

Present status, potential and future needs for mechanization of agricultural operations in Jammu and Kashmir state of India

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Abstract: A study indicates that there is increase in area, production and productivity of major food crops in Jammu & Kashmir State of India over the years but the rate of increase has been slow. Jammu region of the State has maximum cropping intensity (176.8%) followed by Kashmir (123%) and Ladakh (106%). The average land holding in the State is very low (0.66 ha) in comparison to National Average (1.68 ha). The unit farm power availability on gross cropped area basis is 0.78 kW contributed 51.2% by animated (human and animal power) sources and 48.8% from rest of the sources. The present agricultural production is insufficient to mitigate the requirement of growing population due to the limited scope of increase in cultivable area and low level of mechanization. The bottleneck in mechanization are due to non availability of improved equipment, small and scattered land holding, low investing capacity of the farmers and lack of awareness among farmers. Despite these, there is a great need and effort to increase the productivity and reduce the drudgery through mechanization inputs.

Keywords: Mechanization status, mechanization potential agricultural operations, farm power

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1 Introduction

The State of Jammu and Kashmir is located in Northern Himalayan region, spreading over 33-37 °N latitude and 72-80 °E longitude. It consists of three regions namely Jammu, Kashmir and Ladakh. The State is blessed with diverse agro-climatic conditions, topography and natural resources for cultivation of a wide range of agro-horticultural crops. The Kashmir valley receives good rainfall and has rich soils though the temperate zones of Ladakh face climatic barriers against agricultural growth. High soil erosion also reduces fertility. The State has three sub zones. Agriculture is and would continue to be the major source of income and employment for the people of State, due to limited resource endowments in other sectors. The majority of

the net geographical area of the State (101,387 km²), excluding the area under the occupation of Pakistan and China, is rural with 6652 villages (Anonymous 2006-2007).

The agriculture and its allied sectors provide about 36% of the net domestic product and engage about 80% of the population. Draught animals are the main source of farm power. Animal drawn implements such as Indigenous, Tawi, Hill and Soil stirring plough are employed for land preparation activities. Small and marginal farmers still use the manual tillage tools such as spades, shovels, sickle, hand forks while farmers in plain topography use tractors and implements for tillage and transportation purpose (Dixit et. al., 2006; Sharma, 2010). Farm work is generally labour intensive and demands considerable amount of energy. In general level of mechanization in the State is low. Although there is abundance of water received through precipitation (snowfall and rainfall) in the State except in Ladakh region, the major portion is utilized in the lower part of

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the State and in Pakistan. Only 41.7% of the net sown area is irrigated by different sources and remaining area is rain fed. The major source of irrigation is through canals (93.0%). Similarly, the natural energy sources like sunshine, wind, vegetation, water flow and other biological wastes which are abundantly available in the State are not being harnessed properly, resulting in very low per capita energy availability, deforestation and poor health.

The net domestic produce increased from Rs. 1049.5 crores at 1980-81 current prices index to Rs. 24835.7 crores during 2006-07, while per capita income increased from Rs. 1776 to Rs. 22506 during the same period. There are 13.35 lakh land holdings in the State with a population of 101.44 lakh. Nearly 82% of the total geographical area is not available for cultivation whereas rest 18% area is being used for agriculture and other allied activities of which only 7.36% is the net sown area (Table 1). Agriculture sectors during the post-independence era have shown considerable transformation, whereas the net sown area has increased from 0.614 million ha to 0.736 million ha during the last more than 60 years. It is estimated that there is a net deficit of 0.35 million t food grain to ensure food and nutritional security of State population. Keeping these in view, present study was taken up to analyse agricultural and allied scenario of the State with an emphasis on its mechanization aspects.

