

## Long-term Strategies and Programmes for Mechanization of Agriculture in Agro Climatic Zone-V : Upper Gangetic Plains region

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1. NAME OF THE AGRO CLIMATIC ZONE : Upper Gangetic Plains region
2. STATES UNDER THIS ZONE : Western and Central Uttar Pradesh



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

This is among the larger and very thickly populated agro-climatic zones. It covers 32 districts of Uttar Pradesh. A large part of the geographical area is cultivated and is well irrigated. This is the most developed region of the State of Uttar Pradesh. Over 70% of the area is sown and nearly 65% of this is irrigated. The ratio of surface to ground irrigation is about 1 : 2. Agricultural labour and land productivity is high.

The zone is characterized by semi-arid and sub-humid conditions. The mean Annual rainfall varies between 700 and 1,000 mm. There are three sub-zones. These are described below:

#### 3.1 Central Plains

Allahabad, Fatehpur, Pratapgarh, Sultanpur, Rae-Bareilly, Unnao, Lucknow, Bara Banki, Sitapur, Hardoi, Kheri and Pilibhit districts fall under this sub-zone. The region receives on an average 979 mm of rainfall; the climate ranges from dry sub-humid to semi-arid and the soil is alluvium calcareous sandy loam. About 62% of the land is cultivated of which 56% is irrigated.

#### 3.2 North-Western Plains

This sub-zone covers the districts of Shahjahanpur, Bareilly, Rampur, Moradabad, Bijnor, Saharanpur, Muzaffarnagar, Meerut, Baghpat, Ghaziabad and Bulandshahr of Uttar Pradesh. This region has the highest land productivity in the State. About 70% land is under agriculture and another 5% land is under forest cover. 76% of the net sown area is irrigated. Tube wells are the predominant source of irrigation. The zone receives, on an average 907 mm rainfall, the climate is dry sub-humid to semi-arid and the soil is loam to sandy loam.

#### 3.3 South-Western Plains

In spite of a relatively high proportion of arable and irrigated cropped area, land productivity in the southwestern plains of Uttar Pradesh is low. This is largely on account of cultivation of low value crops principally wheat and bajra. The region covers the districts of Badaun, Aligarh, Mathura, Agra, Etah, Farrukhabad, Kannauj, Mainpuri, Firozabad, Etawah, Kanpur Dehat and Kanpur. The climate is semi-arid and the soil type is alluvium calcareous clay. The region receives about 721 mm of rainfall. More than 74% of the net sown area is irrigated and over 69% land is cultivated.

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

This area falls in main Indo-gangetic plains and is very fertile and can give very good yields with proper management. The land topography is of plain land, fairly leveled to very gently sloping with slopes ranging from 0–3%. Soils are deep and water table is high. Canal irrigation, shallow tube wells, open wells and tank irrigation are common for supplemental irrigation. Agriculture is the main occupation of the rural people. The average productivity of food grains is higher than the national average. Many of the farmers take two crops a year, and some with assured irrigation also take third crop during summer.

The region has many rivers. During rainy season, flood and water logging occurs due to poor drainage in some areas. All crops can be grown.

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

During 1995–96, the average operational land holdings in Uttar Pradesh were 0.86 ha against the national average of 1.41 ha. The ratio of marginal, small, semi-medium, medium and large category of farmers were 75.43, 14.56, 7.36, 2.47 and 0.18% respectively. About 90% farmers were under marginal and small categories with an overall average of these two categories as 0.555 ha. Predominance of such small farms poses serious problems in mechanization and use of costly machinery on individual ownership basis, is not economically viable unless it is used for custom services.

### 6. IMPORTANT SOIL TYPES AND CROPS

The soils in this region are generally deep and loamy developed on alluvium soil. The dominant soil scapes, representing the northern plains, constitute gently to very gently sloping lands. In some area the soil is highly calcareous. The soils in general are neutral in reaction and have moderate clay and low organic carbon content.

