Executive Summary

Introduction

Traditionally, Indian farmers relied on equipments, which were simple and could be easily fabricated by village craftsmen. Since introduction of mechanical power, agricultural engineering started gaining importance and thus; organized professional activities started. Though farm mechanization is increasing in India, it is mostly region specific. Besides the region specificity, the growth of agricultural mechanization is mainly hindered by the impediment of decreasing trend in operational land holdings. One of the major factors for poor response of farmers towards mechanization may be that mechanization of small and contiguous groups of land is found to be against economics of scale. Having understood the conformity of farm mechanization with increased production level at lower costs of production; in course of time policy efforts have been made by the Government of India. In addition to two Central Sector Schemes (namely; (i) Promotion and Strengthening of Agricultural Mechanization through Training, Testing and Demonstration, and; (ii) Post-harvest Technology and Management during the 11th Plan Period programmes like; MMA, RKVY, NHM and NFSM are also being implemented for promotion of mechanization. In the above backdrop and based on the primary survey of 100 farmers randomly chosen (50 each from high and low mechanized villages/strata), this study seeks to study the effects of mechanization on agricultural growth and comparative economics of labour and machinery in Bihar.

While the secondary data sources and information provide the breadth of effects of mechanization in agricultural sector as a whole, the primary data based inputs provide the depth. We are sure that the Policy Makers; Agricultural Scientists, scholars, practitioners and officers of Agriculture and allied departments will find this study useful for their purposes.

Reference Period

Reference period of secondary data used in this study is 2001-02 to 2009-10. For primary data, it was 2008-09 to 2010-11.

Mechanization Programmes and Trends of Mechanization in Bihar

In Bihar, agricultural sector is faced with mainly four key challenges: (i) nano size of land holdings, (ii) low yields and high risks, (iii) biotic and abiotic constraints in raising crop yields, and; (iv) weak institutions accompanied by poor infrastructure. As far as efforts of the Government to promote and strengthen mechanization in agricultural sector are concerned since the year 2009-10 during the 11th Five Year Plan, i.e., agricultural machines, tools and equipments are being made available to farmers on subsidy basis mainly under the six schemes/programmes, viz., (i) MMA, (ii) ISOPOM, (iii) Jute Technology Mini Mission – II, (iv) NFSM, (v) RKVY, and; (vi) State Plan on Power Tiller Promotion Scheme. Range of subsidy on agricultural machineries/implements being very wide (from Rs. 3,000/- only on conoweeder to Rs. 30,000/- only meant for rotavator). As small implements were distributed largely, which had led in exceeding of physical targets in some years, so big machines could be distributed in less than targeted numbers.

Share of cost of human labour as percentage of operational cost was found higher in case of paddy. Cost of bullock labour as percentage of operational cost and machine labour as percentage of the same were found higher in cases of lentil and wheat respectively.

Further, higher shares of the cost of human labour and cost of bullock labour to total cost were found for paddy respectively. Cost of machine labour to total cost could be seen the higher in case of wheat and lower for paddy.

It is interesting to have the determinate observation that the share of machinery cost in regard to value of production was higher in case of paddy for human labour, the same for bullock labour and machine labour in case of wheat. Data reveals higher share of cost of human labour for maize, cost of bullock labour for lentil and cost of machine labour for paddy' as percentage of value of production. The most interesting and substantial facts revealed here, are that shares of cost of (i) human, (ii) bullock, and; (iii) machine labour as percentage of value of production were minimum or the lowest for pulse crops only.

As far growth of costs in human labour, bullock labour and machine labour in the year 2008-09 as compared to 1996-97 is concerned maximum increase in human labour was observed in case of wheat, higher decline in bullock labour was seen in case of gram and higher increase in machine labour was found in paddy. The growth of production during the period (in percentage terms) was quite higher in value of production terms for wheat. Like the growth of costs scenario quite higher increase in machinery cost was observed in case of paddy again.