Table 1 Land resource utilization in Jammu and Kashmir (2006-2007)

Classification	Area (million ha)	% of Revenue Records Area	% of Geographical Area
Total geographical area (surveyor general of India)	22.2236	-	-
Area under foreign occupation	12.0849	-	-
Net geographical area	10.1387	-	100.00
Area on revenue records	2.4160	100.00	-
Not available for cultivation (surveyor general of India)	8.3099	-	81.96
Not available for cultivation (revenue records)	0.5820	24.09	5.74
Area under forest	0.6580	27.23	6.49
Uncultivated land including pasture	0.3450	14.28	3.34
Fallow land	0.0890	3.68	0.89
Gross cropped area	1.1264	46.6	9.17
Net sown area	0.7420	30.71	7.36

2 Materials and methods

Information was collected from possible sources on the location, topography, soil type, climate, population, %age of people engaged in agriculture, farming system adopted by farmers, principle crops cultivated in the region and other related activities. The data were used to draw some meaningful conclusions.

3 Results and discussions.

3.1 General topography

The State can be divided into four agro-ecological regions as shown in Table 2.

Table 2 Agro-ecological regions and livelihood production system in Jammu and Kashmir State

Region	Climate, Altitude (m, amsl)	Livelihood production system	Parts of the State
Region I Sub-mountain and low hills	Sub-tropical 200-800	Agri-livestock-fish-horticulture	Jammu, Kathua and lower belt of Udhampur district
Region II Mid Hills	Sub-humid/Intermediate 801-1800	Agri-horti-livestock-fish	Hilly areas of Doda, higher belts of Udhampur, Rajouri and Poonch districts
Region III High Hills	Temperate 1801-2200	Agri-horti-livestock-pasture-fish	Srinagar, Budgam, Anantnag, Pulwama, Baramulla, Kulgam, Bandipora, Shopian and Kupwara districts
Region IV Very High Hills	Cold Arid > 2200	Livestock-silviculture-agriculture	Leh and Kargil districts

There are numerous micro-agro-climatic zones in the region which makes it feasible to cultivate almost all types of agricultural as well as horticultural crops. These crops include cereals, pulses, oilseed, vegetables, fruits, dry fruits, spices and ornamentals. Horticultural crops well adapted to the region includes fruits (apple, almond, walnut, plum, peach, cherry and apricots), vegetables (brinjal, chillies, potato, pea, cabbage, tomato, cauliflower, knoll khol, turnips, onion, garlic etc.), spices (kala zeera and saffron), and flowers (rose, tulip, gladiolus, marigold, carnation, nargis etc.). Forest occupies 6.5% of the net geographical area of the State. The agrarian economy of the hills is heavily dependent on forest and pasture lands, for energy supply, fodder, non-timber products and livestock rearing. This vital sector of the State economy, however, due to high biotic pressure and abiotic factors is degrading. There has been a gradual decrease in the dense forest area.

Cultivable lands are limited; little scope of cultivating fodder as a result of livestock pressure is relatively higher in the region than in the plains. Cold-water aquaculture has a vast potential for horizontal and vertical expansion. The State has also vast potential of hydroelectric power, which has not been fully tapped. There is paucity of electrical power, which hampers agro-industrial and socio-economic development.

3.2 Climate and annual rainfall

The climate found in the zone of the Middle Mountains and the valleys enclosed is of a particular type. Altitude determines the degree of coolness and elevation, the form of precipitation and summer temperature. Winter is cold and of long duration. When the monsoons are strong, rain is caused. In higher mountains round the valley of Kashmir, winter is very cold and there is snow-fall. Summer is very short and milder. The weather conditions vary greatly with the topography and elevation. The mean annual temperature is highest in Jammu (24.5°C) followed by Srinagar (13.3°C) and Leh (5.3°C). Similar trend is observed in the annual precipitation maximum for Jammu (1,200 mm) followed by Srinagar (662 mm) and Leh (92 mm). The Kashmir valley receives good rainfall and has rich soils though the temperate zones of Ladakh face climatic barriers against agricultural growth. The Jammu receives most of the rainfall during monsoon season while Kashmir division receives it in winter. The distribution pattern of rainfall varies greatly with time and space over the year and generally it is erratic in nature, which creates water stress conditions at various stages of crop growth. These climatic and other edaphically conditions have given rise to different agricultural practices and crop sequences in this geographical area.