Traditionally rain fed and irrigated agriculture is common. The main crops grown are rice, maize, pigeon pea, sorghum, pearl millet, moong beans during *kharif* and wheat, Bengal gram, green peas, rapeseed and mustard and lentil during *rabi* season. Sugarcane is the main cash crop. Rice–wheat cropping system is more predominant. Amongst the fruit crops, mango and guava, and amongst the vegetable crops potato, onion, brinjal, tomato, cauliflower and cabbage are important.

The average consumption of fertilizer in 2001–02 in Uttar Pradesh was 130.44 kg/ha against the national average of 90.12 kg/ha.

## 7. CLIMATE AND ANNUAL RAINFALL

The climate of the region is characterized by hot summer and cool winter. Annual rainfall ranges between 700–1,200 mm, 70% of which is received during the months of June to September. The rainfall covers about 70% of the annual PET demand of 1,400 to 1,800 mm and leaves an annual water deficit of 500 to 700 mm during February and June. The growing period ranges from 150–180 days in a year. It experiences dry period from February to June with mean annual temperature of more than 22°C. The areas adjacent to foothills are relatively cooler and experiences thermic soil temperature regime.

## 8. POPULATION AND POPULATION DENSITY

As per 2001 census, the population density of Uttar Pradesh State as a whole was very high, literacy rate was low and percentage of population below the poverty line was also very high. It was 689/km<sup>2</sup> in Uttar Pradesh as compared to 324/km<sup>2</sup> at national level. The literacy rate was low, 61.03%. The percentage of people below the poverty line was 31.15% in 1999–2000.

## 9. BRIEF SCENARIO OF AGRICULTURE SECTOR

About 79.22% of the total population of Uttar Pradesh (166.05 million total population) in 2001 was living in rural areas and depending on agriculture and allied sector for their livelihood. Agriculture sector is the backbone of economy of this region. Due to our social structure in which land belonging to a person gets divided into its children, the land holdings are getting smaller and smaller. The average operational holding size, which was 0.90 ha in 1990–91 in Uttar Pradesh, got reduced to 0.86 ha in 1995–96. This is going to be reduced further to about 0.57 by 2020, unless the Government either takes some drastic measures to change the land tenancy rules or create enough jobs in non-agricultural sector to reduce the dependence of people on agriculture from the present levels of about 79% to about 20% or even less as is the case in developed countries.

On one hand the number of people dependent on agriculture for their livelihood is increasing every year, the share of agricultural and allied sector in the State GDP is going down. While it was more than 60% in 1950, it got reduced to 31.7% in Uttar Pradesh during

2001–02. This is due to the rapid development of industrial and infrastructure sectors on one hand and shifting of agro-processing activities from rural sector to bigger towns due to better availability of electricity and other facilities.

In the rural areas, on an average there are 5 persons in a family. Since the average operational holdings of about 75.42% of the population under marginal and 14.56% in small categories in Uttar Pradesh were only about 0.39 and 1.41 ha respectively in 1995–96, with overall average of these two categories as 0.555 ha, the per capita availability of land in the two combined categories in the State was 0.111 ha only. Most of the people below the poverty line in rural areas (32% below the poverty line living in rural areas) belong to these categories of farmers.

Agricultural mechanization is an important input to agriculture for timely farm operations; reducing the cost of operation; maximizing the utilization efficiency of costly inputs-seeds; fertilizer; plant protection chemicals; water and machinery; improving the quality of produce; reducing drudgery in farm operations; improving the productivity of land and labour and for improving the dignity of labour. The strategy for mechanization in different regions will be different depending on the conditions and resources of that region.

The agricultural mechanization strategy for region no. V has been suggested keeping in view the land holding pattern, the available resources in that region, the percent of population depending on agriculture, the important cropping systems being followed in the region, farm power availability and the infrastructural facilities available for promotion of agricultural mechanization and agro-processing programmes in the region.

