given in Table 1.

#### 6. IMPORTANT SOIL TYPES

- Mixed red and black (Kymore plateau).
- Medium and deep black (Vindhya plateau).
- Deep black with clay (Central Narmada Valley).
- Alluvial, medium black soil, mixed red and black soil and red and yellow soil (Gird sub zone).
- Clay and clay loams and sandy loam soils (Bundelkhand).
- Light reddish brown to black clay loam (Satpura).
- Alluvial, recent alluvium and calcareous (Flood prone eastern plain zone).
- Lithosols at the foot-hills in Udaipur, Bhilwara and Chittorgarh districts, away from the hills they are old alluvium (Sub-humid southern plain and Aravalli hill zone).
- Red, mixed red, black and medium black (Southern humid plain zone).

Table 1. Operational land holding pattern by major size groups

| Sub zone               | Farm size (ha) | Nos.     | Average area (ha) |
|------------------------|----------------|----------|-------------------|
| Kymore plateau         | < 1            | 3,63,668 | 0.41              |
|                        | > 1 to 2       | 1,84,431 | 1.44              |
|                        | > 2 to 4       | 1,59,924 | 2.76              |
|                        | > 4 to 10      | 1,14,379 | 6.06              |
|                        | > 10           | 29,445   | 16.65             |
| Vindhya Plateau        | < 1            | 3,04,096 | 0.45              |
|                        | > 1 to 2       | 2,04,776 | 1.44              |
|                        | > 2 to 4       | 1,76,477 | 2.79              |
|                        | > 4 to 10      | 1,41,834 | 6.11              |
|                        | > 10           | 44,991   | 17.37             |
| Central Narmada valley | < 1            | 80,101   | 0.50              |
|                        | > 1 to 2       | 92,339   | 1.34              |
|                        | > 2 to 4       | 82,447   | 2.81              |
|                        | > 4 to 10      | 76,454   | 6.12              |
|                        | > 10           | 22,586   | 17.58             |
| Gird region            | < 1            | 2,61,438 | 0.51              |
|                        | > 1 to 2       | 2,08,285 | 1.44              |
|                        | > 2 to 4       | 1,91,339 | 2.79              |
|                        | > 4 to 10      | 1,28,022 | 5.95              |
|                        | > 10           | 26,712   | 16.67             |
| Bundelkhand region     | < 1            | 1,28,165 | 0.52              |
|                        | > 1 to 2       | 1,09,047 | 1.45              |
|                        | > 2 to 4       | 89,836   | 2.74              |
|                        | > 4 to 10      | 50,962   | 5.82              |
|                        | > 10           | 8,852    | 15.57             |
| Satpura plateau        | < 1            | 97,234   | 0.41              |
|                        | > 1 to 2       | 77,885   | 1.48              |
|                        | > 2 to 4       | 83,809   | 2.78              |
|                        | > 4 to 10      | 69,731   | 6.10              |
|                        | > 10           | 17,806   | 15.18             |

- Black soils of alluvial origin. The soils vary in depth from shallow to very deep with Kankar and lime cast gravel at varying depths. The texture is generally clay loam to clay. These soils are moderate to slowly permeable and generally non-saline and alkaline. (South eastern humid plain zone)

## 7. ANNUAL RAINFALL

|   |                |
|---|----------------|
| Kymore Plateau zone:                            | 1,200–1,500 mm |
| Gird zone                                       | 800–900 mm     |
| Vindhya Plateau                                 | 1,000–1,200 mm |
| Central Narmada                                 | 1,000–1,200 mm |
| Bundelkhand                                     | 800–1,000 mm   |
| Satpura plateau                                 | 1,000–1,200 mm |
| South eastern humid plain zone                  | 690–1,000 mm   |
| Southern humid plain zone                       | 82 mm          |
| Sub-humid Southern Plain and Aravalli Hill Zone | 1,500–900 mm   |

## 8. POPULATION AND POPULATION DENSITY OF THE ZONE

Kymore Plateau and Satpura Hills Zone:

- Population : 68.99 lakh
- Density per sq. km. : 137

Details relating to population and population density are given in Table 2.

Table 2. Distribution of population and density of population

| State          | Total population | Density (per sq. km) |
|----------------|------------------|----------------------|
| Madhya Pradesh | 6,03,85,118      | 196                  |
| Rajasthan      | 5,64,73,122      | 165                  |
| Uttar Pradesh  | 42,90,928        | 142.8                |

## 9. BRIEF SCENARIO OF AGRICULTURE SECTOR

The important crops of the region area-wise, productivity of crops, productivity of horticultural crops etc., sowing changing scenario/diversification over a period of time is given in the Tables 3 to 6.

Table 3. Area of major field crops in Madhya Pradesh

(Area in '000 ha)

| Major                   | Kymore plateau | Vindhya plateau | Central Narmada valley | Gird region | Bundelkhand region | Satpura plateau |
|-------------------------|----------------|-----------------|------------------------|-------------|--------------------|-----------------|
| 1. Rice                 | 476.7          | 218.2           | 23.3                   | 43.2        | 41.1               | 51.5            |
| 2. Wheat                | 585.1          | 889.8           | 417.2                  | 598.5       | 279.6              | 173.0           |
| 3. Maize                | 49.4           | 30.0            | 4.9                    | 47.6        | 3.6                | 69.5            |
| 4. Jowar                | 57.7           | 54.3            | 12.7                   | 126.4       | 43.1               | 118.2           |
| 5. Bajra                | 991.0          | 67.0            | 186                    | 91.35       | –                  | –               |
| 6. Gram                 | 268.1          | 543.6           | 362.6                  | 376.2       | 128.5              | 53.5            |
| 7. Soybean              | 154.3          | 557.9           | 469.0                  | 178.3       | 92.04              | 206.25          |
| 8. Rapeseed and mustard | 16.83          | 8.17            | 1.18                   | 460.3       | 29.5               | –               |
| 9. Sugarcane            | 2.2            | 17.7            | 32.5                   | 29.1        | 8.1                | 15.0            |
| 10. Groundnut           | 4.4            | 2.75            | –                      | 53.4        | 19.5               | 32.0            |
| 11. Potato              | 50.7           | 34.5            | 11.8                   | 31.5        | 25.7               | 48.2            |