3.3 Climatic pattern

The territory of the State of Jammu and Kashmir lies between four degrees of latitude from 32.17° to 36.58° North. Within this 640 km, there is a sudden rise of altitude from 305 metres to 6,910 m above mean sea level. The State, therefore, lies between the hot plains of the Jammu Province and coldest dry land of Ladakh. These territories are, as such, transitional in climate. Weather

conditions are different at different places. There are many causes of difference:

1. Relief is the main factor. Lofty mountains like the Pirpanjal, the Zaskar and the Karakoram check winds from blowing in thus moisture is stopped from entering the valleys by the lofty mountains.

2. The Monsoon winds in summer cause rain in the Outer Plains and the Outer Hills. But these winds can cross the Pirpanjal range only when they are very strong. In winter winds from the Mediterranean cause snow and rain in the Valley of Kashmir. Snow falls on the mountains which enclose the valley.

3. Forests influence winds, rainfall and temperature. The moisture laden winds cause rainfall in the forests on the hills making the temperature to fall in summer. Thus the climate of Pahalgam, Gulmarg etc. is comparatively milder than that of Srinagar or Sopore.

4. Altitude is also a factor. So the climate of the valley of Kashmir is comparatively milder than that of the Outer Plain that lies on a very low altitude. The rainfall also varies as the altitude rises.

3.4 Type of soil

The skeletal and calcareous soils with alkaline reaction and low to medium in organic matter content occur on gently sloping to Ladakh region. The rest of the region have soils which are shallow to deep loamy with little clay content, forest and podzolic brown with medium to high organic matter and acidic in reaction. Poor in lime but with a high content of magnesia, the soil is treated with chemical fertilisers and enriched with green manure and legume before cultivation. There is sufficient organic matter and nitrogen content in the alluvium of the Kashmir valley as a result of plant residue, crops stubble, natural vegetation and animal excretion.

3.5 Operational land holding pattern

The average size of operated land holding in J&K is 0.66 ha, which is half than average operated holding size in India (Table 3). The fragmentation of land holding is expected to be greater, especially under small and marginal farmers' categories in the State. Majority of the farmers (78%) in the State is marginal having less than 1 ha land holding.

Table 3 Operational land holding pattern by major size groups in the region

Class	Size of land holding, ha	No. of operational holding, in '000		% distribution operated		Av. Size of operational holding, ha	
		J& K	India	J& K	India	J& K	India
Marginal	< 1	1041	56748	77.9	58.07	-	0.38
Small	1-2	186	17881	13.93	18.29	-	1.43
Semi-medium	2-4	89	13254	6.67	13.56	-	2.76
Medium	4-10	18	7920	1.35	8.10	-	5.94
Large	>10	1	1925	0.07	1.97	-	17.20
Total	-	1335	97728	100	100	0.66	1.68

Note: Digest of statistics of Jammu and Kashmir (2006-07) and Statistical Abstract India (1990).

3.6 Brief scenario of agriculture sector

Agriculture, the predominant sector of the economy of Jammu and Kashmir, supports about 80% of its population. Rice is the chief crop of Kashmir zone, followed by maize, barley and wheat. Jammu region dominates both in maize and wheat production. In the Ladakh region, barley is the major cereal crop followed by wheat. The production of three important food crops, namely, rice, maize and wheat, contributes a major portion of the food grain in the State and accounts for 84% of the total cropped area; the balance 16% is shared by other cereals and pulses (Table 4). Nearly 75% of the country's temperate fruits, mainly apples, are grown in the State. Crop diversification towards less perishable horticultural crops like walnut, almond, pistachio, olive, kalazeera, saffron and pomegranate in the region is essential to earn foreign exchange and reduce pressure on the available resources for creating additional infrastructure facilities. The State is deficient in food grains production. Improved technologies have been developed which are superior to the traditional practices in terms of productivity and profitability but their adaptation is not comparable to the adoption level in Indo-Gangetic regions of India. The State needs to shift its agriculture development strategy from food security mode to the value addition mode by growing high value fruits, vegetables and some cash crops. There is good scope for the production of high value, low volume crops like saffron, black zeera and other spices especially in Kashmir region.

