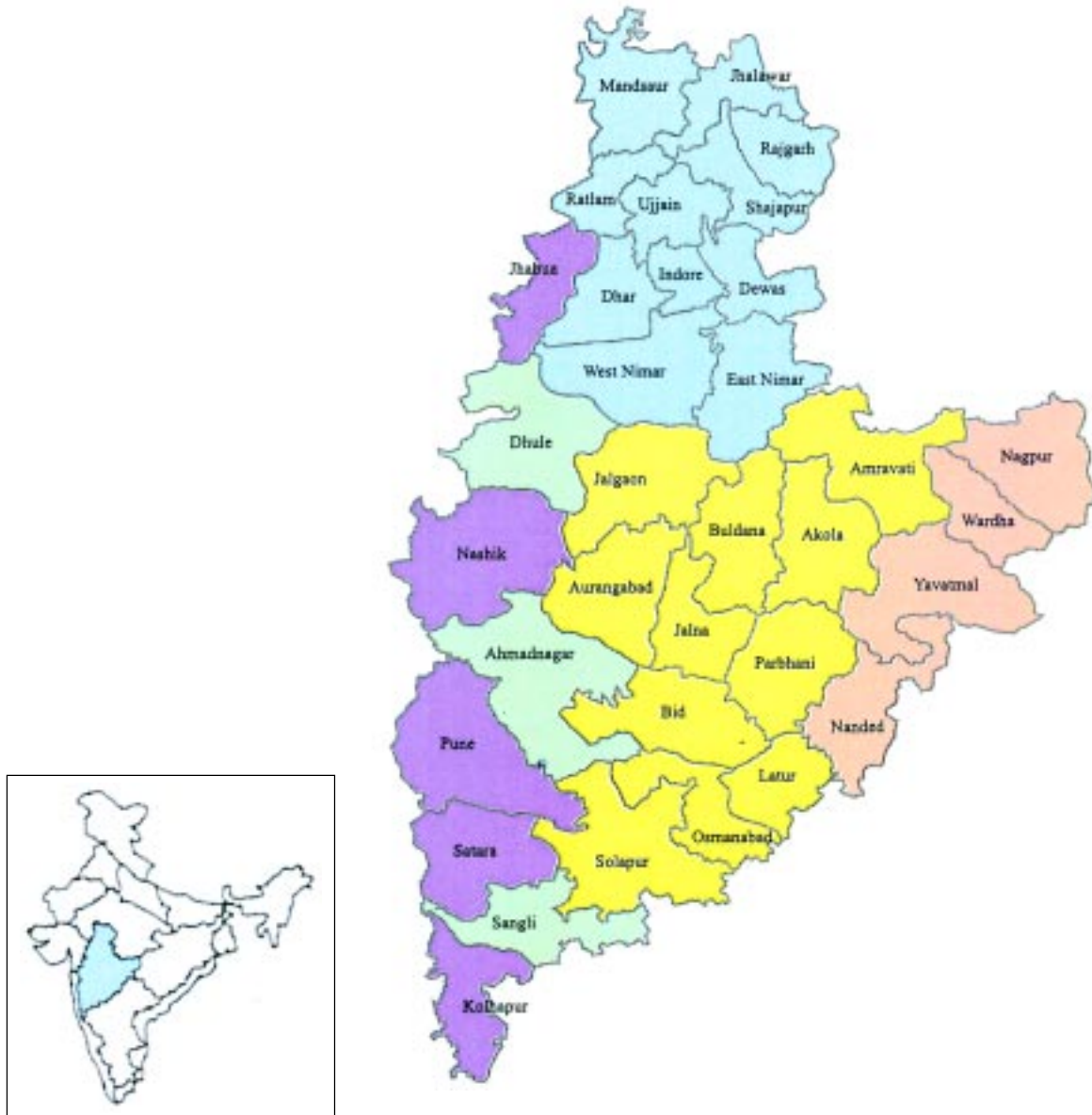


Long-term Strategies and Programmes for Mechanization of Agriculture in Agro Climatic Zone-IX : Western Plateau and Hills region

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1. NAME OF AGRO CLIMATIC ZONE : Western Plateau and Hills region
2. STATES UNDER THIS ZONE : Madhya Pradesh and Maharashtra



3. SUB-AGRO CLIMATIC ZONES WITH THEIR CHARACTERIZATION

This zone comprises of a major part of the State of Maharashtra, parts of Madhya Pradesh and one district from Rajasthan. It is known for its oranges, grapes and bananas. Besides, it also accounts for around half of the jowar production in the country. The zone is divided into four sub-zones.