## 10. BRIEF SCENARIO OF ANIMAL HUSBANDRY SECTOR

An analysis of the time series population of livestock and draught animals shows that while the draught animal population in the recent past has started going down, the overall population of livestock has been going up since 1951. The use of animal energy during 1977 to 1992 in Uttar Pradesh has been declining from 211 animal pair hour/ha in 1977 to about 87.9 animal pair hour in 1992. This was due to increasing population of tractors. The use of animal pair hr/ha in recent years has further gone down.

The production of milk, egg and wool in 2001–02 in Uttar Pradesh was 16,506 tonnes, 997.80 million numbers and 2059 tonnes, respectively.

## 11. BRIEF SCENARIO OF FISHERIES SECTOR

The production of inland fisheries in 2001–02 in Uttar Pradesh was 225,371 tonnes.

## 12. IRRIGATED AREA AND SOURCE OF IRRIGATION

In Uttar Pradesh, during 2001–02 about 64.9% foodgrain crops and 89.5% sugarcane crop were irrigated. The irrigated area under other crops was low. Amongst the sources of irrigation, the area under tube well irrigation was high (58.74%) followed by canal irrigation (24.5%).

## 13. INFRASTRUCTURAL FACILITIES AVAILABLE IN THE ZONE

### 13.1 Metalled Roads

Uttar Pradesh State has fairly good network of metallic roads. However all the villages are not connected with the metallic roads. Villages not having metallic roads are not connected with the public transport system.

### 13.2 Rural Electrification

Till November 1996, about 77% villages in Uttar Pradesh were electrified. However, they also do not get proper supply. The electricity is available hardly for 8–10 hours a day that too the timings are not regular, hence the farmers cannot plan their work properly. They have to necessarily depend on diesel engines for their irrigation, threshing and other stationary jobs.

### 13.3 Important markets for sale of farm implements and machinery/grain mandies

Big manufacturers of tractors and pump sets have their show rooms/dealers in big towns like Kanpur, Meerut, Muzaffarnagar, Ghaziabad, Allahabad, Fatehpur, Lucknow, Bareilly, Moradabad, Saharanpur, Bulandshahr, Aligarh and Agra. These dealers sell the tractors and their spare parts. They also extend repair and maintenance facilities to the farmers. Some of them keep matching implements also. Since the sale of power tillers and combines are limited only a few dealers in big towns like Lucknow and Kanpur have their dealership but they also do not keep the stock in their show rooms. For these items one has to place order at least 2–3 months in advance to enable the dealers to get the machine from the manufacturer.

Almost in every town there are a few manufacturers making different types of implements and machinery, but there are bigger markets for manufacture and sale of farm machinery located in Kanpur, Meerut,

Muzaffarnagar, Ghaziabad, Allahabad, Fatehpur, Lucknow, Bareilly, Moradabad, Saharanpur, Bulandshahr, Aligarh and Agra.

In this region, almost all the 32 districts have Krishi Upaj Mandies. Districts like Allahabad, Lucknow, Pilibhit, Shahajahanpur, Bareilly, Rampur, Moradabad, Saharanpur, Muzaffarnagar, Meerut, Ghaziabad, Aligarh, Agra, Farrukhabad, Etawah and Kanpur have big grain mandies. They also have big fruits and vegetable markets. Meerut and Muzaffarnagar have big jaggery mandies also.

### 13.4 Infrastructural facilities available for manufacture of agricultural implements and Machinery

This region has good number of manufacturers of farm implements and machinery. Almost in every town, there are a few manufacturers making different types of implements and machinery, but there are bigger markets for manufacture and sale of farm machinery located in Kanpur, Meerut, Muzaffarnagar, Ghaziabad, Allahabad, Fatehpur, Lucknow, Bareilly, Moradabad, Saharanpur, Bulandshahr, Aligarh and Agra. These manufacturers manufacture bullock-drawn and tractor-drawn equipment like ploughs, harrows, cultivators, seed/seed-cum-fertiliser drills, potato planters, power threshers, tractor trolleys, bullock carts etc. Some of the manufacturers also make manually operated equipment.