Table 4. Major crops and cropping systems for Rajasthan

| Major crops   | Districts  | Geographical area (m ha) | Major cropping systems   |   |
|---|--|--------------------------|--|---|
|   |  |                          | Rainfed  | Irrigated   |
| Pearl millet, cluster-bean, moth-bean               | Jaisalmer, Barmer, Bikaner, and parts of Jodhpur and Churu | 12.44                    | Cluster bean/kh. Pulses–Fallow–Pearl millet–Fallow Sesame–Fallow–Pearl millet–Fallow Pearl millet–Fallow–Pearl millet–Fallow–Fallow–Mustard Pearl millet + Moong + Moth + Sesame–Fallow  | Pearl millet–Wheat Fallow–Mustard/Barley/Wheat Chilli–Wheat (Relay cropping)  |
| Pearlmillet, mustard, wheat, chickpea, cluster bean | Jaipur, Ajmer, Tonk and Dausa                              | 2.96                     | Kh. Pulses–Fallow–Maize/ Pearlmillet–Fallow Cluster bean–Fallow–Pearl millet–Fallow, Fallow–Mustard/Chickpea/Taramira Groundnut Fallow–Sorghum–Fallow Pearlmillet/Sorghum–Fallow   | Pearl millet/Groundnut Wheat, Vegetables Wheat Cluster bean Wheat/Barley Pearl millet/Barley Pearl millet/Fallow–Mustard/Chickpea Maize–Wheat/Barley            |
| Mustard, wheat, chickpea, pearl millet              | Alwar, Dholpur, Bharatpur, and parts of Sawai Madhopur     | 2.70                     | Kh. Pulses/Sesame–Fallow–Pearl millet–Fallow, Fallow–Mustard–Fallow–Chickpea/Barley, Fallow–Mustard Fallow–Chickpea, Maize/Groundnut/Sorghum (Fodder) –Fallow, Groundnut–Fallow–Pearl millet–Fallow Fallow –Chickpea Fallow Pearl millet | Pearl millet–Wheat/Mustard kh. Onion–Wheat, Groundnut–Wheat Urd bean–Mustard Pearl millet/Sorghum (Fodder)–Mustard  |
| Maize, sorghum, <i>kharif</i> pulses                | Bhilwara, Rajsamand and parts of Chittorgarh, Udaipur and  | 3.36                     | Groundnut–fallow–Maize–Fallow kh. Pulses/Seasame–Fallow, Groundnut/Sesame–Fallow, Sorghum–Fallow   | Maize–Wheat, Cotton–Wheat Maize–Mustard–Groundnut (Summer) Cotton–Fenugreek, Maize–Opium Groundnut–Wheat/Mustard Sugarcane–Onion/Garlic                         |
| Maize, <i>kharif</i> pulses, chickpea               | Banswara, Dungarpur and Parts of Udaipur and Chittorgarh   | 1.72                     | Kh. Pulses (Black Gram)–Fallow–Maize–Fallow, Soybean–Fallow–Maize–Fallow, Fallow–Gram–Maize–Fallow   | Maize–Wheat/Chick–pea, Groundnut–Wheat Paddy–Wheat/Barley Maize–Mustard/Wheat–G. Gram Black Gram–Wheat/Chickpea Soybean/Cotton–Wheat                            |
| Sorghum, wheat, mustard, soybean, coriander         | Kota, Bundi, Jhalawar, Baran and Parts of Sawaimadhopur    | 2.70                     | Soybean–Fallow–kh. Pulses–Mustard kh. Pulses–Mustard–Sorghum–Fallow Maize–Mustard–Soybean–Fallow Soybean–Fallow–Fallow–Mustard–Fallow–Chickpea–Maize–Fallow  | Soybean–Wheat, Paddy–Wheat/Gram Fallow–Wheat/ Mustard Maize–Wheat/Opium Soybean–Coriander/Wheat–Sugarcane Sorghum–Coriander Sugarcane–Sugarcane–Sugarcane–Wheat |

Table 5. Area and productivity of major crops in sub-humid southern plain and Aravalli Hill zone (Rajasthan)

| Important crops                      | Area (ha) ('000) | Productivity (kg/ha)           |
|--------------------------------------|------------------|--------------------------------|
| <b>Field crops</b>                   |                  |                                |
| <b>Cereals</b>                       |                  |                                |
| Pearlmillet                          | 2                | 500                            |
| Sorghum                              | 63               | 651                            |
| Maize                                | 410              | 1407                           |
| Wheat                                | 186              | 1654                           |
| Barley                               | 46               | 261                            |
| Rice                                 | 14               | 1071                           |
| Small millet                         | 8                | 500                            |
| <b>Pulses</b>                        | 102              | 491-698                        |
| <b>Oilseeds</b>                      |                  |                                |
| Rapeseed and mustard                 | 34               | 706                            |
| Sesame                               | 55               | 200                            |
| Linseed                              | 7                | 286                            |
| Groundnut                            | 79               | 785                            |
| <b>Any other (Sugarcane, cotton)</b> | 48               | Sugarcane: 44556<br>Cotton: 16 |

Table 6. Area under common vegetables, spices, condiments and fruits in semi-arid eastern plain zone

| Sl.No.                       | Crop                    | Area, ha |
|------------------------------|-------------------------|----------|
| <b>Vegetable</b>             |                         |          |
| 1.                           | Tomato                  | 3,555    |
| 2.                           | Onion                   | 2,221    |
| 3.                           | Brinjal                 | 1,032    |
| 4.                           | Pea                     | 619      |
| 5.                           | Cabbage and Cauliflower | 875      |
| 6.                           | Okra                    | 701      |
| <b>Spices and condiments</b> |                         |          |
| 7.                           | Cumin                   | 4,757    |
| 8.                           | Chilly                  | 6,200    |
| 9.                           | Coriander               | 1,365    |
| <b>Fruits</b>                |                         |          |
| 10.                          | Melons                  | 4,640    |
| 11.                          | Pomegranate and Guava   | 182      |
| 12.                          | Citrus                  | 100      |
| 13.                          | Papaya                  | 54       |
| 14.                          | Mango                   | 26       |
| 15.                          | Ber                     | 71       |

## 10. BRIEF SCENARIO OF ANIMAL HUSBANDRY SECTOR

Central Narmada Valley Zone has 9,39,400 heads of cattle including 2,86,800 milch and 2,93,300 draft animals. Cattle wealth is not only weak but poor in performance for want of regular supply of green fodder and concentrates to be developed from the locally available materials.

In the southern humid plain zone, total livestock population is 3,415.4 thousand. Of the total livestock population, 44.57% consists of cows and bullocks and 13.69% buffaloes. Goats constituted 28.23% of the total livestock and it is popular as tribal milch animal. Likewise, sheep (12.55%) is other economical livestock of tribals. There were 245.7 thousand poultry birds in the zone. Brief scenario of animal husbandry sector is given in Table 7 & 8.

Table 7. Milk and Egg Production

| Sl. No. | Name of State  | Milk production ('000 tonnes) | Egg production (lakh nos.) |
|---------|----------------|-------------------------------|----------------------------|
| 1.      | Rajasthan      | 4,000                         | 5,250                      |
| 2.      | Madhya Pradesh | 3,220                         | 14,000                     |

Table 8. Draught animals population in the State of Rajasthan

| Sl.No. | Animal   | Nos       |
|--------|----------|-----------|
| 1.     | Bullocks | 2,728,036 |
| 2.     | Camels   | 668,237   |
| 3.     | Donkeys  | 186,747   |
| 4.     | Others   | 94,521    |
|        | Total    | 3,677,541 |

## 11. BRIEF SCENARIO OF FISHERIES SECTOR

Fish production in the zone is given in Table 9.