3.1 Western Hills and Plains

This region, spread over the districts of Kolhapur, Satara, Pune, Nashik and Jhabua, receives a little less than a thousand mm of rains in a year. The climate is semi-arid and the soil type is shallow to medium and deep black soils with sandy loam to loamy texture and neutral reaction. About 58% of the land is cultivated, of which less than 17% is irrigated. Most of the irrigation is in Maharashtra. In Jhabua, irrigated area is only 5.5% of cultivated area. Jhabua is a predominantly tribal area.

According to the Agro Planning Regional Planning Unit, land availability and land productivity are low in this sub-zone. "There is limited scope for expansion of area as well as irrigation for raising agricultural production in the region."

3.2 Scarcity Region

The scarcity region includes Ahmadnagar, Dhule, Sangli and Solapur. Precipitation is quite low at only about 600 mm per annum. The climate and soil is similar to the Western Hills and Plains. The climate is semi-arid and the soil is classified as shallow to medium and deep black soils with sandy loam to clay loam texture neutral to slightly alkaline reaction,

Over two-thirds of the area is cultivated but irrigation facilities are limited to only about 17% of the total cultivated area.

3.3 Central Plateau

This sub-zone spans across 21 districts, of which, 10 are in Maharashtra and 11 are in Madhya Pradesh. The districts from Maharashtra are Osmanabad, Latur, Bid, Aurangabad, Jalna, Parbhani, Akola, Amravati, Buldana and Jalgaon. In Madhya Pradesh, they are, West Nimar, East Nimar, Dewas, Indore, Dhar, Ratlam, Ujjain, Shajapur, Rajgarh, Jhalawar and Mandsaur. The region receives about 880 mm of rainfall, the climate is semi-arid and the soil type is medium to deep black.

Agricultural activity is more concentrated in the Maharashtra parts than in Madhya Pradesh. Net sown area as percentage of total geographical area in Maharashtra is much higher at about 74% as against the less than 60% average in Madhya Pradesh. Irrigation

facilities are poor in both the States—between 10 to 15% of the cultivated area.

3.4 Central Vidarbha

This sub-zone includes the districts of Nagpur, Wardha, Yavatmal and Nanded. It rains about 1,000 mm in a year. The climate is semi-arid to dry sub humid and the soil type is classified as medium to deep black clayey soils neutral to slightly alkaline reaction. Nearly two-third of the land is cultivated, but like in most parts of Maharashtra, irrigation facilities are poor. Only five per cent of the cultivated area is irrigated.

4. GENERAL TOPOGRAPHY OF THE ZONE WITH BRIEF HISTORICAL BACKGROUND OF AGRICULTURAL DEVELOPMENT OF THE ZONE

| | |
|-------------------------|---|
| Malwa Plateau | Plain to very gently sloppy |
| Nimar Plateau | Undulating |
| Jhabua hills | Heavily undulating and sloppy |
| Submontane zone | Moderate rolling topography |
| Scarcity zone | Rolling with 1–2% slope |
| Western Maharashtra | Plain topography |
| Plain Zone | |
| Western ghat zone | The Western Ghat zone is an unevenly narrow strip extending from north to south along the crest of the Sahyadri ranges. It includes hilly, high lying terrains round about the Ghats of Amboli, Phonda and Amba in Kolhapur district, Koyas and Mahabaleshwar in Satara district, Lonawala and Trimbaka in Nasik district covering about 2.10 lakhs ha. |
| Central Vidharba region | Bound on the west by 900 mm and on the east by 1200 mm isohyets |

5. OPERATIONAL LAND HOLDING PATTERN BY MAJOR SIZE GROUPS

The operational land holding pattern by different size groups is given in Table 1.

6. IMPORTANT SOIL TYPES

| | |
|----------------------------------|--|
| Malwa plateau | : Medium black, medium |
| Nimar valley | : Medium black, gravely medium to light |
| Jhabua hills | : Shallow red, skeletal |
| Submontane zone | : Raddish brown to black tending towards lateritic nature |
| Western ghat zone | : Light lateritic and reddish brown |
| Western Maharashtra plain zone | : Grayish black clay loam |
| Central Maharashtra Plateau zone | : Medium to deep black, alkaline |
| Central Vidarbha zone | : Black, medium to heavy in texture, fairly high in clay content, alkaline |