Demographic Profile and Cropping Pattern

It can be circumstantiated that surveyed farmers belonging to medium farm size class had higher average number of adult family members, whereas in regard to male members, small farmers' class was ahead. In regard to illiteracy, education levels up to primary and secondary and above sample marginal farm households were ahead. This could be due to their larger number in the sample. In percentage terms, on the parameter of education of the head of the family large sample households were at top having secondary and above qualification. On average (total) of educational front, medium farmers were ahead. As far percentage distribution of adult educated sample farmers is concerned, small farm size class was at top. Marginal size class had maximum number of SCs & OBCs households. There were no ST farm households in the sample. Percentage distribution of caste composition shows small farm households dominated by OBC, marginal by SC and large by the members of other castes. Higher average areas having irrigation facility were found in case of large and medium farms. In regard to unirrigated areas also, these two farm size classes were ahead. As far percentage distribution of irrigated area is concerned, in regard to total irrigated and total unirrigated areas medium & small and marginal & large respectively were ahead. No canal and tank irrigation was found in the area of study. There was a little fall in Crop Duration Index (CDI) in the year 2010-11 as compared to 2008-09. However, as a result of scanty rainfall in the year 2009-10, there was a clearly revealed decline in CDI. Paddy wheat and maize were the main cereals grown by the sample households, whereas under pulse crops, lentil, moong and gram got good shares of areas in cropping pattern during the three years.

Costs of Mechanization

The analysis causes to lead the finding that wheat incurred maximum input costs on seed and irrigation. In regard to organic manure and fertilizer maize was ahead. Wheat also cornered maximum amount as cost on pesticides/weedicides. It is revealed that level of mechanization in the forms of tractor and harvest combine/carriage cost was higher in wheat than paddy and other crops. In percentage terms, distribution of input costs, in regard to hired labour (bullock and manual taken together), and hired machinery costs (including tractor and harvest combine) paddy and wheat respectively were ahead. As the harvest combine machine was made available for service/use of farmers in mechanized villages after the establishment of Farm Mechanization Bank in Mohanpur village of Shahkund block in the year 2010, so we have actually considered expenditures incurred on carriage of large quantum of harvested grains by tractors under the above noted head.

Here it could be noted that maximum and minimum percentages of machinery costs to value of output and same to marketed surplus were meant for wheat and gram. But, in percentage terms of marketed surplus to value of output paddy was at top and wheat at the bottom suggesting that retention of wheat was higher in this region of the state. Percentages of mechanization costs to value of output were also lower in case of lentil and paddy as compared to maize and wheat.

Data in tables demonstrate that in quantitative terms, the operation of ploughing cornered higher per hectare costs. In context of manually and power operated costs of mechanization, sowing were ahead. In case of power and tractor operated costs of mechanization irrigation and transportation and marketing shared maximum expenditures.

In quantitative terms (on aggregate level) higher cost of mechanization was computed for the operation of ploughing and lower being for threshing. Minimum percentages of the costs of mechanization were found in animal operated activities for threshing, manually operated activities of sowing and the lower in case of ploughing by tractor operated machines.

Pattern of Mechanization

Before jumping to conclusions it is envisaged that most of the sample households owned manual and animal operated machines. Ownership of machinery operation wise also revealed larger percentages of manually operated machines/tools used in the activities like: sowing weeding, plant protection and harvesting. For irrigation, cen-per-cent of the farm households used pump sets mostly diesel run, either owned by them or on custom hiring basis. Animal and manually operated machines/devices were used by most of the farmers for (i) threshing, (ii) weeding, and; (iii) harvesting respectively, whereas tractor was operated prominently for ploughing purposes. While ploughing and harvesting were the main operations, where animal and manually operated machines were employed for larger hours of time usage, there, on the other hand, irrigation and ploughing were ahead by power and tractor operated machines respectively. In percentage terms, operations like: (i) weeding, (ii) plant protection, and; (iii) harvesting shared longer hours of usage by manually operated devices. Longer time and larger total costs (in absolute number and percentage both) could be seen in ploughing and seed-bed preparation by animal operated machines. There is sufficient data to believe that adoption of mechanized practices in operations like sowing and planting were very low in case of surveyed farmers. It was seen that cent-per-cent irrigation operation was performed by diesel pump sets. However, weeding and inter-culturing activities were undertaken cent-per-cent by manually operated devices. Both of these operations took equally large hours of time usages. Cent-per-cent of the plant protection equipments were used, which were manually operated and it took (all in total) 16 hours of time per hectare of cropped area. Operation of harvesting needed quite longer hours of time than plant protection, irrigation, sowing and planting and ploughing & seed-bed preparation. It was wholly performed by manual sickle. Even having used paddy thresher by cent-per-cent-per-cent of the sample households, it had to be given maximum number of hours. General observation is also revealed here that more time was devoted containing quite higher percentage of the total usage in transporting the agricultural produces for marketing by animal