Table 9. Fish Production

| Sl. No. | Name of State  | Fisheries Production ('000 tonnes) |                  |
|---------|----------------|------------------------------------|------------------|
|         |                | Inland Fisheries                   | Marine fisheries |
| 1.      | Rajasthan      | 12.97                              | -                |
| 2.      | Madhya Pradesh | 127.43                             | -                |

## 12. IRRIGATED AREA AND SOURCE OF IRRIGATION

Information on irrigated area and source of irrigation is given in Table 10 and 11.

Table 10. Distribution of irrigated area in the Madhya Pradesh under region VIII

| Sub zone               | Irrigated area, ha |
|------------------------|--------------------|
| Satpura Plateau        | 2,05,455           |
| Kymore Plateau         | 3,44,554           |
| Vindhyaachal Plateau   | 7,12,589           |
| Central Narmada Valley | 6,18,347           |
| Gird Region            | 8,82,277           |
| Bundelkhand            | 3,97,886           |

Table 11. Percentage distribution of irrigated area (source-wise)

| Irrigation sources | Sub-humid southern | Flood prone eastern plain zone (%) | South eastern humid plain zone (%) |
|--------------------|--------------------|------------------------------------|------------------------------------|
| Tanks              | 17.0               | —                                  | 4.5                                |
| Tubewells          | 4.2                | 35.18                              | 2.5                                |
| Wells              | 77.8               | 51.18                              |                                    |
| Canal              | —                  | 9.30                               | 35.0                               |

## 13. INFRASTRUCTURAL FACILITIES AVAILABLE IN THE ZONE

- (i) Most of the villages in Madhya Pradesh are not connected by metalled road. Survey results reveal that only 18.6% of the villages are connected by metalled roads in the State, whereas, 82.6% of the villages are at a distance of upto 10 km from metalled road.

- (ii) Most of the villages are electrified.
- (iii) Important markets for sale of farm implements and machinery/grain mandies are Bhopal, Vidisha, Indore, Dewas, Gwalior, Khurai, Rewa, Jabalpur, Sagar.
- (iv) The gird zone is also connected with network of regulated markets established at various mandies spread in whole of the zone. There are 26 regulated markets at present working efficiently and trading agricultural products of farmers. Presently, the facilities for stay of the farmers and sellers to cattle at the market yards are lacking in most of the places. Godown for storage of the produce are lacking and there is a need for a network of godowns at rural market centers.
- (v) Infra-structural facilities available for manufacture of agricultural implements and machinery are given in Table 12.
- (vi) Infra-structural facilities available for sale/repair and maintenance of tractors and other machinery in the region

### (a) ICAR Institutes/Regional Stations:

1. Central Institute of Agricultural Engineering, Bhopal: Rural youth and women training.
2. Central Institute of Cotton Research, Nagpur: Mechanization on cotton equipment.
3. Indian Institute of Soil Science, Bhopal: For demonstration of improved equipment for existing cropping pattern in the region.
4. National Research Centre for Soybean, Indore: For demonstration of improved implements on soybean cultivation.

Table 12. Facilities available for manufacture of agricultural implements and machinery

| Annual production capacity (No. of units) | Infrastructure   | Man power | Manufacturing facility |                                   |                               | Standard components  | Product range                |  | Marketing system       | After sales service/repair | Availability of spare parts |
|---|--|-----------|------------------------|-----------------------------------|-------------------------------|--|------------------------------|--|------------------------|----------------------------|-----------------------------|
|   |  |           | Floor area, sqm.       | Level of manufacturing technology | Annual turnover (Rs in lakhs) |  | Equipment being manufactured | Power operated   |                        |                            |                             |
| 91-41                                     | Pillar drill, engine lathe, hydraulic press, pedestal grinder, arc welding set, spray painting, fluted rollers | 4-5       | 1000-2000              | Good                              | 13, 23-22.40                  | Bearing (TATA), shovel, tynes, disc springs, fastners fluted rollers | Thresher (20)                | Trolley (55), cultivator (75), harrow (45), leveller (15), seed drill (21) | Direct sale to farmers | Repair at factory          | Supply on demand            |

5. IARI Regional Research Centre/Station, Indore: For demonstration of improved implements related with wheat cultivation.
  6. National Research Centre on Weed Control, Jabalpur: For demonstration of improved technologies of weeding.
  7. National Research Centre for Grapes, Pune: For demonstration of improved technologies of weeding.
  8. National Research Centre for Onion and Garlic, Raj Guru Nagar, Pune: For demonstration of improved technologies of weeding.
- (b) Agricultural Universities/Regional Stations: AICRP on FIM Centres located at CTAE, Udaipur (Rajasthan), JNKVV, Jabalpur and MPUAT, Udaipur.
- (c) Krishi Vigyan Kendras: KVKs of CIAE, Bhopal, Banswara, Durgapur (Jaipur), Kota, Bundi, Jaipur, Alwar, Jhalawar and KVKs of Chhindwara, Satna, Bilaspur, Seoni, RAK College, Sehore, CAE, Jabalpur.
- (d) Offices of State Department of Agriculture, SISI units located in the zone: Directorate of Agricultural Engineering, Madhya Pradesh located at Bhopal; Directorate of Agriculture, Madhya Pradesh located at Bhopal ; Directorate of Agriculture, Rajasthan located at Jaipur; Directorate of Agriculture, Uttar Pradesh located at Lucknow.
- (e) Important NGOs and other extension organizations available in the region. Vidhya Bhawan Rural Institute, Rajasthan.
- (f) Facilities available for credit: NABARD and all nationalised banks, State cooperative banks, regional rural banks.

**14 (a) TRADITIONAL AND IMPROVED AGRICULTURAL IMPLEMENTS BEING USED AND IMPROVED AGRICULTURAL MACHINERY SUGGESTED FOR INTRODUCTION**

These are given in Table 13.

Table 13. Traditional & Improved agricultural implements

| Operation                  | Implements being used              |  | Improved implements suggested for introduction  |
|----------------------------|------------------------------------|--|---|
|                            | Traditional                        | Improved   |   |
| 1                          | 2                                  | 3  | 4   |
| <b>Seedbed preparation</b> |                                    |  |   |
| Ploughing                  | Bullock drawn plough, Dabra plough | Bullock drawn mould board plough, Tractor mounted mould board plough                             | Bullock drawn multipurpose tool frame with attachment, naveen bakhar blade, improved patella harrow                       |
| Harrowing                  | Bullock drawn bakhar               | Animal drawn disc harrow, improved patella harrow, Rotavator, Tractor mounted offset disc harrow | Animal drawn improved patella harrow  |
| Bakherring/Cultivating     | Desi plough                        | Improved bakhar blade, Rotavator, Tractor mounted duck foot cultivator                           | Bullock drawn multipurpose tool frame with attachment, animal drawn cultivator, power tiller operated cultivator          |
| Clod Crushing              | Animal drawn <i>pata</i>           | Tractor offset disc harrow, Tractor mounted disc harrow (trailed type)                           | Tractor mounted spiked clod crusher, Tractor mounted combined tillage tool, rotavator, Tractor mounted pulverizing roller |
| Land levelling             | Animal drawn <i>Karha</i>          | Animal drawn land leveller, Tractor drawn land leveller, self propelled hydro dozer              | Animal drawn land leveller, Tractor drawn land leveller, self propelled hydro dozer                                       |