Table 1. Operational land holding pattern by major size groups in the region

| Sub zone | Farm size (ha) | Nos. | Average area (ha) |
|---------------------------------------|----------------|-------------|-------------------|
| Madhya Pradesh | | | |
| Malwa plateau | < 1.0 | 25,977 | 0.52 |
| | > 1 to 2 | 2,49,322 | 1.40 |
| | > 2 to 4 | 2,36,617 | 2.85 |
| | > 4 to 10 | 2,24,026 | 6.18 |
| | > 10 | 66,516 | 16.08 |
| Nimar plateau | < 1.0 | 51,306 | 0.55 |
| | > 1 to 2 | 80,035 | 1.51 |
| | > 2 to 4 | 86,449 | 2.83 |
| | > 4 to 10 | 78,377 | 6.15 |
| | > 10 | 20,158 | 15.15 |
| Jhabua hills | < 1.0 | 38,346 | 0.56 |
| | > 1 to 2 | 3,99,733 | 1.47 |
| | > 2 to 4 | 38,521 | 2.82 |
| | > 4 to 10 | 24,497 | 5.89 |
| | > 10 | 3,064 | 13.59 |
| Sub montane zone | 0 to 2 | 22.90 | — |
| | > 2 to 4 | 31.09 | — |
| | > 4 to 20 | 39.55 | — |
| Central Maharashtra plateau | 0 to 2 | 24.20 | — |
| | > 2 to 4 | 33.2 | — |
| | > 4 to 20 | 32.6 | — |
| Central Vidarbha zone | 0 to 1 | 1,57,93,476 | — |
| | > 2 to 9.9 | 5,09,120 | — |
| | > 9.9 to 20 | 31,392 | — |
| Western Maharashtra plain zone | | | |
| Nasik division | < 1.0 | 3,48,610 | — |
| | > 1 to 2 | 4,39,905 | — |
| | > 2 to 4 | 3,40,611 | — |
| | > 4 to 10 | 1,84,998 | — |
| | > 10 | 22,493 | — |
| Pune division | < 1.0 | 5,11,699 | — |
| | > 1 to 2 | 4,99,679 | — |
| | > 2 to 4 | 4,17,925 | — |
| | > 4 to 10 | 2,18,940 | — |
| | > 10 | 39,985 | — |

7. ANNUAL RAINFALL

Madhya Pradesh

| | |
|---------------|----------------|
| Malwa plateau | : 900–1,000 mm |
| Nimar valley | : 800–1,000 mm |
| Jhabua hills | : 600–800 mm |

Maharashtra region

| | |
|--|---------------------|
| Western Ghat zone | : 2,000 to 6,050 mm |
| Sub Montane zone | : 700 to 2,500 mm |
| Western Maharashtra plain zone Ganeshkhind | : 700 to 1,200 mm |
| Scarcity zone | : < 750 mm |
| Central Maharashtra plateau zone | : 500 to 1,100 mm |
| Central Vidarbha zone | : 900 to 1,200 mm |

8. POPULATION AND POPULATION DENSITY OF THE ZONE

| | |
|---|--------------------------|
| Sub Montane zone | : Population 48,00,000 |
| Western Ghat zone | : Population 6,98,000 |
| Scarcity zone | : Population 1,89,28,000 |
| Western Maharashtra plain zone population | : 31,00,000 |
| Population density | : 174/sq.km |

9. BRIEF SCENARIO OF AGRICULTURE SECTOR

In the Western Ghat zone, about 27% of the area is under forest, which are mostly denuded. The conservation of these land resources is a major problem. The area under spices is 353 ha and under fruits and vegetables is 2,933 ha. Considering the poor economic condition of farmers and sloppy lands, the horticulture is priority need of the zone. The conditions prevailing at Western Ghat zone are well suited for the cultivation of rainfed fruit like mango, cashewnut, jackfruit, karonda, jamun, etc. There is also vast potential for growing different plantation and spice crops. The area under these crops is increasing vary fast. The post harvest losses of fruits and vegetables are about 25%.

10. BRIEF SCENARIO OF ANIMAL HUSBANDRY SECTOR

In the Western Ghat zone, 0.183 million cattle exist. Out of the total male cattle in the zone, 0.16% are

| Sl. No. | Name of State | Milk production ('000 tonnes) | Egg production (lakh nos.) |
|---------|----------------|-------------------------------|----------------------------|
| 1. | Maharashtra | 2,610 | 29,370 |
| 2. | Madhya Pradesh | 3,220 | 14,000 |

Table 2. Area and production of major field crops under agro-ecological region IX in Madhya Pradesh

| Important crops | Malwa plateau | | Nimar plateau | | Jhabua hills | |
|----------------------|----------------|--------------------------|----------------|--------------------------|----------------|--------------------------|
| | Area ('000 ha) | Production ('000 tonnes) | Area ('000 ha) | Production ('000 tonnes) | Area ('000 ha) | Production ('000 tonnes) |
| Rice | 11.5 | 4.6 | 41.3 | 21.8 | 27.8 | 8.3 |
| Wheat | 700.6 | 1,472.3 | 110.3 | 244.5 | 34.8 | 66.5 |
| Maize | 317.0 | 426.2 | 52.9 | 71.9 | 103.9 | 112.3 |
| Sorghum | 274.1 | 208.0 | 255.8 | 216.1 | 19.1 | 10.8 |
| Bajra | 6.27 | 2.79 | 19.35 | 6.28 | 14.74 | 6.43 |
| Gram | 621.1 | 519.9 | 30.2 | 20.4 | 37.4 | 19.5 |
| Soybean | 1,914.2 | 1,921.8 | 104.2 | 6.79 | 25.96 | 16.09 |
| Rapeseed and mustard | 70.1 | 59.8 | – | – | 0.029 | 0.011 |
| Cotton | – | – | 33.28 | 32.46 | 14.4 | 8.5 |
| Sugarcane | 19.3 | 48.1 | 17.7 | 37.1 | – | – |
| Groundnut | 27.8 | 27.3 | 64.7 | 52.9 | 15.7 | 13.0 |
| Potato | 237.1 | 247.2 | 1.1 | 1.2 | – | – |

