The Pharma Innovation Journal 2023; 12(1): 2305-2309

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(1): 2305-2309

www.thepharmajournal.com
Received: 18-11-2022
Accepted: 21-12-2022

Ashwin Sinha
Student, Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Sunil Kumar Singh
Assistant Professor, Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
Ashwin Sinha
Student, Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Resource utilization and their efficiency in potato production in Northern hills of Chhattisgarh

Ashwin Sinha and Sunil Kumar Singh

Abstract
The presented study was carried out to estimate resource use efficiency and assess the relative importance of various inputs in potato production. The study was conducted Surguja and Balrampur districts of Northern Hills Zone of Chhattisgarh due to intensive cultivation of potato in these districts. The primary data from 100 potato growers was collected through personal interview method. The Linear and Cobb-Douglas production function were tried to assess the influence of various productive resources in production of potato and Cobb-Douglas production function were found best fit. The study revealed that expenditure on plant protection measures, machine labour and manure & fertilizer had positive and statistically significant effect on potato production and explained 66.67 per cent variation in total potato production. Resource use efficiency analysis indicated that plant protection measures, machine labour and manure & fertilizer were underutilized. Hence, the farmers-producers need to use more quantity of these inputs for obtaining higher returns from potato cultivation.

Keywords: Marginal value product, northern hills zone, potato, resource use efficiency

Introduction
Potato (*Solanum tuberosum* L.) is one of the most important cash and tuber crop in both sub-tropical and temperate climate of the world including India. Tuber crops play an important role in food and nutritional security apart from generating income, employment and livelihood opportunities. Suitability to grow under a wide range of environments made it popular worldwide. It has a high nutritional value (Woolfe, 1987) [15] and produces quickly and more nutritious food on less land and in harsher climates than any other major crops (FAO, 2008) [2]. Potato is known to be originated in South America. In India, it was introduced by the Portuguese sailors during early 17th century and its cultivation was spread to North India during the British period. After wheat, rice and maize, potato is the most important food crop in the world. India is a major producer of potato along with China, Russia, Ukraine and Poland. Potato is cultivated in almost all states under diverse agro climate conditions in India. About 85 per cent of potatoes are cultivated in Indo-Gangetic Plains of Northern India. The major potato growing states are Uttar Pradesh, West Bengal, Punjab, Bihar, Haryana, Madhya Pradesh, Gujarat and Maharashtra. More than 90 per cent potato is grown in Rabi season under assured irrigation facility. The rest is taken up during Kharif season. The area and production of potato in the country is estimated to be 2173 thousand ha. and 5019 thousand MT, respectively (NHB, 2018. In Chhattisgarh, potato is considered as an important commercial crop. It is mainly cultivated in some parts of Surguja, Balrampur, Bilaspur, Raigarh, Jashpur and Raipur districts with a total area of 0.0413 million ha. producing 0.58 million tonnes with an average productivity of 14.26 tonne/ha. In the state, it is grown in Rabi season except in Mainpat and Samripat hills, where it is grown in both Kharif and Rabi season. Surguja district has the largest area with 0.0058 million ha. producing of 0.08 million tonnes with an average productivity of 15.45 tonne/ha. (Department of Horticulture, Gov. of Chhattisgarh, Raipur, 2015).

Materials and Methods
A multi-stage random sampling design was adopted for the selection of potato growers. Chhattisgarh state consists of 27 districts, which are divided into three agro-climatic zones *viz*., Northern Hills Zone, Chhattisgarh Plains Zone and Baster Plateau Zone. The two districts namely Surguja and Balrampur of Nortehrn Hills Zone were selected for the study due to their importance in the potato production. Mainpat block from Surguja and Kusmi block from Balrampur were selected for study due to intensive potato cultivation in these blocks, in

Northern Hills Zone. The six villages *viz*., Ropkhar, Narmdapur, Kuniya, Kamleshwarpur, Champarta, Keshra, from Mainpat and five village *viz*., Samripat, Jamirapat, Gajadharpur, Gopatu, Jokapat, villages from Kusmi block were selected. A complete enumeration of selected villages was carried out to identify the potato growers. A population of 760 farming households were surveyed and preliminary information on crop grown, area under crop, land holding etc. were collected. Out of 760 farming household, 319 were engaged in potato cultivation. The potato growers were further, classified into marginal farmers, small farmers, medium farmers and large farmers having operational land holding of up to one hectare, up to two hectare, up to four hectare and more the four hectare, respectively. Finally, a sample of 100 potato growers was selected randomly with the help of probability proportion criteria from the above mention villages. Thus, the sample comprising 40 marginal, 32 small, 17 medium and 11 large categories were selected. The data for the present study were collected from both primary and secondary sources. The primary data were collected during January and February, 2018 from sampled households using well structure schedule through personal interview. The data on various aspects of potato enterprise like, area under potato crop, expenditure on human/machine labour, seed, manures and fertilizer, irrigation and plant protection measures, value of machinery and equipment used in potato production, miscellaneous expenses etc. were collected. Secondary data regarding area under potato crop, production and productivity of potato were also collected from state statistical abstract and district statistical abstract, etc. The collected data were compiled and analysed systematically to achieve the objectives of the study. The tabular and functional analytical tools were employed for the analysis of data. The tabular analysis was used to study the cropping pattern of the sampled households. The influence of factors, like seed, fertilizer, labour, irrigation etc., on potato production was assessed with the help of production function analysis. The Cobb-Douglas production function is one of the most widely used production function for assessing the influence and efficiency of factors used in production process (Goni *et al*. 2013; Iqbal *et al*. 2015; Kumar *et al*. 2018; Dhakal *et al*. 2019; Acharya *et al*. 2019 and Wassihun *et al*. 2019; Nath and Singh 2020; Somjai *et al*. 2020; Geo *et al*. 2020;) [8, 9, 11, 6, 1, 14, 12, 13, 7]. Thus, in the presented study, Cobb-Douglas production function was used to estimate the resource use efficiency and contribution of various inputs to total output. The Cobb- Douglas production function of following nature had been employed.