(Continued)

(Table 13 continued)

| 1   | 2   | 3   | 4  |
|---|---|---|--|
| Planking  | Animal drawn <i>pata</i>  | Tractor drawn harrow cum <i>patela</i>  | Tractor drawn harrow cum <i>patela</i>   |
| <b>Seeding/Planting</b>                         |   |   |  |
| Sowing  | Duphan and Tifan, Seeding behind country plough for crops, viz. Wheat, Soybean, Gram, Mustard, Sorghum, Maize, Pigeon-pea | Animal drawn two row seed drill (Mahakal), Animal three row seed-cum-fertilizer drill, Tractor drawn seed-cum-fertilizer drill., Zero-till seed drill | Animal drawn two row and three row seed cum fertilizer drill, Tractor drawn seed cum fertilizer drill cum planter, Zero – till seed drill                |
| Planting  | Duphan and Tifan, Seeding behind country plough for crops, viz. Soybean, Pigeon-pea, Maize, Groundnut, Cotton             | Animal drawn seed-cum-fertilizer drill, Animal drawn and Tractor mounted inclined plate planters  | Animal drawn seed-cum-fertilizer drill, Animal drawn and Tractor mounted inclined plate planters, Raised-bed planter, pneumatic planter and till planter |
| Transplanting                                   | Manual rice transplanting with hand and broadcasting of Rice seed   | Manual rice transplanter, self-propelled riding type rice transplanter  | Manual rice transplanter, self-propelled riding type rice transplanter and walk behind type rice transplanter  |
| <b>Weeding and Hoeing</b>                       |   |   |  |
| Weeding   | Khurpi, Kudal, Spade  | Wheel hoe   | Dryland weeder, twin wheel hoe, grubber  |
| Interculture                                    | Khurpi, Bullock drawn Single/double <i>Dora</i>   | Single wheel hoe, twin wheel hoe, Animal drawn <i>triphali</i> , Tractor drawn cultivator   | Single wheel hoe, twin wheel hoe, Animal drawn three row cultivator, self propelled weeder, rotary power weeder  |
| Bund/furrow making                              | Spade, Animal drawn bund former   | Animal drawn channel-cum-bund former, Tractor drawn bund former   | Tractor drawn furrower, tractor mounted broad bed former   |
| <b>Spraying and dusting</b>                     |   |   |  |
| Spraying and dusting field crops                | Foot operated sprayer, hand operated duster   | Manual knapsack sprayer, motorized knapsack sprayer   | Motorized knapsack sprayer, self-propelled boom sprayer, self propelled high clearance sprayer, tractor mounted aeroblast sprayer                        |
| Spraying tall crops                             | Foot operated sprayer   | –   | Self propelled high clearance sprayer, tractor mounted aeroblast sprayer   |
| Spraying trees/shrubs                           | –   | Foot operated sprayer, Manual knapsack sprayer  | Self-propelled boom sprayer, self propelled high clearance sprayer, tractor mounted aeroblast sprayer  |
| <b>Irrigation</b>                               |   |   |  |
| Water lifting                                   | Water lifting bucket, karha   | Low lift pump, Electric motor coupled centrifugal pump, tube wells  | Electric motor coupled centrifugal pump, tube wells  |
| Application of water (surface, sprinkler, drip) | Surface irrigation  | Sprinkler irrigation, check basin   | Sprinkler irrigation, check basin, drip irrigation   |

**Harvesting/digging/uprooting:** Improved sickle, self propelled reaper, Tractor drawn reaper, tractor drawn potato digger cum elevator, tractor mounted groundnut digger.

**Threshing/shelling:** CIAE multicrop thresher, TNAU groundnut thresher, high capacity multicrop thresher, power operated maize dehusker cum sheller, manual groundnut decorticator.

(Continued)

(Table 13 continued)

| 1                                 | 2                    | 3                                 | 4  |
|-----------------------------------|----------------------|-----------------------------------|--|
| <b>Winnowing/cleaning/grading</b> | Manual winnowing fan | Pedal operated cleaner cum grader | Pedal operated/motorized cleaner-cum-grader      |
| <b>Straw Management</b>           |                      |                                   |  |
| Reaping                           | Sickles              | –                                 |  |
| Incorporating in soil             | Desi plough          | –                                 | Tractor operated flail type chopper-cum-spreader |
| Baling                            | Baling manually      | –                                 | Tractor operated straw baler                     |
| Densifying                        | –                    | –                                 |  |
| Stubble shaving                   | –                    | –                                 | Tractor operated stubble shaver                  |

**14 (b) PRESENT STATUS OF FARM MECHANIZATION, POTENTIAL AND FUTURE NEEDS OF THE ZONE**

These are given in Table 12 to 18.

Table 14. Farm Power Sources under agro ecological region VIII (Madhya Pradesh)

| Items                       | Kymore plateau | Vindhyachal plateau | Central Narmada valley | Grid region | Bundelkhand region | Satpura plateau |
|-----------------------------|----------------|---------------------|------------------------|-------------|--------------------|-----------------|
| Agril. labourer (No./100ha) | 39.4           | 28.7                | 36.5                   | 12.2        | 18.0               | 28.0            |
| Human energy (kW/ha)        | 0.020          | 0.014               | 0.018                  | 0.006       | 0.009              | 0.014           |
| Draft animal (No./100ha)    | 77.0           | 39.7                | 30.3                   | 32.0        | 51.2               | 59.4            |
| Animal energy (kW/ha)       | 0.185          | 0.095               | 0.073                  | 0.077       | 0.123              | 0.143           |
| Tractor (No./100ha)         | 0.7            | 1.8                 | 1.7                    | 1.9         | 1.2                | 0.4             |
| Power tiller (No./100ha)    | 0.01           | 0.01                | 0.01                   | Negligible  | Negligible         | Negligible      |
| Electric motor (No./100ha)  | 5.7            | 6.5                 | 2.5                    | 3.9         | 5.6                | 12.3            |
| Diesel engine (No./100ha)   | 0.8            | 2.1                 | 1.0                    | 1.7         | 2.0                | 0.5             |
| Mechanical energy (KW/ha)   | 0.438          | 0.830               | 0.575                  | 0.728       | 0.628              | 0.580           |
| Total energy (KW/ha)        | 0.643          | 0.939               | 0.666                  | 0.811       | 0.760              | 0.737           |