3.7 Brief scenario of fisheries sector

There are 30,453 fishermen and 10,000 workers are employed in the fisheries sector which contributes 1.92 lakh quintals of fish production in the State during the

year 2006-2007. However, there has been a big gap between demand and supply of fish. The State has potential of producing over 40 million t of fish along the length of 27,781 km of rivers and streams in the State. There are 18 State-owned trout hatcheries and 22 fish farms. There is good scope for expanding employment opportunities through the development of this sector

Table 4 Area, production and productivity of important crops in Jammu and Kashmir (2003-2004)

A. Total area under cultivation (lakh ha)				
Commodities	Jammu region	Kashmir region	Ladakh region	State
Rice	1.12	1.40	-	2.52
Maize	2.21	1.02	-	3.23
Wheat	2.61	0.01	0.04	2.66
Pulses	0.20	0.08	0.01	0.29
Oilseed	0.17	0.47	0.007	0.64
Total (major food crops)	6.31	2.97	0.05	9.33
Vegetables	0.3000	0.2615	0.0115	0.5730
Horticulture	0.93	1.85	0.037	2.83
B. Production (lakh t)				
Rice	1.82	3.72	-	5.54
Maize	3.84	1.02	-	4.86
Wheat	4.92	0.019	0.040	4.98
Pulses	0.089	0.046	0.006	0.14
Oilseed	-	-	-	0.41
Vegetables	3.98	5.64	0.34	99.63
Horticulture	1.31	13.59	0.14	15.04
C. Average productivity (q/ha)				
Rice	16.33	26.43	-	21.96
Maize	17.33	10.05	-	15.05
Wheat	18.92	19.98	-	18.72
Pulses	4.79	5.24	6.25	5.01
Oilseed	-	-	-	6.68
Vegetables	13.26	21.56	29.50	17.38
Horticulture	-	-	-	53.1

3.8 Brief scenario of livestock sector

The State has a precious wealth of livestock in forms of cattle-buffalo, sheep, goats, poultry, etc. The cattle

and poultry amongst all the livestock are considered the most important tools for the development of the rural economy. On an average there were 6.38 animals per household (livestock census-2003). The production of *pashmina* shawls and other animal products like carpets, shawls and blankets of Kashmir earn handsome foreign exchange for the nation. Livestock activity contributes about 11% to the State GDP. Therefore livestock industry in the State has vast scope for development rendering quick economic returns. In terms of livestock production, there is a gap between demand and supply.

3.9 Brief scenario of dairy sector

The milk production has increased from 3.69 lakh t³ in 1995-1996 to 6.66 lakh t³ in 2001-2002, but the demand for milk and milk products has increased at a faster rate. There is great scope for dairy development in the State. The State is lagging far behind the State of Haryana and Punjab due to non replacement of low milk yielding local breed of cattle by the introduction of some high milk yielding new breed. The sector has great potential for creating considerable job opportunities.

3.10 Brief scenario of sericulture sector

Sericulture is the traditional occupation for a large section of the population (25,280 families) in the State. Inadequacy of mulberry leaves and damage caused by insects and pests has caused problems in the development and expansion of mulberry trees. Despite several initiatives taken by the State government, the number of mulberry trees is still very low (increased from 601, 000 to 1,402, 000 trees in last 20 years). There is inconsistency in the production of cocoons due to the climatic limitation of the State and inadequate rearing equipment is another matter of concern. As a result, proper growth and development of silkworms does not take place resulting in decline in this profession.