In spite of good manufacturing base for production of different types of agricultural machinery, their availability in many of the districts is not very satisfactory. The quality of implements being manufactured by majority of the manufacturers of the region is not very good and needs improvement.

Manufacture and sale of farm machinery is mostly in private sector. However UP Agro Industries Corporation and State Directorate of Agriculture also have their own workshops in Lucknow and Allahabad in this region for the manufacture of implements. Almost all the manufacturers of tractors, pumpsets, plant protection equipment have their dealers located at district headquarters and in big towns.

### 13.5 Infrastructural facilities available for sale/repair and maintenance of tractors and other machinery in the region

For sale, repair and maintenance of different types of agricultural machinery, there are very good infrastructural facilities available, almost in every town. Facilities for specialized jobs like crankshaft grinding, injector pump testing etc are available at district headquarters only.

### 13.6 Facilities available for extension/training of farmers, artisans/farm women, Entrepreneurs etc.

A number of ICAR Institutes, their Regional Stations, State Agricultural Universities and Krishi Vigyan Kendras are located in this region. Some facilities for training of farmers, farm women, mechanics, school dropouts are available in these organisations and at Farmer's Training Centres run by the State Governments. Specialised training programmes for the sugarcane farmers is organized by the Ganna Kisan Sansthan, Lucknow. But all these trainings are not at all adequate. Training facilities related to operation, maintenance and repair of different types of agricultural machinery is either almost missing or is highly inadequate and need to be strengthened substantially as the population of power-operated machinery is increasing at a fast rate. The average annual sale of tractors in the State of Uttar Pradesh during the last 10 years was about 50,000 tractors and in some years between 65,000–67,000 tractors, but there are no facilities to train that many tractor drivers in the State/region.

### 13.7 Facilities for credit

Nationalised/Commercial Banks, Regional Rural Banks and Cooperative Banks, whose branches are spread all over the region, are providing credit facilities to the farmers for the purchase of agricultural inputs including agricultural machinery. Credit is also available from Cooperative Societies and Sugarcane Unions. Credit from these banks/cooperative societies is available on reduced interest rates for agricultural purposes.

The Government of India introduced the "Kisan Credit Card" Scheme during 1998–99 which is now being implemented by 27 commercial banks, 373 district central/State cooperative banks and 196 regional rural banks throughout the country including this region. Till 31st March, 2002, there were 36,63,438 Credit Card holders in UP.

### 13.8 Incentives, concessions, subsidies available to farmers/manufacturers of agricultural implements

Subsidies on different types of agricultural machinery are available for different categories of farmers under centrally sponsored scheme. These subsidies are provided to the farmers under the Micro-Management scheme of the State Governments.

### 13.9 Infrastructure for Execution and Monitoring of Agricultural Engineering Extension Programmes

In the State of Uttar Pradesh the infrastructure for execution and monitoring of the agricultural engineering programmes is very poor. There are a few positions of agricultural engineers in the Directorate of Agriculture but that is highly inadequate and practically there is very little activity in this Directorate on front line demonstration, training, promotion and monitoring of agricultural mechanization programmes in the State. The budget allocation for this type of activities is also very meager.

### 14. AGRICULTURAL IMPLEMENTS BEING USED BY THE FARMERS

Majority of the farmers are using animal-drawn equipment. During the last 10 years, the population of tractors in this region has increased substantially and use of power machinery is now becoming popular. The average annual sale of tractors and power tillers in Uttar Pradesh was more than 50,000 tractors and 400 power tillers. Custom hiring of tractors, threshers and other power-operated machinery is becoming popular.

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

#### Strengths

1. Land topography of this region is of plain land, fairly leveled.
2. The soils are light, alluvium—derived soils mostly khaddar (recent alluvium) and hanger (Old alluvium). The soils are deep, loamy and high in organic matter content. The soils are very suitable for mechanized cultivation.
3. The rainfall in the region is good, ranging between 700–1,200 mm.
4. The region has good number of tube wells and a number of canals. Irrigation potential is high, water table is high. Good scope of shallow tube wells.
5. The region has good climate. Predominantly there are three seasons—hot summer (April–June), hot and humid rainy season (July–October) and cool dry winter (November–March). The growing period ranges from 150–180 days in a year. Two crops are common but with irrigation, third crop can also be taken during summer.