Table 15. Trends in growth of farm power under region VIII

| Farm power source | (million kW) |         |         |         |                    |
|-------------------|--------------|---------|---------|---------|--------------------|
|                   | 1971–72      | 1981–82 | 1991–92 | 1996–97 | % share in 1996–97 |
| Human             | 0.608        | 0.764   | 0.941   | 1.045   | 8.4                |
| Animal            | 2.645        | 2.245   | 2.980   | 2.93    | 24.37              |
| Tractor           | 0.129        | 0.575   | 2.16    | 3.664   | 29.94              |
| Irrigation pumps  | 0.420        | 1.268   | 3.172   | 4.55    | 37.17              |
| Total             | 3.802        | 5.032   | 9.253   | 12.24   | 100                |
| KW/ha             | 0.21         | 0.27    | 0.475   | 0.625   | –                  |
| Tractive power    | 3.39         | 11.42   | 23.34   | 29.46   | –                  |

Table 16. Growth of farm power sources under region VIII

|  | 1971-72 | 1981-82 | 1991-92 | 1996-97  |
|--|---------|---------|---------|----------|
| Human Population in agriculture, million | 12.15   | 15.27   | 18.81   | 20.9     |
| Total bovine, million                    | 10.58   | 9.7     | 11.93   | 11.93    |
| Tractor                                  | 5,160   | 22,993  | 86,420  | 1,46,545 |

Table 17. Trends in growth of population of bullock drawn implements

| Implements         | ('000)  |         |         |         |         |          |
|--------------------|---------|---------|---------|---------|---------|----------|
|                    | 1966-67 | 1971-72 | 1976-77 | 1981-82 | 1986-87 | 1991-92* |
| Wooden plough      | 39.92   | 39.29   | 41.03   | 43.04   | 43.02   | 43.39    |
| Steel plough       | 3.52    | 5.36    | 6.5     | 6.69    | 8.86    | 11.79    |
| Blade harrow       | —       | 11.74   | 11.66   | —       | —       | —        |
| Disc harrow        | —       | —       | —       | 3.36    | 1.18    | —        |
| Cultivator         | —       | —       | —       | 4.26    | 4.96    | 5.79     |
| Puddler            | 2.72    | 1.69    | 2.06    | 2.32    | 3.29    | 4.67     |
| Sowing devices     | 1.14    | 4.09    | 4.86    | 5.62    | 6.47    | 7.45     |
| Leveling kara      | —       | 0.37    | 8.89    | 10.47   | 8.70    | —        |
| Olpad Thresher     | —       | —       | —       | 0.36    | 0.37    | 0.32     |
| Cane Crusher       | 0.65    | 0.68    | 0.78    | 0.69    | 0.72    | 0.75     |
| Parsian Wheel      | 0.68    | 0.64    | 0.57    | 0.53    | 0.34    | 0.22     |
| Bullock cart       | 12.69   | 12.96   | 12.67   | 13.67   | 14.35   | 15.07    |
| Sprayer and Duster | 0.21    | 0.44    | 1.55    | 1.55    | 1.67    | 1.79     |

Table 18. Trends in growth of power operated agricultural machinery

| Power Source                 | ('000)  |         |         |         |         |         |
|------------------------------|---------|---------|---------|---------|---------|---------|
|                              | 1971-72 | 1976-77 | 1981-82 | 1986-87 | 1991-92 | 1995-96 |
| Combine (Tractor)            | 3.5     | 5.6     | 12      | 37      | 61.5    | 110     |
| Harvester (Self)             | 4.5     | 3.0     | 3       | 18      | 35.0    | 41      |
| Power sprayer/duster         | 448     | 851     | 1,239   | 1,853   | 2,771   | 3,500   |
| MB and disc plough           | 573     | 925     | 1,429   | 2,392   | 4,004   | 4,750   |
| Disc harrow                  | 556     | 1,292   | 1,892   | 3,574   | 4,751   | 6,000   |
| Cultivator                   | 815     | 1,766   | 3,150   | 5,956   | 11,558  | 13,000  |
| Seed drill/Seed ferti. drill | 246     | 640     | 1,606   | 2,777   | 4,301   | 5,500   |
| Planter                      | 85      | 244     | 305     | 443     | 643     | 5,750   |
| Leveller                     | 494     | 1,201   | 4,140   | 7,008   | 11,861  | 12,000  |
| Potato digger                | —       | —       | 569     | 878     | 1,355   | 1,400   |
| Thresher                     | 2,058   | 4,841   | 10,250  | 13,638  | 18,138  | 30,900  |
| Wheat                        | 1,825   | 4,278   | 8,319   | 11,599  | 16,172  | 25,000  |
| Paddy                        | 136     | 575     | 1,318   | 1,148   | 1,622   | 4,500   |
| Other                        | 97      | 188     | 613     | 891     | 1,295   | 1,400   |
| Sugarcane Crusher            | 872     | 1,045   | 1,208   | 1,512   | 1,892   | 2,000   |

## 15. SWOT ANALYSIS OF MECHANIZATION PROGRAMME IN THE REGION

### Strengths

- The region has a number of ICAR Research Institutes and their Regional Stations, Agricultural Universities, Centres of All India Coordinated Research Projects, and Krishi Vigyan Kendras to support the agricultural R&D programmes including that of agricultural mechanization.
- In this zone for Rajasthan part, Maharana Pratap University of Agriculture and Technology, Udaipur is playing a key role in sustainable agricultural development through KVK's and Agricultural Research Stations.
- National Research Center on Rapeseed and Mustard located at Bharatpur is engaged in research and to solve practical problems for raising bumper crops.
- In Bundelkhand region, Indian Grassland Fodder Research Institute, Jhansi has developed new grass varieties and technologies, which are acceptable in the region.
- In Jhansi, National Research Center on Agro Forestry is situated, which contributes for agro forestry research, training and demonstrations.
- Central Sheep and Wool Research Institute, Avikanagar in Rajasthan contributes for research and conducts training, demonstrations for better care and more wool to boost the economy.
- Sale of tractors and power tillers during the last 10 years has increased. The survey data confirms that there are more number of tractor users than tractor owners. Custom hiring of tractors, threshers and other machinery are becoming popular.
- A fairly good infrastructure for manufacture, sale and repair of different types of agricultural machinery has been established in the zone.
- Region has good potential for growing fruits and vegetables. The region has good infrastructure of Banking System.
- The Madhya Pradesh State has Central Training and Testing Institute at Budni (Hoshangabad district). In the State, Indian Institute of Soil Science is dedicated for serving farmers regarding soil related problems. For value addition of raw soybean, AICRP on Soybean Processing and Utilization is functional at CIAE, Bhopal which imparts trainings to entrepreneurs in addition to research activities. There are more than 20 KVK's

run by State Agricultural University and ICAR. For soybean, wheat and weed science, three National Research Centers are functioning at Indore and Jabalpur.