operated means of conveyance. Per hour cost incurred in machine driven device was higher than that of animal operated device.

Farmers' Perceptions

The analysis related to farmers' perceptions has been made in absolute and percentage terms. The factors for which farmers' perception have been obtained contained: (i) economical, (ii) quicker operations, (iii) reduction in drudgery, and; (iv) any other. For measuring the intensity of perception, ranking (viz., Rank – I, Rank-II and Rank – III) has been taken into consideration.

Quicker operation, economical and quicker operations again were considered main reasons by the farmers for the use of machinery revealed in the form of getting Rank – I, II & III respectively. In percentage terms also, the scenario was similar. Irrigation and ploughing related operations were the main for which machines were widely used. For all the three ranks, these operations were prominent. In the study area, tractor operated plough and then animal operated plough were reported as most appropriate machines/devices for this purpose. It was observed that manually and animal operated seed drills were the most appropriate sowing and planting machines by the sample households. Cent-per-cent surveyed farm households pronounced diesel pump set to be the most appropriate machine for irrigation. Farmers' perception towards manually operated weeding and inter-culture machines to be highly suitable was in consonant with earlier data showing number of farmers using machineries. Among plant protection equipments, manually operated machine was considered as appropriate one by larger proportion of farmers. No other machine except self propelled reaper was described as appropriate as sickle for harvesting by the sample farmers.

Power operated thresher was perceived as most appropriate machine for threshing. Though quite large number of sample households used manual and animal operated devices for this purpose. For marketing and transportation tractor trolley like: device/machine was perceived as the most appropriate means. Main revealed problem in case of animal operated plough and tractor plough were expensive to hire and expensive to purchase respectively. Hire facility not available and

expensive to hire in case of tractor driven seed-cum-fertilizer drill respectively were noted as major problems by surveyed farmers. While expensive to hire and hire facility not available in case of manually operated weeding and inter-culture machines respectively were the major problems as perceived by the farmers. In regard to irrigation related problems; (i) expensive to purchase, (ii) expensive to hire, (iii) repair and service facilities expensive, and; (iv) high maintenance cost were experienced as low and middle ranking major problems. In case of plant protection machineries used problems of hiring facility not available and expensive to hire were major but low ranking problems. Hire facility not available (in case of manual sickle), particularly when labourers were not available in desired number, non-availability of paddy thresher on time and expensive to hire bullock driven cart marketing means of transportation have been reported as major problems. Better land utilization and reduced drudgery were the two prominently reported answers in response to usefulness of machineries. It was interesting to note that majority of the total farmers surveyed were though not aware of all the government programmes and types of assistance being provided, however, some of them did receive assistance of one kind or the other under some of programmes/schemes. Quite lower percentage of total farmers surveyed didn't find the programme useful, as they were not even aware about most of the farm mechanization initiatives. However, a little less than half of the total farm households surveyed found the programmes/schemes useful. It is clearly revealed that whatever increases in production were observed in regard to paddy, wheat and gram had caused as a result of mechanization. Conclusively, positive effects of mechanization on agricultural growth, and comparative economics of labour and machinery are there. Its adjacency to actual contribution needs to be examined separately.