3.11 Cropping intensity

Cropping intensity is highest in Jammu region (176.8%) followed by Kashmir (123%) and Ladakh (106%) region (Table 4.). Though the cropping pattern is dominated by food crops, yet the State is deficient in food grains. The import of food grains year after year is suggestive of the fact that modernization of agriculture is imperative if the State has to achieve self-sufficiency in

food grain production and ensure food and nutritional security of its people. It is to be recognised that food grain requirement for the estimated present population is of the order of 1.97 million t, whereas the production is 1.62 million t, a net deficit of 0.35 million t.

3.12 Status of mechanization

The small land holding, undulating topography, terraced irregular shape fields and low investment capacity of farmers makes the mechanization difficult with farm equipment available in the market. The traditional tools and implements are still in use with farmers. There are no specialized markets for the production and marketing of farm implements in the State except some manufacturing and marketing units in Jammu. Traditional hand tools and implements are made and maintained by local craftsman. Divisional level Govt. Agricultural Engineering workshops exist in the State which manufacture and market subsidised hand tools and implements for farmers through various programmes of the State Government. The availability of agricultural workers, draught animals, diesel/electric pump, tractors, wheat thresher, ploughs and chaff cutter were 93.3, 141.6, 1.84, 1.25, 0.20, 732.9 and 8.79 per '00' ha gross cropped area, respectively (Table 5).

Table 5 Indicators of Agricultural Mechanization in Jammu and Kashmir (2006-2007)

S. No	Items	Value
1.	Gross Cropped Area (in '00' ha)	11264.0
2.	Agricultural workers (no./ '00' ha)	93.3
3.	Farm power availability (kW/ha)	0.78
4.	Draught animals (no./ '00' ha)	141.6
5.	Diesel / electric pump (no./ '00' ha)	1.84
6.	Tractor (no./ '00' ha)	1.25
7.	Paddy thresher (no./ '00' ha)	Neg.
8.	Wheat thresher (no./ '00' ha)	0.20
9.	Maize thresher (no./ '00' ha)	Neg.
10.	Plough (no./ '00' ha)	732.9
11.	Chaff cutter (no./ '00' ha)	8.79
12.	Others (all types of Implements & machinery)	361.1

Note: Capacity: Agricultural workers-0.05 kW; Draught Animal- 0.25 kW; Diesel/Electrical motors- 4.46 kW; Tractor- 24 kW.

3.13 Farm operations

a. Land preparation: Land preparation plays a major role in crop establishment. The land preparation includes ploughing, planking, FYM application and clod breaking. Farmers mostly use bullock drawn indigenous

wood plough for seed bed preparation (Figure 1). A wooden yoke is used for hitching the implements (Figure 2). Tractors and tractor drawn implements such as disc plough, disc harrow and spring tyne cultivator are also used for this purpose on big farms. For intercropping in orchards, rotary tiller is now gaining momentum. However, in hilly areas, subsistence and smallholder farms, the land preparation are mainly done by hand tools. The clod breaking is a severe problem particularly in maize growing areas, which is usually carried out by female and children with wooden hammer or hand tools.



Figure 1 Wooden plough used for ploughing



Figure 2 Wooden yoke used for yoking of draught animals

b. Puddling: Puddling is the most crucial requirement in paddy cultivation. It is done for churning of soil in standing water for rice sowing/ transplanting. The main purpose of puddling is to reduce leaching of water; to kill weeds by decomposing and to facilitate the transplanting of paddy seedlings by making the soil softer. In the valley, farmers generally practice puddling by indigenous plough or peg type indigenous puddler (Figure 3), which involves higher labour involvement and cost. In Jammu region, it is mainly by animal driven country plough, tractor driven harrows/ cultivators and rotary puddlers.