6. Rice-Wheat cropping system is most predominant. According to the projections of Rice Wheat Consortium, with good management, the region has a potential of rice-wheat yield between 16.50 to 17.35 t/ha, while the present average yields are only between 4.64 to 4.87 t/ha (average rice yields between 1,900–2,100 kg/ha and wheat between 2,740–2,770 kg/ha.) Region has good potential for growing fruits and vegetables.
  7. There is a good scope of increasing production of milk poultry and inland fisheries.
  8. The 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.
  9. The infrastructure for manufacture, sale and repair of different types of agricultural machinery is fairly good in almost every district of the region.
  10. There are good markets for sale of agricultural produce. Almost every important district in the region has a Krishi Upaj Mandi.
  11. 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.
  12. The region has 2 colleges of Agricultural Engineering at Allahabad and Etawah and has good number of trained personnel and experts in the field of agricultural mechanization.
  13. The region has good infrastructure of Banking System.
  14. There are good number of highly trained and experienced professional agricultural engineers available in the region who can help in planning and execution of different types of agricultural mechanization programmes.
3. The average operational holding size in 1995–96 was only 0.86 ha in Uttar Pradesh, that too is fragmented in 3–4 parcels. This makes mechanized farm operations difficult. Individual ownership of costly machines is often not economically viable.
  4. Although there are Directorates of Agriculture, Horticulture, Fisheries and Animal Husbandry in the State 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 the State, the information and manpower for extension of agricultural mechanization programme is very poor. The State of Uttar Pradesh was the first State to have a separate Department of Agricultural Engineering headed by a Chief Agricultural Engineer, even in fifties, but over a period of time and due to the policies of the State Government, the activities of the department were reduced and merged with the Directorate of Agriculture.
  5. The State does not have a clear-cut policy to encourage and promote use of tractors, power tillers and better quality of agricultural machinery for precise and timely farm operations. The existing programmes are meager and weak.
  6. Although about 77% of the villages in Uttar Pradesh were electrified in 1996, but electricity is available for not more than 8–10 hrs a day. The farmers cannot depend on electric supply for their irrigation or for operation of threshers and other stationary machines. They have to either keep alternative arrangements of diesel engines and pump sets or delay the farm operations.
  7. Due to poor extension services, the funds allotted for subsidy on different types of agricultural machinery are not being utilized properly, specially for animal-drawn equipment.
  8. In the State micro level planning, there are no priorities for agricultural mechanization programmes. They are often left out.

### Weaknesses

1. The population pressure in this region is high. The population density in Uttar Pradesh was 689/km<sup>2</sup> in 2001 as against the national average of 324/km<sup>2</sup>.
2. Due to high density of population and less resources more number of people are dependent on agriculture and the percentage of population below the poverty line in 1999–2000 in Uttar Pradesh was 31.15% as against the national

### Opportunities

1. The region has good fertile land, receives good rainfall and the water table is high. By adopting proper improved agricultural production technologies and water management practices, the entire agricultural land can be converted into irrigated land and productivity can be increased