Action Points

On the basis of analytical discussions, and secondary and primary data based observations made through the preceding six chapters, the following Action Points can be appropriately suggested:

1. Higher costs of mechanized farming, particularly in wheat, are due to good number of irrigation and threshing operations. It could be reduced to some extent by exploring and developing low cost irrigation infrastructure. *(Attn: Department of Water Resources, Government of Bihar, Director-Cum-Dean, Research, "Bihar Agricultural University, Sabour, (Bhagalpur)" RAU, PUSA (Samastipur) and WALMI (Patna).*
2. Zero tillage (particularly in wheat), saves about 1 and half hour of time required for preparing one hectare of land. It also helps in reducing the consumption of diesel by about 20 litres required in sowing wheat/hectare of land. So, 'zero tillage method' needs to be popularized and promoted. *(Attn: Directorate of Agricultural Extension, Government of Bihar).*
3. In the areas/regions of low agricultural mechanization, emphasis should be given on establishing Farm Machinery Banks on district/commissionery level. *(Attn: Ministry of Agriculture, Government of India & Department of Agriculture, Government of Bihar).*
4. In view of increasing number of farmers willing to adopt mechanization in their agricultural operations, the areas/regions where 'Farm Mechanization Banks' are already in existence, the number of particular type of machines/implements should be increased. *(Attn: Director, Agriculture, Government of Bihar & Ministry of Agriculture, Government of India).*
5. As 'Power tillers or 2WTs (two-wheel tractors)' perform the same tasks as' '4WTs,' and these are more effective and desirable for marginal and small holdings, so use of 'Power Tillers (PTs)' needs to be assisted and promoted. *(Attn: Department of Agricultural Extension, Directorate of Agriculture, Government of Bihar, NABARD & Other Public Sector Banks).*

6. Even farmers with small holdings wish to use selected improved farm equipments through custom hiring to increase productivity and to reduce 'cost of production.' So, demonstration and on the field training should be given/arranged on regular intervals in regard to uses of machine and animal drawn steel plough, disc harrow/cultivators, seed drill, row planter, etc. *(Attn: Directorate of Extension, Government of Bihar).*
7. With a view to overcome the problems of scarcity of capital and/resource to hire machines/tools, Users group or Farmers Co-operative Societies should be formed under mechanization schemes. Further, it should be linked with banks through Micro finance lending. *(Attn: Ministry of Agriculture, Government of India, NABARD, Department of Institutional Finance, Government of Bihar).*
8. In comparatively low mechanized villages/areas, some of the prominent impediments were non-availability of assured sources of irrigation and very poor power supply position, particularly for agricultural operations. To remove these constraints, separate electricity feeders for rural areas be given on priority basis. *(Attn: Department of Water Resources, Government of Bihar, and Bihar State Power Holding Company Ltd. (BSPHCL), Patna.*
9. Mechanized practices in agricultural operations (particularly sowing, planting, etc.) have crept in. But, its level is very low. So, there is need to make farmers more responsive towards mechanization of agriculture by suitably explaining and properly training them about the comparative advantages and usage of agricultural tools, machineries and equipments. *(Attn: Directorate of Agriculture Extension, Government of Bihar).*
10. No use or limited uses of Harvester combine, thresher and other machines/ implements were the result of non-familiarity of farmers with these machines and lack of technical knowledge about how to operate them. So, on regular intervals, trainings to operate those machines/implements need to be urgently given. *(Attn: Directorate of Agricultural Extension, Government of Bihar).*

11. To expand the purview of Agricultural mechanization, "Rice-rubber Houlier Sail-arm Machine and facility of laser leveler (on hiring basis) should be made available. *(Attn: Directorate/Division of Extension, Agricultural Engineering, Directorate of Agriculture, Government of Bihar).*
12. Tractor for "Farm Machineries Bank" should be made available on permanent basis. *(Attn: Directorate of Agriculture, Government of Bihar.*
13. With a view to promote mechanization in agriculture in less mechanized areas of Bhagalpur, Banka and Munger districts, unchecked excavation of sand, particularly from the bed of river Chandan and construction of check dams at some points in this river, need to be strictly stopped and constructed respectively, so that adequate irrigation is ensured during all seasons. *(Attn: Departments of Mines & Water Resources, Government of Bihar).*
14. In view of the lower share of machine labour costs of incurred in pulse crops as percentage of values of their production, greater emphasis needs to be given for promoting mechanized practices in cultivation of pulses. (Attn: *Ministry of Agriculture, Government of India, Department of Agriculture, Government of Bihar).*

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