Figure 3 Wooden puddler used for puddling

c. Sowing/Planting: Sowing/planting of almost all crops are mainly done by hand. For vegetables, small spade is used to assist in marking holes (Figure 4). The use of machinery is limited due to small land holding, undulating topography and fragmentation of land. Broadcasting or kera method (dropping seed behind plough) is normally adopted for sowing of various crops like maize, legumes, wheat, oilseed; which not only consumes more man-power but also affects the crop stand, resulting in poor yield (Dixit et al, 2006). Mechanization in the medium and large farms is limited to certain activities only such as land preparation and ridge formation for tuber crops while the actual planting is mostly done manually. Even for commercial scale rice transplanting, maize planting as well as for vegetable planting, human labour is the main source of power except that ridge for vegetable crops and maize planting is made with tractor drawn ridger.



Figure 4 Hand tools used for land clearing and sowing

d. Weeding/Intercultural operation: Weeds compete with the crop plants for soil nutrients, moisture, light and space. Unless weeds are controlled in time, the crop yields are reduced drastically. Weeding/intercultural operation in vegetables and field crops is done manually using local spade and shovels (Figure 4), which consumes a lot of time and involves great drudgery. In recent past weeders like V blade hoe, double end hoe, medium cultivators, wheel hoe and paddy rotary weeders have been introduced.

e. Crop protection: The principal methods of controlling diseases and insect-pests are through proper cultural practices. By tilling the soil properly, insect-pests, larva and eggs are all made exposed to sun radiation. Field sanitation, rouging and crop rotation

techniques are also practiced for disease control as they reduce the spread of plant diseases. However, the use of chemicals for crop protection is widely adopted to protect their crops from insect-pest and various diseases. The agro-chemicals mostly used are selective herbicides, fungicides and insecticides for small to large farms. The lever operated knapsack sprayer and foot sprayer (Figure 5) are commonly used on small farms. On medium to large farms particularly in orchards, motorized and power operated sprayers are commonly practiced.



Figure 5 Foot pump used for spraying

f. Harvesting: Farmers use plain and serrated sickles for harvesting of crops and grasses, which are locally available at a low cost (Figure 6). The output of these sickles is low and effort required is high. Harvesting of tuber crops are done by manually digging with local spades, which is a time consuming and tiresome method of harvesting. Apple, pears and plum are major fruit crops of Jammu and Kashmir. Harvesting of these fruits is generally done manually with the help of ladders (Figure 7). Fruits are generally damaged due to lack of a suitable harvesting device. For the harvesting of walnut, a person climbs on a tree and strike of fruit branches with a bamboo is employed because walnut tree is very tall. This method of walnut harvesting causes lots of accidents to the farmers. In recent past combine harvesters have been introduced in Jammu Plains.



Figure 6 Crop and fruits harvesting tools



Figure 7 Orchard ladder used for apple harvesting

g. Threshing: After harvesting the paddy is kept in windrows in the field to dry and threshing of paddy is still done manually by beating a bundle of crops on an iron drum or wooden log. After threshing, winnowing is done by hand winnower. The losses are quite high in this method. Although, handle operated and pedal operated threshers are also available. Threshing of wheat is fully mechanized operation generally done by power thresher on custom hiring.

h. Post harvest operations: Farmers are following the traditional method for drying of paddy, vegetables, walnut, almond, saffron and other field crops. The post harvest losses in quality and quantity of these crops are very high as farmers have their own way of drying, storing and processing of farm products. Rice is hulled by hullers in whom breakage of grain is high. Uncertainty of rain makes it difficult to dry rice under sun. After harvesting of rice, it is stacked in heap for drying. There are very few modern rice mills that also in Jammu plains, there is no modern oil extraction plant, dal mill or

processing plant for dry fruits, saffron and other spices. Drying of saffron is carried under shade which generally takes 27-53 hours to dry the product to a safe moisture level of 8% (Alam, 2008). Slow drying results in quality deterioration of saffron.

It shows that most of the farm operations are done manually. The use of improved farm implements is very low in the State as compared to developed States of India. Primitive types of hand tools and animal drawn equipment are being used for agriculture, horticulture and forestry.