- In Madhya Pradesh State, Oilseed Federation, State Seed Corporation and National Seed Corporation are also contributing for the betterment of farming community. Madhya Pradesh State has good potential for horticulture and pulses mechanization. There are five ICAR Institutes and one Testing and Training Institutes, Directorate of Agricultural Engineering, State Agro Industrial Development Corporation and JNKVV, Jabalpur, which ensure sustainable agriculture development in the State.
- The leading institute of agricultural engineering located at Bhopal develops improved farm implements to bridge the mechanization gaps and conducts trainings for farmers, artisans, engineers, State Agricultural officers and manufacturers. For all major crops, the Central Institute of Agricultural Engineering, Bhopal has recommended package of improved implements.
- The commonly commercialized equipment are inclined plate planter, self-propelled reaper, multicrop thresher, animal drawn seed-cum-fertilizer drill, wheel hoe, tubular maize sheller and manual groundnut decorticator which have potential for adoption at large scale.
- In agro ecological region, farmers use MB plough, disc harrow and seed drill on bullock owned farm. The use of manual knapsack sprayer is also popular among farmers. On tractor owned farms, tractor drawn duck foot cultivator, Tractor drawn seed-cum-fertilizers and tractor operated power thresher (Hadamba) are in use.

### Opportunities

- By adopting precision agriculture and use of package of improved equipment, the overall productivity can easily be increased twice.
- For soybean cultivation, drainage technology play a key role in *kharif*. By adopting proper water management practices the entire agricultural land can be converted into irrigated land. Use of sprinkler and drip irrigation system can help in increasing water use efficiency.
- The area has good potentiality of growing good quality fruits and vegetables. The horticultural mechanization can complete the jobs in time with good produce. Modern irrigation methods and

rotavator, power sprayers have good potential. By following scientific methods of production, making best use of agricultural labour force and adopting proper Post Harvest Technology at farm/village level, the production of horticultural crops can be increased many folds.

- The good opportunities are available for agro processing activities in the production catchments for increasing income and employment opportunities and reducing poverty line.
- If greater emphasis is given on production of horticultural crops, poultry, etc. on scientific lines with proper infrastructural support for washing, cleaning, grading, drying, packaging, storage, cold storage, handling and transport with refrigerated vans/cool chain, the region can emerge as a big supplier of these products and can supply its produce to big markets and other cities in the region.
- The production of high value crops can be increased substantially, with encouragement to contract/cooperating farming on scientific lines.
- Since individual ownership of costly agricultural machinery is not economically viable due to small holdings, custom services of improved, energy efficient, high capacity precision equipment have good scope of introduction and popularization in this region. This activity should be encouraged.

### Weaknesses

- The average operational holding size in 1995–96 was below 0.5 ha in the region. The region has fragmented lands. This makes mechanized farm operations difficult. Individual ownership of costly machines is often not economically viable.
- Although there are Directorates of Agriculture, Horticulture, Fisheries and Animal Husbandry in these States but their extension services in terms of creating awareness about new technologies, conducting field demonstrations, conducting training programmes and providing latest information to farmers are very poor. In these States, the infrastructure and manpower for extension of agricultural mechanization programme is very poor.
- The States do not have package of equipment of better quality for precise and timely farm operations. The tractors annual use is very low in the region.
- Although about 3/4 of the villages are electrified, but electricity is not available for more than 8 hrs

a day in the rural areas. The farmers cannot depend on electric supply for their irrigation or for operation of threshers and other stationary machines and have to depend on tractors and diesel engines.

- The leading soybean State of Madhya Pradesh has not mechanized different agricultural operations.
- The network for quality-improved implements all across the State is very poor. The farmers in the region do not possess matching implements according to their power sources.
- The efficient tillage equipment MB plough, disc harrow and rotavator have got partial acceptability. The seed drills being used by farmers do not include standard material and components.
- There is hardly any mechanization for fruits and vegetable cultivation. The cereals and pulses are still threshed manually or by bullock trampling. The harvesting is also performed manually for wheat, rice, oilseeds and pulses.
- The farmers are not using tractor mounted rotavator, self propelled rice transplanter, self propelled power weeder and self propelled vertical conveying reaper, multicrop thresher.
- The rice crop is not transplanted by manual rice transplanter. The use of manual pre-germinated rice seeder is also not in use anywhere.
- The planting operation of maize in Rajasthan region is not mechanized yet. The dibbler, animal drawn planter, tractor drawn planter, tubular maize sheller, power operated maize dehusker cum sheller are not in practice in maize growing areas of Rajasthan.

### Opportunities

- The efforts made for mechanization can only succeed if all concerning agencies shoulder assigned task in close coordination to each other.
- The Panchayats in coordination with KVK's can play more effective role through demonstration and training program on improved implements and machinery. The wheat growing districts in Madhya Pradesh may take benefits of straw combine in wheat-harvested fields with combine harvesters.
- In Vindhya and Malwa regions, there are tremendous scopes in multiplying high capacity threshers.
- For groundnut cultivation animal/tractor drawn

inclined plate planters and tractor mounted groundnut digger have opportunities for efficiently mechanizing these operations in the zone.

- For sugarcane and cotton mechanization, the use of high capacity equipment, e.g. tractor mounted sugarcane sett cutter planter and animal/tractor drawn inclined plate planter have good potential due to saving in cost of operation and time.
- The use of manual rice transplanter, manual pre-germinated rice seeder, self propelled rice transplanter, self propelled power weeder and multicrop thresher have tremendous scope in Madhya Pradesh part of this region. For tillage, rotavator is cost effective in black cotton soil conditions of this region.
- The use of tractor mounted inclined plate planter, pneumatic planter have good scope for further promotion in this region of Madhya Pradesh. In Rajasthan part, Animal drawn three row seed drill, animal drawn planter, self propelled vertical conveyor reaper have better opportunities for promotion in Udaipur, Kota and Banswara region.

### Threats

- Due to land tenancy laws, the operational holdings have reduced in the zone restricting the scope for agricultural mechanization.
- In view of the diminishing contribution (GDP) of agriculture sector in the zone, there is a danger that the future allocations for agricultural development, and more particularly for agricultural mechanization, may not get adequate priority in funds allocations and the programmes may suffer for want of adequate funds.
- Unless proper attention is given to proper soil conservation, drainage and water management programmes, the water logging and soil erosion problems will become serious in future and it would be difficult to maintain soil fertility.
- In the absence of proper facilities for post harvest technology and value addition of agricultural produce, especially the perishables and semi-perishables, at farm/village level, heavy losses of these produce are going to continue in future also.
- Unless proper facilities for quality testing are developed in the production catchments, the farmers cannot export quality items to increase export of agricultural produce.
- Insufficient allocation of budget for agricultural sector to bridge the mechanization gaps.

- The breed of bullock is not of good quality in the zone.
- The farm power availability/ha is low in the region.
- Exhodus to urban area if agriculture is not made attractive.
- No processing technology for perishable and semi-perishable products causing more losses.
- Lack of efforts for micro irrigation system in the zone.

## 16. LONG TERM PROGRAMMES AND STRATEGIES FOR AGRICULTURAL MECHANIZATION IN THE ZONE

For preparing long term strategies for agricultural mechanization till 2020, it is important to visualize the scenario prevailing at that time and the challenges which are to be overcome to meet the aspirations from agriculture sector in the zone. It is visualized that with the annual growth rate of about 2.1%, the population will be approximately 1.5 times. To be self sufficient in food grain production to have enough food for the entire population of the State @ about 250 kg/head and to have surplus for sale to deficient States or for export, the annual production of food grains in the zone will have to be increased to about twice.

