

Extent and Impact of Farm Mechanisation in Hilly State of Himachal Pradesh

Aditi Raina^{1*}, Rajesh Thakur² and Sanjeev Kumar³

ABSTRACT

Farm mechanization has been identified as one of the critical inputs for increasing the productivity of land by ensuring timeliness of agricultural operations, increased labour work output per unit time by reducing efforts, drudgery and improved quality of farm operations. The present study was conducted in Kangra district of Himachal Pradesh. Primary data were collected from 80 farmers. The net savings in case of land preparation operations through mechanization were estimated at Rs. 4454, 2330 and 658/ha, in case of wheat, maize and paddy respectively. Similarly, through the mechanization of sowing operation, the net gain was highest in wheat followed by maize and paddy i.e. Rs. 3910, 2347 and 2551/ha. Through the adoption of various farm mechanization practices on sample farms, they were able to save 56 to 67 man days of human labour and 23 to 35 bullock days/ha in major crops. The total added expenses on account of inputs and hiring charges were ranging between Rs 10652/ha in maize to 13665/ha in paddy. Per hectare net savings through mechanization was to the tune of Rs 8531, 15152 and 5685/ha in case of maize paddy and wheat, respectively.

Key words: Extent, Farm costs, Farm mechanization, Farm returns

INTRODUCTION

Farm mechanization is recognized as one of key drivers amongst the major factors of agricultural growth and overall development of the country. Historically, the role of tools and implements in agriculture has been crucial since man got associated with cultivation of crops. As our civilizations progressed, the types of tools and implements used in agriculture have also changed over time with generations. With the advancement in knowledge, skill and technology, there has been continuous change in designs of farm machinery and implements for the want of higher efficiency and reducing the drudgery of farm labour in accomplishing farm operations (Mehta *et al.*, 2019). The contribution

of farm mechanization in increased agriculture production is quite significant. Mechanization is the use of modern implements as well as motorized equipment like plough, harrow, ridger and also the use of agro-chemicals like insecticides, herbicides, fertilizers and improved seeds in the farm (Sarkar and Roy, 2014). In general, the term “Mechanization” is used for overall description of the application of tools, machines and equipment (Clarke, 2000). Human labour (agricultural workers), draught animals and motorized power are the major sources of farm power employed for operating these tools and implements in agriculture. The productivity of agricultural enterprises in our country is quite low as compared to developed countries. Majority (83%) of Indian farmers are small ones who cultivate less than two hectares of

¹Assistant Professor, University Institute of Agricultural Sciences, Chandigarh University, Gharuan, Mohali-140413, Punjab

²Professor, Department of Agricultural Economics, CSKHPKV, Palampur-176062, Himachal Pradesh

³Assistant Professor, School of Agriculture, Shoolini University of Biotechnology and Management Sciences, Bajhol, Solan-173229, Himachal Pradesh

*Corresponding author email id: aditi.agri@cumail.in

land. Thus, there exists ample scopes for increasing the crop production through increased efficiency of critical farm inputs and management practices by mechanizing the tedious and time consuming farm operations. Mechanization planning requires the quantitative assessment of a mechanization index, and its impact on agricultural production and economic factors like cost of cultivation, deployment of animate and mechanical power, and economic advantage (Singh, 2006). According to the World Bank estimates, half of the Indian population would be urban by the year 2050. Indian Economic Survey (2018) estimated that percentage of agricultural workers in total workforce would drop to 25.70 per cent by 2050 from 58.20 per cent in 2001.

Himachal Pradesh is one of the model hill states of the country as far as development of agriculture is concerned. The state is endowed with varied type agro-climatic conditions, which favours successful cultivation of the wide range of agricultural and horticultural crops. The extent of farm mechanization in the state in terms of availability of mechanical power as well as power operated tools and implements are quite low. The paper presents the extent of farm mechanization, its impact in hill region of the state and the pattern of farm mechanization.