- manifolds. Use of sprinkler and drip irrigation system can help in increasing water use efficiency.
2. By adopting precision agriculture and use of appropriate type of agricultural machinery, the overall productivity can easily be increased 2–3 times at a lower cost of production.
  3. 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 and profitability from fruits and vegetables crops can be increased many folds.
  4. The region has good opportunity of agro-processing activities in the production catchments for increasing income and employment opportunities. This can help in lowering the percentage of people living below the poverty line.
  5. The region can emerge as a big supplier of horticultural produce, milk, fish, poultry, etc. which can be supplied in big markets of Delhi, Kolkata, Mumbai, Chennai etc. in addition to other big towns in the State itself, if greater emphasis is given on production of these items on scientific lines with proper infrastructural support for washing, cleaning, grading, drying, packaging, storage, cold storage, handling and transport with refrigerated vans/cool chain.
  6. The production of high value crops can be increased substantially by giving due encouragement to contract/cooperating farming on scientific lines.
  7. Individual ownership of costly agricultural machinery is not economically viable on small holdings, custom services of improved, energy efficient, high capacity precision equipment are becoming popular in the region and have very good scope of their popularization in future also to take the advantage of mechanization to all categories of farmers. This activity should be encouraged.
- for want of adequate funds.
2. The region has good rainfall but in certain parts also receives floods during monsoon. 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.
  3. Due to land tenancy laws the operational holdings will be further getting smaller which will reduce the scope for agricultural mechanization and use of bigger size machinery.
  4. In 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.
  5. Unless proper facilities for quality testing are developed in the production catchments, the farmers will not be able to produce export quality items to increases export of agricultural produce.

#### 16. Long-term programmes and strategies for agricultural mechanization in the region

1. 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. It is visualized that with the annual growth rate of about 1.8%, the population of Uttar Pradesh in 2020 will be approximately 230.81 millions people. To be self sufficient in foodgrain production, to have enough food for the entire population of the State @ about 200 kg/head/annum and to have surplus for sale to deficient States or for export, the annual production of foodgrains in Uttar Pradesh will have to be increased to about 70 million tonnes. This will call for increasing the productivity levels from 2,157 kg/ha to 3,500 kg/ha in Uttar Pradesh by 2020. Production of other items will also have to be increased in the same proportions.

#### Threats

1. The contribution of agriculture sector to the State GDP is diminishing. 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

#### 16.1 Issues

By 2020, following targets will have to be met:

1. In the State of Uttar Pradesh, the food grain production will have to be increased from about 43.26 MT to about 70 MT (61.81% increase) by 2020, which will require an annual growth rate of over 3%. The average productivity has to be

increased from the present level of 2,157 kg/ha to about 3,500 kg/ha. Production of other items like oilseeds, horticultural crops, milk, meat, egg, fisheries will also have to be increased in the same proportions.

2. Farm power availability to be increased from present level of 1.75 kW/ha to about 3 kW/ha (71.43% increase) by 2020.
3. By 2020, the operational holdings in Uttar Pradesh is likely to reduce from 0.86 ha to about 0.57 ha, unless the land tenancy rules are revised. This will make mechanized operations more difficult.
4. The total population in the State is likely to increase from the present level of 160.05 million people to about 230.81 million people (39% increase) in 2020, and even if 60% people live in villages at that time, the rural population of the State in 2020 will be approx. 138.49 million, which will be about 7 million in excess of the present rural population of Uttar Pradesh. These people will also depend on agriculture, unless alternative jobs are created in other sectors.
5. Increased production will require more water. Annual requirement of water for agriculture will increase substantially. The irrigated area of foodgrain crops in Uttar Pradesh is not likely to increase beyond 75% by 2020 from the present level of about 64.9%. The increased production will have to be managed primarily by adopting better water management practices.
6. Draught animal population in the State is decreasing in recent years but the overall livestock population is increasing which will demand more feed and fodder to be provided in future.
7. 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.
8. Those crops which have high water requirement and comparatively give low returns on investment, will have to be replaced with more reliable and profitable crops through diversification of cropping systems. The selection of crops will have to be done in consultation with agricultural scientists and experts.
9. 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.

10. For gainful employment of surplus labour force in the villages, agro-processing, agro-clinic and agro-service center facilities will have to be promoted and expanded.