This will call for increasing the productivity levels in this zone around 3,500 kg/ha. Production of other items will also have to be increased in the same proportions.

### 16.1 Issues

By 2020, the following targets will have to be met:

- Production of other items like oilseeds, horticultural crops, milk, meat, egg, fisheries will also have to be increased in the same proportions. The annual growth rate should be 4% in this zone.
- Farm power availability to be increased from present level of 1.12 kW/ha (in 2001) to about 2.75 kW/ha in the zone by 2020.
- Operational holdings will reduce from 0.50 ha in 1995–96 to about 0.35 ha in this zone in 2020.
- Annual requirement of water for agriculture will increase substantially. The irrigated area of food grain crops in the zone is not likely to increase from the present level of 37% to beyond 65% by 2020. The increased production will have to be managed primarily by adopting better water management practices.
- Recent trends show that the draught animal population in the zone is decreasing but the overall

livestock population is increasing which will demand more feed and fodder to be provided in future.

- The losses of agricultural produce specially that of horticulture, milk and fisheries are high and need to be reduced substantially to increase profitability of farmers, by adopting appropriate on-farm and village level post harvest and value addition technologies in the zone.
- Crops having high water requirement and comparatively low returns on investment will have to be replaced with more reliable and profitable crops through diversification of cropping systems. The selection of crops can be done in consultation of agricultural scientists and experts.
- With the increase in crop production, more surplus crop residues will be available. Its proper utilization and management for feed, fodder and energy will require greater attention in the zone.
- For gainful employment of surplus labour force in the villages, agro-processing, agro-clinic and agro-service centre facilities will have to be promoted and expanded in the zone.

## 16.2 What is required

- Precision farming for timely, precise and judicious application of agricultural inputs (seed, fertilisers, water, plant protection chemicals, agricultural machinery, etc.) for maximizing utilization efficiency of inputs, land and labour.
- Precision land leveling and use of efficient irrigation equipment for economizing in water requirements of crops.
- Diversification of crops suiting to water availability in the region, agro-climatic conditions and for better economic returns to the farmers. Area under cultivation of horticultural crops—fruits, vegetables, flowers and medicinal plants should be increased. Area under soybean and wheat should be reduced to promote diversified agriculture.
- Mechanization of agricultural operations to reduce cost of operation.
- Gradual increasing in farm power availability from the present level of 1.12 kW/ha to 2.75 kW/ha in the zone by 2020, by timely farm operations.
- Identification/development and promotion of high capacity, energy efficient equipment to do timely operations to reduce cost of operation and specific energy requirements.

- Promotion of custom hiring of high capacity equipment so that marginal, small and medium categories of farmers can also take the advantage of mechanization.
- Promotion of on-farm and village level Post-Harvest Technologies and agro-processing activities in the production catchments to reduce losses, give better returns to farmers and generate more employment opportunities.

## 16.3 Strategies

### 16.3.1 Farm Power

1. This region, with medium population, should progressively adopt to selective mechanized farming for timely and precise field operations at reduced costs and to maximize utilization efficiencies of costly inputs (seed, fertilizer, plant protection chemicals, water, machinery etc.) and for conservation of natural resources—soil, water and environment.
2. Availability of adequate farm power for mobile and stationary farm operations in this zone should be 2.5 times by 2020. For stationary operations like water lifting, threshing, chaff cutting, cane crushing, cleaning, grading and other agro-processing and value addition activities, adequate electrical energy should be insured. For this, it should be ensured that the farmers get electricity for at least 16–20 hours. In this zone, electricity need should be supplemented through renewable energy sources.

### 16.3.2 Improved Agricultural Implements and Machinery for Crop Production

3. Top priorities should be given to these crops by adopting improved varieties, high doses of fertilizer and precision equipment for proper placement of inputs. This will boost up the production of the whole region.
4. Subsoilers and equipment for deep tillage for breaking hardpan and eradication of kans and other perennial weeds should be introduced in the zone.
5. For timely farm operations, reduction in cost of operations and saving energy in tillage and sowing/planting/transplanting operations, large scale adoption of rotovators and promotion of precision drills, planters and transplanters for all crops should be promoted and given high priorities. Presently mechanization of rice

transplanting and planting of sugarcane, cotton and many other crops is at very low level. Suitable machines will have to be introduced and popularized. Check row planters for cotton and other crops will have to be introduced.

6. Power operated weeders for narrow and wider row crops will have to be introduced and popularized. High clearance tractors with narrow tyres will be required to be introduced for intercultural operations.
7. Self propelled boom sprayers, orchard sprayers and electro-static-spraying equipment will be required to be introduced for proper spraying in field and tall crops/orchards and for better deposition of chemicals.
8. Presently harvesting is done mostly by using sickles. Combines and harvesters for almost all crops like sorghum, pearl millets, maize, pulses, oil seeds, sugarcane, cotton, safflowers, sunflowers, castor etc., will have to be introduced and popularized for timely harvesting.
9. Threshing of wheat, rice, sorghum, some pulses and oil seeds crops are fairly mechanized. Threshing of other crops – pigeon pea, safflower, sunflower etc. are to be introduced and popularized. In future, emphasis should be given on popularization of high capacity, energy efficient, multi-crop threshers.
10. In order to make efficient use of available human and animal energy, improved, efficient and ergonomically designed hand tools and matching animal operated equipment for different operations like seed bed preparation, sowing/planting, weeding/interculture etc. should be promoted and popularized.

### 16.3.3 Mechanization of Horticultural Crops

11. Whole set of equipment for mechanization of orchard crops—pit making, transplanting of saplings, pruning, spraying in tall crops, harvesting of fruits etc. need to be identified/imported/developed, introduced and popularized.
12. Vegetable crop production has to be mechanized for which full set of equipment from seedbed preparation, planting, transplanting of seedlings, inter culture, irrigation, spraying harvesting, picking/digging has to be identified/developed and introduced.
13. Different types of manually operated and power operated garden tools will have to be introduced and popularized for promotion of raising of

seedlings for growing of fruits, vegetables and flowers and for work in the gardens.

14. Use of plastic mulch reduces water requirement and checks weed growth. Equipment for laying plastic mulch, low plastic tunnels for cultivation of vegetables, cut flowers etc. will be required to be introduced and popularised.
15. Green house technology has good scope in India for growing seedlings, flowers, high value off-season vegetables and some fruit crops. This technology needs greater promotion. Equipment for mechanization of cultivation in green houses will be required to be introduced and popularized.

### 16.3.4 Feeds and Fodders

16. Equipment for harvesting of fodder crops, making silage, feed blocks, feed pallets will be required to be introduced and popularized in future. The tractor mounted fodder harvester-cum-chopper, self propelled fodder harvester should be promoted to reduce human drudgery in this zone.