breeding bulls. The female livestock in the Ghat zone is about 53% of the total cattle population. The cattle in the zone is maintained mainly for draught purpose.

In Scarcity Zone, total population of sheep and goats is about 55 lakh (20.46 sheep and 35.19 lakh goats).

11. BRIEF SCENARIO OF FISHERIES SECTOR

| Sl. No. | Name of State | Fisheries Production ('000 tonnes) | |
|---------|----------------|------------------------------------|------------------|
| | | Inland Fisheries | Marine fisheries |
| 1. | Maharashtra | 135.39 | 397.90 |
| 2. | Madhya Pradesh | 127.43 | – |

12. IRRIGATED AREA AND SOURCE OF IRRIGATION

Malwa Plateau irrigated area : 13,06,540 ha

Nimar Plateau irrigated area : 3,10,519 ha

Jhabua Hills irrigated area : 60,626 ha

Scarcity zone irrigated area : 3.63 lakh ha 6.1% of the cropped area

Irrigated area and source of irrigation are given in Table 3 & 4.

13. INFRASTRUCTURAL FACILITIES AVAILABLE IN THE ZONE

- (i) Metalled road connecting villages : 60%
- (ii) Electrified villages and reliability of supply of electricity for agricultural purpose: 96%
- (iii) Important markets for sale of farm implements and machinery/grain mandis. Mandis located at Taluka level in Maharashtra and weekly hat bazaars in Madhya Pradesh; Agro Industries Development Corporation Workshops, Madhya Pradesh; Directorate of Agriculture, Krishi Upaj Mandi. District Agril. Office; State Agricultural Universities and Krishi Vigyan Kendras.

Table 3. Irrigated area and irrigation sources (Nos.) under region IX in Madhya Pradesh

| Irrigation source | Malwa Plateau | | Nimar Plateau | | Jhabua Hills | |
|-------------------|---------------|----------|---------------|----------|--------------|--------|
| | Area (ha) | Nos | Area (ha) | Nos | Area (ha) | Nos |
| Electric pumps | 24,638 | 4,27,676 | 7,325 | 1,12,499 | 6,863 | 16,102 |
| Diesel pumps | 40,591 | 14,231 | 16,647 | 11,454 | 4,293 | 10,173 |
| Deep tubewell | 2,826 | 870 | 329 | 82 | 24 | 9 |
| Shallow tube well | 56,948 | 16,059 | 160 | 0 | 0 | 0 |
| Open well | 4,76,844 | 3,12,005 | 1,38,604 | 81,807 | 7,644 | 8,740 |

Table 4. Area and irrigation sources in (Maharashtra State) Western Ghat under region IX

| Irrigation sources | Nos. | Irrigation sources | Area irrigated (ha) |
|-------------------------|----------|--------------------|---------------------|
| Number of the tubewells | 4,646 | Canal | 3,91,912 |
| Pumpsets | | Tanks | 1,01,391 |
| Electric | 8,86,921 | Wells | 13,54,771 |
| Diesel | 41,989 | Other sources | 2,09,771 |

- (iv) Infrastructural facilities available for manufacture of agricultural implements and machinery (include range of machinery being manufactured): Through Madhya Pradesh and Maharashtra—Laghu Udyog Nigam.
- (v) Infrastructural facilities available for sale/repair and maintenance of tractors and other machinery in the region: Through effective network of reputed manufacturers of tractors and matching equipment.
- (vi) Facilities available for extension/training of farmers, artisans/farm women, entrepreneurs etc. related to agricultural mechanization: Through thirteen Krishi Vigyan Kendras in Madhya Pradesh and Central Institute of Agril. Engineering, Bhopal.
- (a) ICAR Institutes/Regional Stations.
- (i) Central Institute of Agril. Engg, Bhopal: Rural youth and women training.
 - (ii) Central Institute of Cotton Research, Nagpur: Mechanization on cotton equipment.
 - (iii) Indian Institute of Soil Science, Bhopal: For demonstration of improved equipment for existing cropping pattern in the region.
 - (iv) National Research Centre for Soybean, Indore: For demonstration of improved implements on soybean cultivation.
 - (v) IARI Regional Research Centre/Station, Indore: For demonstration of improved implements related with wheat cultivation.
 - (vi) National Research Centre for Grapes, Pune: For demonstration of improved technologies of weeding.
 - (vii) National Research Centre for Onion and Garlic, Raj Guru Nagar, Pune: For demonstration of improved technologies of weeding.
- (b) Agricultural Universities/Regional Stations
- (i) MPKV, Rahuri: Development and demonstration of location specific improved