## 16.2 What is required

1. Precision land levelling and use of efficient irrigation equipment for economizing in water requirements of crops.
2. 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.
3. Mechanization of agricultural operations to reduce cost of operation.
4. Gradual increasing in farm power availability from the present level of 1.75 kW/ha in Uttar Pradesh to about 3 kW/ha by 2020, for timely farm operations.
5. 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 sugarcane should be reduced.
6. Identification/development and promotion of high capacity, energy efficient equipment to do timely operations to reduce cost of operation and specific energy requirements.
7. Promotion of custom hiring of high capacity equipment so that marginal, small and medium categories of farmers can also take the advantage of mechanization.
8. 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.
9. Crop residue management for feed, fodder and energy. For finding solutions to the important issues, as stated above, the long-term agricultural mechanization strategies which are required for agricultural production and on-farm/village level processing, training of manpower, manufacture, sale and repair of different types of agricultural machinery, collection of reliable data regarding production and distribution of different types of agricultural machinery and monitoring the programmes related to agricultural mechanization,

are given below. It is presumed that by 2020 about 70% of the tillage, land levelling, sowing/planting, irrigation and threshing of all the important crops will be fully mechanized and other operations, for different types of crops will be mechanized upto about 25–30%.

## 16.3 Strategies

### 16.3.1 Farm Power

1. This region, although highly populated, should progressively adopt to power 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 Uttar Pradesh should be increased from the present level of about 1.75 kW/ha to 3.0 kW/ha 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 provided. For this it should be ensured that the farmers get at least 16–20 hours uninterrupted electrical power supply, every day. If grid power availability is not assured, decentralized power generation using locally available materials should be encouraged in rural areas.

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

3. Annual yield potentiality of Rice–Wheat cropping system of this region has been assessed, by the Rice-Wheat Consortium, between 16.5 to 17.5 tonnes/ha. 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. Sub-soilers and equipment for deep tillage for breaking hardpan and eradication of kans and other perennial weeds should be introduced.
5. For timely farm operations, reduction in cost of operations and saving energy in tillage and sowing/planting/transplanting operations, large scale adoption of rotavators, conservation tillage technologies (promotion of zero till drills, strip till drills, roto-drills, till-plant machines, raised

bed planters, ridger seeder etc.) 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. Electronic devices for identifying gaps and counting seeds/seedlings in planters/transplanters will be required to be introduced and popularised.

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. Aero blast sprayers, orchard sprayers and electrostatic-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. (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. 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.
11. 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 land levelling and use of sprinklers and drip irrigation systems to economise in water requirement, should be given high priority.
12. 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.

13. 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

14. 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.
15. 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.
16. 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.
17. 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.
18. 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

19. Equipment for harvesting of fodder crops, making silage, feed blocks, feed pallets will be required to be introduced and popularized in future.

### 16.3.5 Biomass Management

20. 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.

21. For organic farming demand of good quality manure will increase. 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.
22. 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

23. 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 self-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.
24. 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 Infrastructural Improvements

25. Testing facilities for agricultural machinery and agro-products for quality control should be created in the region and manufacturers, processors and experts should be helped in improving the quality of their products.
26. 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 center. The center 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 farm equipment, sources of supply, costs etc. are not available at these information centers. 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 IT (information technology) and kiosks centers should extensively be used. An experienced agricultural engineer should man these centers.

29. Farm machinery exhibitions and demonstrations should 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 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.

#### 16.3.8 Institutional Framework

37. A Farm Mechanization Development Council, under the Chairmanship of Minister of Agriculture be setup at the State level to plan, guide, review and monitor the programmes related to agricultural mechanization in the State. This Council should be represented by the officials of the Deptt. of Agriculture, Agricultural Engineering, Animal Husbandry, Horticulture, Fisheries, Irrigation, industries, manufacturers of agricultural machinery, leading banks, Agro Industries Corporation, State Planning Commission, 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 State is poor and inadequate. There is a strong need for creating a separate Directorate of Agricultural Engineering in the State 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.

### **16.3.9 Policy Issues**

39. To encourage agricultural mechanization on sound footing 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 insure their farm equipment and to provide an insurance cover to the farm labour, group insurance scheme for equipment like tractors, power tillers combines threshers etc. should be started and the premium rate should be 0.5% or less of the machine value insured.

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