METHODOLOGY

The study was conducted in Kangra districts of Himachal Pradesh. Multi-stage random sampling design was used for the selection of respondents. The data were collected through the personal survey method on specifically designed survey schedule. The primary data from the selected households were subjected to calculations using cost and returns concept. The amounts of depreciation and interest on fixed investment were calculated at rates as indicated below:

- a) Interest on fixed capital investment like; manually operated implements and powered operated machinery @ 10%.
- b) Depreciation on fixed assets like; manually operated implements @ 20% and powered operated machinery @ 10%.

- c) Rental value of owned land was taken as average value of on which the farmers well leasing out land for cultivation.

This was estimated as follows:

$$T_f = I (D + r)$$

Where, T_f = Total Fixed Cost, I = Initial capital investment, D = Depreciation rate and r = Rate of interest.

Variable costs are those which vary with the level of output produced on the farm. The interest on total working capital was calculated for half of the crop period and added in total working capital to arrive at total variable cost of selected crop enterprises as indicated in the following formula:

$$\text{Total Variable Cost} = \sum_{i=1}^n P_i X_i + \left(\sum_{i=1}^n P_i X_i \right) r \times K_i / 2$$

Where, P_i = Price of i^{th} input per unit, X_i = Quantity of i^{th} input used, K_i = Crop period of i^{th} crop in months and r = Monthly interest rate charged on working capital @ 5% per annum

Estimation of impact of farm mechanization on farm costs

The average pattern of farm mechanization of different was compared with traditional practices of farming for individual crop production operation as well as for the crops in terms of Labour saving and Added expenses. Net gain or impact of mechanization was estimated as difference between cost savings associated with improved technology over traditional technology and additional costs incurred on account of use of farm mechanization and inputs.

RESULTS AND DISCUSSION

Based on the input and labour use pattern under existing and traditional farm practices, the cost of production was estimated for the selected crops grown by the sample households of the study area. The crop production under the existing scenario was performed by using a combination of modern and traditional farming practices. The based on the input and labour use pattern,

the cost structure for the selected crops is presented in Table 1. It can be observed from the table that per hectare total cost of production of maize, paddy and wheat was Rs. 52762, 65771 and 56870, respectively on overall farm situation. The share of fixed costs to the total costs of production varied between 16 per cent in case of paddy to 20 per cent in case of maize. The table further indicates that among the major constituents of variable cost, the magnitude of human labour in case of maize and paddy was highest i.e. 40.34 and 38.10 per cent, respectively, whereas, in wheat the contribution of material inputs was highest (Rs. 15841/ha). The table

further indicates that by using the existing/modern technology, the net returns over fixed cost were found to be positive. It varied from Rs. 39023/ha in case of maize to Rs. 53567/ha in case of paddy. The returns over variable costs for these crops were estimated to the tune of Rs. 7595, 9130 and 8188/ha in case of maize, paddy and wheat, respectively on overall farm situation indicated profitable in different crop production operations with existing technology.

It can be observed from the Table 1 that per hectare total cost of production of maize, paddy and wheat was found to be Rs. 58195, 72245 and 68873, respectively

Table 1: Cost of cultivation of major crops with existing and traditional technology on sample farms (Rs./ha)

S. No.	Particulars	Maize		Paddy		Wheat	
		Existing	Traditional	Existing	Traditional	Existing	Traditional
1	Fixed costs						
a.	Interest on manually operated implements @ 10%	364	121	364	121	364	121
	Interest power operated machinery @ 10%	6272	-	6272	-	6272	-
b.	Depreciation manually operated implements @ 20%	728	243	728	243	728	243
	Depreciation on power operated machinery @ 10%	6636	-	6636	-	6636	-
c.	Land rent	6000	6000	6000	6000	6000	6000
	Total (a+b+c)	10667 (20.23)	6364 (10.94)	10667 (16.29)	6364 (8.82)	10667 (18.75)	6364 (9.24)
2	Variable costs						
i	Material inputs	11873 (28.22)	11873 (22.92)	11909 (21.68)	11909 (18.09)	15841 (34.29)	15841 (25.34)
ii	Human labour	16981	25796	20995	31185	15238	26064
ii	Bullock labour	2201	13523	7822.5	21653	2575	19832
	Total labour	19182 (45.59)	39319 (75.85)	28817 (52.47)	52838 (80.19)	17813 (38.55)	45896 (73.43)
iii	Expenditure on account of use of Machinery services	10652 (25.28)		13666 (24.56)		12128 (26.25)	
iv	Interest on working capital @ 6	388 (0.92)	640 (1.23)	713 (1.30)	1133.5 (1.72)	421 (0.91)	772 (1.23)
	Total variable cost	42095 (79.77)	51831 (89.06)	55104 (83.71)	65881 (91.18)	46203 (81.25)	62509 (90.76)
3	Total cost (1+2)	52762	58195	65771	72245	56870	68873
4	Gross returns	51226	51226	64234	64234	54392	54392
5	Net returns over						
i	Fixed cost (4-1)	39023	43326	53567	57870	43725	48028
ii	Variable cost (4-2)	7595	-2142	9130	-1647	8188	-8117
iii	Total cost (4-3)	-1536	-8506	-1537	-8011	-2479	-14481