- agril. equipment through prototype feasibility testing and front line demonstrations.
- (ii) JNKVV, Jabalpur: Through front line demonstrations.
- (c) Krishi Vigyan Kendras
- (i) KVKs located at Amravati, Jalgaon, Akola and Nasik in Maharashtra.
 - (ii) KVKs located at Sehore, Seoni, Jabalpur, Khargone and Indore in Madhya Pradesh.
- (d) Offices of State Department of Agriculture, SISI units located in the zone.
- (i) Directorate of Agril., Madhya Pradesh, Madhya Pradesh Laghu Udyog Nigam, MP State Agro Industries Development Corporation, Directorate of Agril. Engineering, Madhya Pradesh, Directorate of Agril. Engineering, Maharashtra.
 - (ii) M/s Lalwani Industries, Plot No. 8 and 9, Road No. 19, Sector-1, Govindpura Industrial Area, Bhopal.
 - (iii) M/s Laxmi Agro Industries, Near Railway Crossing, Berasia Road, Bhopal-462 008
 - (iv) M/s Prakash Agro Industries, 18/19, Kali Parade, Industrial Area, JP Nagar, Bhopal-462 001.
 - (v) M/s Shri Shankar Industries, 40, Hamidia Road, Bhopal.
 - (vi) M/s Yashoda Engineering, Shop No.14, New Rajeev Nagar Bemara Kala, Bhopal-462 010.
- (e) Important NGOs and other extension organizations available in the region.
- (i) M/s Vasantdada Sugar Institute (VSI), Pune (Maharashtra).
- (f) Facilities available for credit
- (i) Regional Rural Banks, State Cooperative Banks, Nationalized Banks, NABARD.
- (g) Incentives, concessions, subsidies available to farmers/manufacturers of agricultural implements
- (i) 50% concessions for purchasing of implements to SC/ST categories and 25% to other backward classes.

14(a) TRADITIONAL AND IMPROVED AGRICULTURAL IMPLEMENTS BEING USED BY THE FARMERS FOR DIFFERENT OPERATIONS AND IMPROVED AGRICULTURAL MACHINERY PROPOSED TO BE INTRODUCED FOR POPULARIZATION.

These are given in Table 5.

Table 5. Traditional and improved agricultural implements being used by the farmers for different operations and improved agricultural

| Operation | Implements being used | | Improved implements suggested for introduction |
|----------------------------|------------------------------------|---|---|
| | Traditional | Improved | |
| 1 | 2 | 3 | 4 |
| Seedbed preparation | | | |
| 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 <i>patella</i> harrow |
| Harrowing | Bullock drawn bakhar | Animal drawn disc harrow, improved <i>patella</i> harrow, Rotavator, Tractor mounted offset disc harrow | Improved <i>patella</i> harrow, Animal drawn |
| 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 |
| Planking | Animal drawn <i>pata</i> | Tractor drawn harrow-cum- <i>patela</i> | Tractor drawn harrow-cum- <i>patela</i> |

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

These are given in Table 6 & 7.

15. SWOT ANALYSIS OF MECHANIZATION PROGRAMME IN THE REGION

Strengths

- The sale of tractors, diesel engine and electric motors in Maharashtra and Madhya Pradesh parts of this zone has increased during the last decade. 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.
- There is fairly good infrastructure for manufacture, sale and repair of different types of agricultural machinery.

Table 6. Indicators of Agricultural Mechanization in Madhya Pradesh

| Items | Malwa | Nimar | Jhabua |
|----------------------------------|-----------|-----------|----------|
| Agricultural land (in' 00 ha) | 33,116.89 | 10,810.26 | 3,596.10 |
| Farm Power availability (kW/ha) | 0.892 | 0.660 | 0.583 |
| Agricultural Workers (no./00 ha) | 30.8 | 38.8 | 7.3 |
| Draught animals (no./00 ha) | 30.6 | 49.6 | 84.7 |
| Tractor (density/00 ha) | 1.2 | 0.3 | 0.2 |
| Diesel engines (density/00 ha) | 0.4 | 1.1 | 3.0 |
| Electric motors (density/00 ha) | 12.9 | 10.3 | 4.5 |
| Tube wells (density/00 ha) | 2,826 | 329 | 24 |