3.14 Irrigation

The State has plenty of water resources but more than 2/3rd of its gross cropped area is rain-fed. Hilly and mountainous terrain makes harnessing of river water difficult. Hill ranges are snow covered and provide perennial flow to down plains. There has been a steady increase in the net irrigated area by different sources (canals, tanks, wells and others) during the last fifty years, reaching 3.10 lakh in 2006-2007. Canal irrigation constitutes the largest single source of irrigation accounting for 93.0%. Tanks, wells and other miscellaneous sources contribute the rest. The available data show that rice and maize cultivation get the maximum share of available water sources. The State offers good scope for the exploitation of ground water, as current ground water development is a meagre 1.34%. Lack of information on the availability of resources at the block level on area-specific basis, the absence of coordination between the different State agencies involved in ground water activities and shortage of technical staff for formulation of ground water as well as surface water-based schemes are the main reasons for the difficulties in exploiting ground water up to its potential in selected areas of Jammu and Kashmir.

3.15 Manufacture/ Workshop facility

There are no specialized markets for the production and marketing of farm implements in the State except some manufacturing and marketing units in Jammu. Traditional hand tools and implements are made and maintained by local craftsman. Divisional level Govt. Agricultural Engineering workshops exist in the State which manufacture and market subsidised hand tools and

implements for farmers through various programmes of the State Government. Fabrication of hand tools like hand hoe, spade, garden hoe, orchard ladder, wooden plough, pick axe, wooden puddler, sickle, wooden yokes etc. is done by local craftsman. There is no genuine workshop for repair of animal, power tiller and tractor drawn implements.

3.16 Farm power availability

The availability of farm power per unit area (kW/ha) has been considered as one of the parameters for expressing level of mechanization. Farm machinery use depends upon the farm power available for various tractive and stationary operations. At present, the availability of farm power is 0.78 kW/ha in the State (gross cropped area basis) whereas the National average (projection) is 1.502 kW/ha. There is great variability in unit farm power availability within State i.e. it is as high as 3.06 kW/ha in RS Pura & Bishna and as low as 0.47 kW/ha in Ramnagar areas of Jammu region of the State (Sharma, 2009; Sharma, 2010). Draught animals continue to provide major tractive power for field operations in the State. Animate power (draught animals and human power) and mechanical power contributed 51.2% and 38.4% of the total farm power respectively during 2005-06 (Figure 8). It indicates that animate power still plays a major role in sources of farm power. The availability of farm power in the State is very low and has much need for further mechanization.

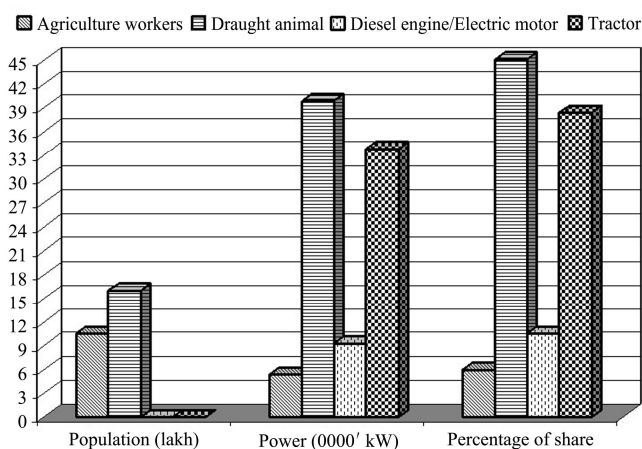


Figure 8 Population of farm power sources and their power availability in J&K

3.17 Mechanization potential

The State possesses a huge potentiality to adopt selective mechanization rather than sweeping

mechanization. The farmers face difficulties in timely completion of field operations due to lack of mechanization inputs like improved implements for tillage operation, puddling, sowing/planting, interculturing, irrigation equipment, plant protection, harvesting, threshing, drying and processing equipment. The application of mechanization technology would increase agricultural productivity. Consequently, labour tied up with manual farm operations would be released to higher value activities. Rice-wheat cropping system has potential to provide food and feed security in the State hence priorities should be given to these crops by adopting improved varieties along with mechanization inputs for timely and efficient operation.