Note: Figures in parentheses indicate percentages to the total in each category

on overall farm situation. The share of fixed costs to the total costs of production was 11, 9 and 9 per cent. The table further indicates that among the constituents of variable cost, the magnitude of human labour in case of maize, paddy and wheat was highest to the tune of Rs. 49.77, 47.34 and 41.70 per cent, respectively. By using the traditional technology, the net returns over fixed cost were found to be positive and estimated as Rs. 43326, 57870 and 48028/ha in case of maize, paddy and wheat, respectively on overall farm situation. The returns over variable costs indicate the cultivation of maize, paddy and wheat becomes unprofitable by use of traditional technology, when total variable costs are taken into account. There is loss to the tune of Rs. 2142, 1647 and 8117/ha in case of maize, paddy and wheat, respectively on overall farm situation. The table further indicates that when total costs of production were taken into account; the production of selected crops becomes unprofitable. Per hectare loss in case of wheat was highest (Rs. 14481 followed by Rs. 8506 and 8011, respectively in maize and paddy on overall farm situation.

The impact of farm mechanization on farm costs was examined for individual crop production operations as well as for average situation for major crops. It was done by using the partial budgeting techniques. The savings in labour cost, added costs for mechanization in case of land preparations was estimated and are presented in Table 2. It can be seen from the table that by doing the land preparation by using tractor or power tiller, the saving of human labour varied from 6 man days/ha in maize to 11 man days/ha in case of wheat. Similarly, saving in case of bullock labour was also quite high. It was estimated at about 11, 7 and 13 bullock days/ha in case of maize, paddy and wheat, respectively on overall farm situation. The table clearly indicates that added expenses for mechanizing this operation by using tractor/power tiller were estimated to be Rs. 4522/ha in case of paddy, while it was around Rs. 4001/ha in maize and Rs. 3865/ha in wheat on overall farm situation. The net gain by mechanizing land preparation operation was highest in wheat followed by maize and paddy i.e. Rs. 4454, 2330 and 658/ha, respectively. Due to these savings, there has been reduction in the total variable costs to the tune of about 7, 5 and 1 per cent in case of wheat, maize and paddy, respectively.

Table 2: Impact of use of tractor/power tiller for land preparation and sowing, weedicide for weeding and thresher for threshing on farm cost (Rs./ha)