Table 7. Indicators of Agricultural Mechanization in Maharashtra

| Items | Nasik division | Pune division | Kolhapur division | Aurangabad division | Latur division |
|----------------------------------|----------------|---------------|-------------------|---------------------|----------------|
| Agricultural land, ('00 ha) | 24,718 | 31,605 | 15,941 | 20,839 | 25,782 |
| Man power availability (Nos./ha) | 2.72 | 1.84 | 2.49 | 1.72 | 2.5 |
| Agricultural Workers | 22,32,562 | 2,170,846 | 15,33,953 | 12,90,852 | 18,49,527 |
| Draught animals | 9,99,757 | 7,07,191 | 3,52,363 | 6,60,620 | 8,04,088 |
| Tractors | 13,112 | 10,743 | 9,228 | 3,559 | 2,525 |
| Diesel engines | 8,995 | 27,903 | 27,181 | 5,986 | 8,579 |
| Electric motors | 1,38,824 | 1,52,838 | 80,296 | 97,940 | 97,126 |

- 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.
- National Research Centre for grapes and National Research Centre for Onion and Garlic, Pune are serving through R&D of improved technologies and demonstrations/trainings for respective crops.
- In this zone Central Institute for Cotton Research located at Nagpur is engaged in developing improved technologies for Cotton crop. The National Research center for Citrus at Nagpur is serving farming community with new varieties and technologies. Maharashtra Animal and Fisheries Science University is engaged in education and extension in the respective fields.
- Region has good potential for growing fruits and vegetables.
- There is a good scope of increasing production of milk, poultry and inland fisheries.
- The region has good infrastructure of Banking System.
- In Malwa region of this zone, soybean and wheat crops, agricultural operations like tillage and threshing have mechanized (80%).
- The State of Maharashtra is progressive due to adoption of modern equipment like sprinkler set, drip irrigation system, power tillers for orchard cultivation, multicrop planters, sunflower thresher, multicrop thresher, sugarcane planter and power sprayers.
- In paddy growing regions (Sub-zone I, II, III, IX) transplanters and reapers have been demonstrated.
- Under Sugarcane mechanization, Rotavator and Sugarcane Planter have good potential and its use is progressing, due to State government support.
- The State agricultural universities (Mahatma Phule Krishi Vidyapeeth, Rahuri; Dr Punjabrao Krishi Vidyapeeth, Akola; Marathwada Agril. University, Parbhani) have taken demonstrations and training program to speed up farm mechanization. The State has four universities .
- The Central Training and Testing Institute at Budni (Hoshangabad district) caters training needs of farmers of this zone.
- For Malwa, Nimar and Jhabua regions of this zone, 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 Agriculture Engineering has recommended package of improved implements.
- In agro-ecological region IX, farmers use MB plough, disc harrow, rotavator, puddler, seed drill planter, cultivator, digger, and power thresher. 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.

Weaknesses

- The sub regions from V to VIII felt need for proper sorghum and *bajra* harvester, which can reduce human drudgery.
- The package of improved matching equipment with power tiller for all agricultural operations especially for horticultural mechanization have

not been developed and accepted.

- The unavailability of indigenous sugarcane and cotton harvesters are also hindrance in increasing the production and productivity of principal crops.
- The hand tools and animal drawn equipment have not been multiplied and distributed under dryland farming regions.
- The efficient fruit harvesting equipment are not available in this zone. The annual uses of tractors , power tiller and bullock pairs are low.
- The custom hiring/contract farming have not been emphasized by the respective State governments resulting in slow pace of agricultural developments.
- The leading onion State, Maharashtra has no mechanization in agricultural operations causing human drudgery and increased cost of different operations.
- The agricultural operations' mechanization for fruits (orange and grapes) is very limited which require adoption of package of improved equipment for timeliness and elimination of human drudgery.
- In Jhabua region improved manual hand tools and implements for different crops do not exist. Similarly, bullock drawn implements package for different crops are not in use any where in this part of this zone.
- The cotton belt of this zone is still using conventional practices. The planters, weeders and sprayers are not commonly used by major section of farmers in the zone.
- In Madhya Pradesh part of this zone, there is no adequate attention on mechanization for fruit cultivation. The rotavator, boom sprayer, ridger, cultivator, posthole digger and weeders have not been introduced, resulting in more human drudgery.
- There are mechanization gaps in different agricultural operations for different crops in this zone. The implements repairs facilities are also not available in close vicinity.
- The lack of training facilities on the use of improved equipment is the main reason for lower rate of adoption.
- There are no existence of Agro clinic, Agro Processing Centre for value addition of post harvest agricultural products and solar dryers in application in this zone.
- Bullock breeds are poor.
- There are inadequate infrastructures for warehousing. Cold storage are very limited in the zone.