The farm power availability at 0.78 kW/ha (gross cropped area basis) has potential for increase, as it is much lower than the national average of 1.502 kW/ha. There is tremendous need for the mechanical and electrical power sources and their matching implements to increase the cropping intensity. For stationary operations like water lifting, threshing, chaff cutting, cleaning, grading and other agro processing activities, adequate electrical energy is essential. In all the three regions of the State, animal power utilization is only 250-300 h annually (as against ideal utilization of 2,500 h). Most of the time the draught animals remain idle due to limited period of use for tillage, sowing and puddling operations only. Farmers have to spend the money on the maintenance of draught animals for the entire year. Thus, the animal power is wasted without its optimum utilization. However, it is not possible to replace completely the animal power with the mechanical power. Besides, the State has a great number of draught animals (15.96 lakh). To maintain an eco-friendly system, there is a need to select, test and popularize animal drawn improved implements for tillage, sowing, puddling and intercultural operations. This will increase the efficiency of animal and reduce the drudgery of the farmers. In addition, the idle period of draught animals can be utilized for generation of electricity through rotary mode of operation. In the hilly areas of the State, power tiller matching implements for seed bed preparation, sowing, plant protection, harvesting, threshing etc. are

relevant on small, irregular and undulated fields and could be introduced.

Moreover, better performance of the existing farms would be gotten through timeliness of operations and minimization of avoidable losses that occur during harvest and post harvest operations. Improved harvesting equipment like serrated sickles, fruit pluckers, vertical conveyer reapers and mini combine harvester could be introduced. To overcome drudgery in threshing and cleaning of cereals, pulses and oilseeds, appropriate power threshers could be adapted. Seasonal leafy vegetables and fruits like apple, pear, cherry, strawberry, almond, walnut, saffron and kala-zeera (black zeera) could be used for value addition. This will be helpful in reducing the supply –demand deficit in off-season.

Fruit crop mechanization equipment for pit making, transplanting of saplings, pruning, spraying in tall crops, harvesting of fruits etc. could be identified/ adopted/ developed and popularized.

3.18 Constraints of agricultural mechanization

The choice, extent and adoption of mechanization for Jammu and Kashmir agriculture have some severe limitations mentioned below:

- 1) The most crucial is the economic conditions of the farmers as majority of the farmers are marginal and small.
- 2) The undulating topography and terraced irregular shape fields make mechanization difficult with farm equipment available in the market.
- 3) The availability and access to farm machines is very low due to lack of production and marketing facilities for farm implements in the State except Jammu region.
- 4) The packages of improved matching equipment with power tiller for agricultural operations have yet to be accepted by farmers of the region.
- 5) The custom hiring/ contract farming have not been emphasized on for commercialization of agriculture.

4 Conclusions and suggestions

On the whole Jammu and Kashmir has huge potential to adopt agricultural mechanization for increasing agricultural production. Taking the fragile nature of the State and the conservation issues in sustainable farming

into consideration, adoption of mechanization input to agriculture needs to be selected wisely. The following points are suggested as accelerate the pace of mechanization:

- 1) Hand tool technology can be improved for marginal and small farmers through introduction of appropriate and suitable tools developed elsewhere.
- 2) Adaptation of improved and suitable animal drawn matching implements and by for using animal for other use to increase their annual utilization.
- 3) Popularization of mechanical power technology

through large scale demonstrations on farmer's fields.

- 4) Development of custom hiring services in power equipment and machinery through entrepreneurs, self help groups and cooperatives.
- 5) Creation of repair facility with a supply of genuine spare parts of farm machinery.
- 6) Development of a proper agricultural engineering package for the State.
- 7) There is scope of micro-irrigation systems largely due to the scarcity of irrigable water and uneven terrain conditions.

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