S. No.	Particulars	Maize				Paddy				Wheat			
		Tractor/ power tiller for land preparation	Tractor/ power tiller for sowing	Weedicide for weeding	Thresher for threshing	Tractor/ power tiller for land preparation	Tractor/ power tiller for sowing	Weedicide for weeding	Thresher for threshing	Tractor/ power tiller for land preparation	Tractor/ power tiller for sowing	Weedicide for weeding	Thresher for threshing
1.	Savings (Rs)	6331	5516	4336	2589	5180	6347	6121	5426	8319	6551	2493	8621
i	Human labour (MD)	6.16	11.43	11.01	15.23	8.61	4.59	16.9	24.27	10.7	5.55	14.66	20.42
ii	Bullock labour (BD)	10.57	7.15	4.93	0	7.43	11.13	6.5	2.6	13	11.21	-	10.3
2.	Added expenses on account of use of tractor/power tiller services	4001	3169	2765	2053	4522	3796	2559	3606	3865	2642	1915	3989
3.	Net Gain (Rs.)	2330	2347	1571	536	658	2551	3562	1820	4454	3910	577	4631
4.	Per cent change in cost structure												
i	Total Fixed cost	-	0	0	0	-	0	0	0	-	0	0	0
ii	Variable cost	-4.48	-4.52	-3.01	-1.04	-0.99	-3.86	-5.40	-2.89	-7.12	-6.24	-0.92	-7.42
iii	Total Cost	-3.94	-3.98	-2.65	-0.91	-0.89	-3.49	-4.87	-2.59	-6.40	-5.61	-0.83	-6.66

It was reported by the respondents that in traditional practices, just like land preparation, sowing was also a human and animal power dominated operation (Table 2). Through the adoption of mechanical power operated implements there were saving to the tune of Rs. 5516, 6347 and 6551/ha in case of maize, paddy and wheat, respectively on overall farm situation. The added costs on account of services of tractor/power tiller, etc., for these crops were found to be at Rs. 3169, 3796 and 2642/ha in case maize, paddy and wheat, respectively on overall farm situation. Net gain was highest in wheat followed by maize and paddy i.e. Rs. 3910, 2347 and 2551/ha. The decrease in variable costs was to the tune of about 5, 4 and 6 per cent over traditional practices in case of maize, paddy and wheat, respectively on overall farm situation.

It was reported by the respondents that in traditional practices of weeding and intercultural were also human labour based operations (Table 2). With the application of herbicides through spray pumps, the extent of labour use for weed management was found to be decreased in major crops. The saving of human labour was highest in case of paddy (about 17 man days/ha) followed by wheat and maize. The monetary value of human and bullock labour saved varied between Rs 2493/ha in wheat to Rs. 6121/ha in paddy. The added costs on account of use of pumps, weedicide, etc., for these crops was found to be highest i.e. Rs. 2765/ha in case of maize followed by paddy and wheat on overall farm situation. Net gain was highest in paddy followed by maize and wheat i.e. Rs. 3562, 1571 and 577/ha. The decrease in variable costs was to the tune of about 3.01, 5.4 and 0.92 per cent over traditional practices in case of maize, paddy and wheat, respectively on overall farm situation. This decrease was found to be relatively higher on large farms as compared to small farms except in paddy crop.

The savings in labour, added costs are for mechanization in case of threshing is presented in Table 2. The table clearly indicates that the added costs of using services of thresher were estimated to be highest in case of wheat about Rs. 3989/ha followed by paddy and maize i.e. Rs. 3606 and 2053/ha on overall farm

situation. It can be seen from the table that by doing the threshing by using thresher, the saving of human labour varied from 15 man days of maize to 24 man days/ha in case of paddy. Similarly, saving in terms of bullock labour was estimated to be at about 10 bullock days in case of wheat and 3 bullock days in case of paddy on overall situation. Net gain by mechanized threshing operation were highest in wheat followed by paddy and maize i.e. Rs. 4631, 1820 and 536/ha. Due to these savings, the variable cost of production varied between 1 per cent in case of maize to about 7 per cent in case of wheat on overall farm situation.

The average pattern of savings in labour as well as additional costs incurred on account of mechanization and their net impact on farm costs on account of farm mechanization in existing crop production scenario over traditional farm practices has been analyzed and presented in Table 3. It can be observed from the table that through the adoption of mechanized crop production practices there has been considerable saving in human labour in all the selected crops. It was estimated at about 56, 64 and 67 mandays/ha in case of maize, paddy and wheat, respectively on overall farm situation. Similarly, the contribution of farm mechanization towards saving of bullock power was also quit high i.e. it varied between 23 to 35 bullock days/ha among different crops. In monetary terms, the per hectare total savings of human and bullock labour was found to be highest in case of paddy (Rs 28817) and lowest in case of wheat (Rs 17813) on overall farm situation. The table further indicates that while mechanizing farm operations, the additional expenses has also been incurred which includes hiring of tractor/power tiller, thresher, cost of weedicide, etc. The per hectare added expenses were estimated at Rs 10652 in maize, Rs 13665 in paddy and Rs 12128 in case of wheat on overall farm situation. The per hectare net gain through mechanization was to the tune of Rs 8531, 15152 and 5685 in case of maize, paddy and wheat, respectively on overall farm situation. Due to the saving in variable costs, it was decreased by about 16, 30 and 8 per cent in case of maize, paddy and wheat, respectively on overall farm situation. There has been reduction in the variable cost of production over traditional crop production practices ranging about 1 per