- In Western Hills and plains, scarcity zone, Jhabua region, Central plateau, Central Vidarbha, the irrigation facilities are below 15%.

Opportunities

- The industrial liaisoning with manufacturers and demonstration of complete equipment package for specific crop need to be emphasized.
- By adopting precision agriculture and use of appropriate type of agricultural machinery, the overall productivity can easily be increased by 1.5 times.
- In Maharashtra part of the zone, the area has good potentiality of growing good quality fruits and vegetables. The region has also high population density. 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.
- In Madhya Pradesh part of the zone, the good opportunities are available for agro processing activities in the production catchments for increasing income and employment opportunities and reducing poverty line.
- In agro climatic zone IX, with encouragement to contract/cooperating farming on scientific lines, the production of high value crops can be increased substantially.
- In Maharashtra State of the zone, the State advances in the cultivation of onion, banana, orange, sugarcane and cotton. The levels of mechanization with diversity in agriculture need to be increased to boost the economy of farmers.
- There is ample scope to enhance cropping intensity in different regions if package of improved equipment for different crops and power sources are adopted. The skill to adopt improved equipments through trainings need to be developed. The effective linkages with manufacturers of machinery can play a key role to bring more area under mechanized farming.
- The planners can include efficient equipments for mechanizing different agricultural operations of cotton, sunflower, sugarcane and different orchard crops. The annual uses of power sources should be enhanced with the use of matching equipments.
- The package of equipment for horticultural cultivation have great opportunities. For grapes orchards, power tiller and pomegranate operated field machinery are yet to be popularized. The use of power tiller operated boom sprayer, self-

propelled boom sprayer, Jyoti multicrop planter provide good opportunities for promotion in this region.

- Similarly, tractor mounted multipurpose sugarcane equipment, tractor mounted sugarcane multipurpose hoe and tractor mounted sugarcane trash shredder provide good scope in the Maharashtra State
- For sugarcane and cotton mechanization, the use of high capacity equipments, 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.
- There are good opportunities to promote package of equipment for horticulture equipments.
- There is good potential for adoption of modern irrigation methods (drip, sprinkler irrigation).
- In Maharashtra part of the zone, for orchard cultivation, power tiller with matching implements has good opportunities.
- The green house use has good potential for vegetable cultivation in Maharashtra.
- Development of the sugarcane harvester, mini combine, cotton harvester, sorghum harvester can fulfill the need of farmers.

Threats

- The high capacity efficient machines may cause labour displacement in the villages, because of, is no multiple cropping system exist in the region.
- The farm power availability/ha is low in the zone.
- The network for sales and after sales repair is ensured, otherwise, mechanization will leave bad impact.
- The bullock owned farmers should plan for other uses of animal power to afford the annual expenditure on feed and maintenance of bullock pair.
- Due to land tenancy law, the operational holdings will be further getting smaller, which will reduce the scope for agricultural mechanization in dryland regions of this zone.
- In absence of proper facilities for post harvest technology and value addition of agricultural produce, especially the perishable and semi-perishables, at farm/village level, heavy losses of these produce are going to affect in future also.
- Unless proper facilities for quality testing are developed in the production catchments, the farmers will not be able to produce export quality items to increase the export of agril. produce.

- In the Vidarbha region, farming is difficult task in absence of dryland equipments package for different crops. Due to land tenancy laws, the operational holdings will be further getting smaller, which will reduce the scope for agricultural mechanization in the Maharashtra and Madhya Pradesh part of the zone.
- Insufficient allocation of budget for agricultural sector to bridge the mechanization gaps.
- The breed of bullock is not of good quality.
- Exodus to urban area, if agriculture is not made attractive.
- No processing technology for perishable and semi-perishable products causing more losses.

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

Resources like land and water are limited and shrinking as population increases. Keeping pace with the present growth of population and consumption pattern, an annual growth of 4–5% would be needed for sustainable agricultural development in this zone during the next decade. Sustaining agriculture in zone, to meet the growing domestic demand and export through modernization, will be the guiding factors for any future developmental planning in relation to population growth.

16.1 Improved Agricultural Implements and Machinery for Crop Production

- There is need to introduce self propelled harvester and mini combine for safflower crop in Western Maharashtra plain and Scarcity Zone.
- There is need to mechanize planting, harvesting and sugarcane trash management in all regions.
- The sorghum and *bajra* crops should be mechanized in the Western Maharashtra plain zone, Scarcity Zone and Central Vidarbha zone for harvesting operation.
- There is need to mechanize planting, interculture and shredding operation for cotton crop in the Scarcity zone, Central Maharashtra and Central Vidarbha zone.

16.2 Mechanization of Horticultural Crops

- There is need to adapt coconut climber and harvester for the sub-mountain zone and Western Maharashtra plain zone.
- The banana crop in the Central Maharashtra plateau and Central Vidarbha region should be mechanized.