### 16.3.5 Biomass Management

17. Equipment for harvesting, retrieval, densification fortification, handling and transport of crop residues will be required to be introduced in large numbers for making best utilization of straw and other crop residues for feed, fodder and energy.
18. There is need to introduce equipment for handling, transport and application of manure in the field, in liquid and solid forms, will be required. Such equipment will be required to be imported/developed and introduced on large scale.
19. There is need to promote equipment for clearing of shrubs, weeds, and grasses along the roadside will be required for better look and hygiene.

### 16.3.6 On-farm Post-Harvest Technology

20. Post harvest equipment and technology will be needed for cleaning, grading, drying, cooling, evaporative cooling, storage, cold storage and handling of farm produce to improve their quality and shelf-life. Cool chains for transport of perishable materials like fruits, vegetables, milk and milk products, fish, meat etc. will be required in large numbers to reduce losses.
21. Agro-processing activities should be promoted in the production catchments to reduce losses, minimize transport cost and to increase income and employment opportunities in rural areas.

### 16.3.7 Efficient Water Management

22. Crops with high water requirement and comparatively low returns should be diversified with high value and high return crops as recommended by agricultural scientists and experts.
23. For increasing production and productivity, more water will be required. Water management practices for conservation, storage, reducing conveyance losses through lining of channels and use of plastic pipes etc., economic application through precise/laser land leveling and use of sprinklers and drip irrigation systems to economise in water requirement, should be given high priority.
24. For making farm ponds, bunds, farm roads, drainage channels etc., power operated trenchers, angle dozers, drudgers, buck scrapers and other earth moving machinery will be required to be introduced on large scale.

### 16.3.8 Infrastructural Improvements

25. Testing facilities for agricultural machinery and agro-products for quality control should be created in the region and manufacturers, processors and exporters should be helped in improving the quality of their products.
26. The Agricultural Engineering Colleges located in this region should adequately be strengthened in their testing facilities and they should be approved for testing of certain types of agricultural machinery and for Quality Certification of Agro-Products.
27. A Display Centre of Improved Agricultural Machinery be established in this region with full information and video clippings of the working of different types of equipment, from where the farmers/extension workers/policy makers etc. can get information about different types of agricultural machinery, their specifications, source of supply and cost. An experienced agricultural engineer should man this centre. The centre should also have the information on the improved agricultural machinery being used in other advanced countries.
28. For providing information to the farmers, information centers have been established by Department of Agriculture at some important places. These centers are computerized and provide information on soil, crop, variety, fertilizer, chemicals, diseases and pest, irrigation

requirements, loans, subsidies etc. Adequate information on the availability of farm equipment, sources of supply, costs etc. are not available at these information centres. Farm machinery being a costly input to agriculture, farmers should be provided information and properly guided in selection of appropriate equipment for them. For this purpose, use of Information Technology (IT) and kiosks centres should extensively be used. An experienced agricultural engineer should man these centres.

29. Farm machinery exhibitions and demonstrations should be organized at important places in the region every year and groups of farmers should be taken to these exhibitions to see those improved equipment and their working and to identify items which may be of interest to them.
30. Adequate facilities should be created and expanded for training of trainers, farmers, drivers/operators, mechanics, and manufacturers to support the agricultural mechanization programmes. Nationalised banks, fertilizer companies, tractor/power tiller/combine/engine manufacturers should be involved in organizing such training programmes.
31. Training programmes should be organized for the entrepreneurs in manufacture/running of custom service centres/Agri-clinics/repair and maintenance workshops and providing contract services for different farm operations.
32. For creating awareness amongst the farmers and extension workers, regular programmes should be broadcasted/telecasted on radio and TV networks. Video films on the working of different equipment should be prepared and shown to the farmers. Front Line Demonstrations (FLDs) of new equipment should be conducted in farmer's fields and large number of farmers should be invited to see the demonstration.
33. The region has fairly good facilities for the manufacture of different types of agricultural machinery. Good manufacturers should be encouraged and given incentives to manufacture good quality equipment at competitive prices. Items to be promoted in future and their likely demand should be projected and announced in advance by the Directorates of Agriculture/Agricultural Engineering so that the manufacturers plan and make those things available to the farmers.
34. A proper mechanism should be developed to

collect information, annually, about the production and sale of different types of agricultural machinery in the State, on the pattern on which crop production and yield data are being collected. This will help in getting better idea about the present trends and demand of different types of agricultural machinery and will help in better planning for the future agricultural mechanization programmes. Such data should be published annually and should be available on computer/internet.

35. To take the advantage of use of improved high capacity agricultural machinery by all categories of farmers, custom services of agricultural machinery by private entrepreneurs should be encouraged and promoted. They should be given incentives and long-term loans on concessional rate of interests. This will boost use of efficient agricultural machinery for timely farm operations at reduced cost.
36. Visit of selected groups of progressive farmers should be organized to other States/countries where they can see the modern farms and use of improved agricultural machinery. Similarly visits of selected manufacturers of the region should also be organized to progressive States and countries to see modern farms, manufacturing units and get information on different types of improved agricultural machinery. A team of Research Engineers/Scientists, manufacturers, policy makers should be sent to National/International Farm Machinery Shows to identify potential machinery for introduction in the region/State/Indian conditions for future adoption and popularization.

#### 16.3.9 Institutional Framework

37. Farm Mechanization Development Council, under the Chairmanship of Minister of Agriculture be setup to plan, guide, review and monitor the programmes related to agricultural mechanization in the respective States. This council should be

represented by the officials of the Department of Agriculture, Agricultural Engineering, Animal Husbandry, Horticulture, Fisheries, Irrigation, industries, manufacturers of agricultural machinery, leading banks, Agro Industries Corporations, State Planning Commissions, ICAR Institutes in the region, State Agricultural Universities and Progressive farmers. This Council should meet twice a year.

38. The existing infrastructure and manpower for identification, planning, execution, guidance and monitoring of agricultural mechanization and agro-processing activities in the zone is poor and inadequate. There is a strong need for creating a separate Directorate of Agricultural Engineering in the zone to plan, execute, review, and monitor various programmes related to agricultural mechanization and post harvest activities in the State. A Monitoring Cell should also be established in the Directorate of Agriculture/Agricultural Engineering for this purpose. This Cell should maintain computerized databases and progress reports of all the programmes.

#### 16.3.10 Policy Issues

39. To encourage agricultural mechanization on sound footings, there should be a State Policy for Agricultural Mechanization.
40. In order to encourage use of energy efficient equipment, the farmers should not be provided free electricity. Rather the electricity should be provided to them at subsidized rates and they should be given incentives in the support price of food grains.
41. To encourage the owner of farm machinery to ensure their farm equipment and to provide an insurance cover to the farm labourers, group insurance schemes for equipment like tractors, power tillers, combines, threshers, pumpsets etc. should be started and the premium rates should be kept very low, less than 0.5% of the cost of the machinery to be insured.

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