Table 3: Impact of mechanization of existing practices over traditional practices (Rs./ha)

S. No.	Particulars	Maize			Paddy			Wheat		
		Small	Large	Overall	Small	Large	Overall	Small	Large	Overall
1.	Savings (Rs)	19305	18895	19182	29117	28119	28817	17861	17702	17813
i	Human labour (MD)	52.87	62.60	55.80	65.74	59.24	63.8	69.49	61.68	67.15
ii	Bullock labour (BD)	22.2	23.68	22.65	28.69	25.26	27.66	33.5	36.88	34.51
2.	Added expenses on account of use of machinery services									
i	Tractor/power tiller	8322	6831	7874	9576	8195	9161	7447	6270	7094
ii	Weedicide	700	782	725	885	865	879	1023	1046	1030
iii	Thresher	2112	1914	2053	5061	210	3606	3668	4739	3989
iv	Winnowing	0	0	0	18.3	21.05	19.13	15.5	14.25	15.13
	Total charges	11134	9527	10652	15540	9291	13665	12154	12069	12128
3.	Net gain	8172	9368	8531	13577	18828	15152	5708	5632	5685
4.	Per cent change in cost structure									
i	Total fixed cost	2.97	-2.02	1.47	2.97	-2.02	1.47	2.97	-2.02	1.47
ii	Variable cost	-15.26	-18.15	-16.13	-34.50	-19.27	-29.93	-7.21	-10.25	-8.12
iii	Total cost	-13.07	-16.21	-14.01	-30.95	-17.48	-26.91	-6.17	-9.41	-7.14

cent in case land preparation in paddy to 7 per cent in case of threshing in wheat. Further, when these operations were taken together as existing situation, the contribution of farming mechanization reached upto 22 per cent. This indicates that in order to increase the profits from major crop enterprise, there is a need to promote farm mechanization in the study area.

CONCLUSION

Himachal Pradesh is one of the model hilly states of the country as far as development of agriculture is concerned. The extent of farm mechanization in the state in terms of availability of mechanical power as well as power operated tools and implements are quite low. Therefore, the study highlighted the net savings in case of land preparation and sowing operations through mechanization was highest in wheat followed by maize and paddy. Through the adoption of various farm mechanization practices on sample farms, they were able to save 56 to 67 man days of human labour and 23 to 35 bullock days/ha in major crops. The total added expenses on account of inputs and hiring charges were

ranging between Rs 10652/ha in maize to 13665/ha in paddy. The per hectare net savings through mechanization was to the tune of Rs 8531, 15152 and 5685/ha in case of maize paddy and wheat, respectively.

Paper received on : December 11, 2020

Accepted on : December 24, 2020

REFERENCES

- Clarke, L.J. (2000). Strategies for agricultural mechanization development. Agricultural Support System Division. FAO, Rome, Italy 7.
- Mehta, C.R., Chandel, N.S. and Jena, P.C. (2019). Indian agriculture counting on farm mechanization, *Agricultural Mechanization in Asia, Africa & Latin America*, **50**(1), 84-89.
- Sarkar, D. and Roy, D. (2014). An economic analysis on costs of farm mechanization in West Bengal, *International Journal of Current Research*, **6**: 4437-4440.
- Singh, G. (2006). Estimation of a mechanization index and its impact on production and economic factors-a case study in India. *Biosystems Engineering*, **93**, 99-106.