- In all the zones of Maharashtra there is need to mechanize vegetable and fruit cultivation.

16.3 Biomass Management

In Maharashtra part of the zone sugarcane bagasse and groundnut shell should be used for gasification plant for use in industrial applications. In Madhya Pradesh the biomass management should be strengthened in different districts of the zone.

16.4 Integrated Land Use Planning and Water Management

There is an urgent need for micro level planning due to competing demands on land for agriculture, forestry, grass lands etc., on one side and urban and industrial development on the other. This should also be seen in the light of gradual reduction in the average size of farm holdings due to ever increasing population. Land use planning has also to be considered along with watershed management, as our water resources are depleting at an alarming rate. This demands evolving economically viable and environmentally sound water conservation and management techniques. Due attention has to be given to minimize and/or control surface run off through *in situ* water conservation measures and development of micro-watersheds to ensure adequate moisture for crop production. Precision controlled irrigation through micro and drip system, especially in horticulture and high value crops, may save water and thereby more area can be brought under irrigation.

16.5 Enhancing Agricultural Production and Productivity

Concerted efforts are required to provide good quality certified seeds, chemicals and other inputs to the farmers at reasonable price in the region. Micro processor based green house and covered cultivation, micro sprinkler, fertigation, organic farming, hybrid seeds, plants propagated through tissue culture and biotech may have to be introduced in a big way which would require different approach for infrastructure and human resource development. Development of technology for dryland/rainfed areas will be another challenge for increasing production and productivity.

16.6 Achieving Rapid Mechanization

This demands good quality machines and better sales & service facilities. Farm machinery industry will have to modernize their products not only in terms of performance characteristics but also for comfort, safety

and energy conservation in zone. The industry should develop new machines for mechanization of horticulture, plantation and agro-forestry to bridge mechanization gaps in both the States of this zone.

16.7 Encouragement to Contract and Commercial Farming

Contract farming and franchise cultivation by the industries with progressive farmers not only will ensure quality produce for processing but will also help the producer to modernize agriculture for producing high value crops. Diversification of agriculture for growing high value crops and horticulture, floriculture, industrial crops, mushroom cultivation, agro forestry and energy plantation would again require higher investment which may not be feasible for individual farmers due to financial and technological limitations. The group farming could be encouraged by industries under contract farming or franchise cultivation arrangement.

16.8 Encouragement to Diversification

- In the field of floriculture and medicinal and aromatic plants cultivation selective mechanization is required. To promote Jethropa cultivation, farm mechanization is need of the hour in this zone
- Agro-processing and other agro-based industries in rural areas. Primary processing facilities need to be developed in rural areas for on farm processing of cereals, pulses, oilseeds and fruits/vegetables. This will provide more employment to rural people.

16.9 Marketing, Processing and Transport of Horticultural Produce

Simple techniques to increase shelf life like wax coating, polythene/cellophane, packaging etc. will reduce the losses considerably which should be adopted at farm level. There is a need to develop and provide specialized containers for packaging and transport to promote export

16.10 Livestock Improvement and their Management

Due to existence of large number of poor quality livestock in the Zone, serious attention has to be given for their improvement through better management, health, feed and breeding. The industries will have to contribute not only for processing of the animal products but also for providing services like cattle feed and fodder,

poultry and animal shelter, milk handling and processing plants.

16.11 Aquaculture Development

There is immense potential in fisheries sector. Construction of ponds, aerators, hatcheries, fishing gear, cold containers, processing, packaging, transport etc. require specialized technology for domestic and export market. Refrigerated container for handling and transport would help in increasing their shelf life besides more economic returns to producers.

16.12 Enhancing Rural Employment

The introduction of highly advanced technology in traditional/cottage industry in food sector such as rice and *dhal* milling, oil extraction, flour milling, processed instant foods etc., which were earlier processed at rural level, are however, likely to reduce the rural employment opportunities. It will be in the overall interest of the country to establish primary processing units in rural areas only.

16.13 Enhancing Export of Value Added Processed Foods and Farm Machinery

Export of oil, meals, cereals, (rice, durum wheat), fish and marine products, fruits and vegetables, cut flowers, tea, coffee, spices, textiles, etc., have to be increased. This will generate more income or revenue to the exporters, middlemen, and allied service industries in addition to the producers who would equally get benefit of producing quality products. The export of agro products would also increase employment in other service sectors engaged in packaging, handling, transport (road, rail, ship and air) directly or indirectly. Better packaging technology is needed for raw as well as processed products, which will help in maintaining original quality of produce in terms of appearance, colour, texture, flavour and taste. Moreover, increased export of agro-produce would also require better quality products, storage facilities, controlled temperature containers/controlled atmospheric and aseptic packaging, modern material handling equipment and services. □