$$Y = a_0 x_1^{b1} x_2^{b2} x_3^{b3} x_4^{b4} x_5^{b5} x_6^{b6} x_7^{b7}$$

Where, Y is the income from potato production /ha. (Rs.); X_1 is the expenditure on human labour /ha. (Rs.); X_2 is expenditure on machine labour /ha. (Rs.); X_3 is the expenditure on bullock labour /ha. (Rs.); X_4 is the expenditure on seed /ha. (Rs.); X_5 is the expenditure on manures and fertilizer /ha. (Rs.); X_6 is the expenditure on plant protection measures /ha. (Rs.); X_7 is the miscellaneous expenditures /ha. (Rs.); a_0 is the constant parameter and b_i is the regression coefficient associated with i^{th} variable.

Resource use efficiency measures whether input are used efficiently or not. The resource use efficiency was assessed by estimating the marginal value product (MVP) of significant regression coefficients in the estimated production function. The MVP of significant regression coefficients were computed as:

$$MVP_i = b_i \frac{\bar{Y}}{\bar{x}}$$

Where, b_i is the estimated regression coefficient associated with i^{th} variable; $\bar{Y}$ is the geometric mean of Y variable and $\bar{x}$ is the geometric mean of X variable.

The resources were used efficiently if the MVP of input is equal to its unit price and any deviation of MVP of input from its unit price may be termed as resource use inefficiency. The higher difference between MVP of an input and its unit price, greate is the inefficiency and vice versa. Further, t-statistics was used to test the statistical significance of the difference between the MVP of an input and its unit price.

$$t = \frac{|MVPi - Pi|}{S.E.(MVPi)}$$

S.E. (MVPi) is the standard error of MVP_i which is computed follows:

$$S.E.(MVP_i) = S.E.(b_i) \frac{\bar{Y}}{\bar{x}}$$

Where, S.E. (b_i) is the standard error of regression co-efficient associated with i^{th} input; and P_i is the unit price of the i^{th} input.

Results and Discussion

Cropping pattern and cropping intensity of sampled households

The cropping pattern of sampled farmers is presented in Table 1. The perusal of table 1 indicated that total gross cropped area was observed to be 0.69 ha., 1.92 ha., 3.35 ha. and 6.19 ha. and 3.04 for marginal, small, medium, large and overall farmers, respectively. The highest cropped area is found to be in *kharif* season among all the categories. The area under different crops in *kharif* season is observed to be 73.91 per cent, 71.88 per cent 71.34 per cent 71.08 per cent and 72.05 for marginal, small, medium, large and overall farmers. The area under different crops in *rabi* season was observed to be 27.95 per cent for overall farmers. The overall cropping intensity was estimated to be 139.98 per cent for sampled households. It is observed that the cropping intensity is highest for large farmers (140.60 per cent) and lowest for marginal farmers (135.29 per cent). The cropping intensity of the sampled farmers, can further be increased by improving irrigation facilities in the study area. The area under *kharif* potato was observed to be 0.19 ha., 0.45 ha. and 0.76 ha, 1.79 ha. and 0.70 ha. for marginal, small, medium, large and overall farmers.

Resource use structure in potato production

The socio-economic condition of the farmers affect the efficiency and pattern of input use (Islam *et al*. 2016). The agricultural productivity and profitability can be improved by acquiring the technical and managerial skills and by judicious utilization of resources available (Bajracharya and Sapkota, 2017). Thus, information of per hectare utilization of different resources in cultivation of potato by sample household had been presented in Table 2.

Human labour
It can be observed from the table that, on an average 90.02 man days human labour was used for potato cultivation, comprising 28.94 male labour days and 61.08 female labour days. Per hectare labour utilization indicated a decreasing trend with the increase in the size of holdings. The use of human labour was found maximum (94.38 days) in marginal farmers and minimum (86.60 days) for large farmers.

Bullock labour
The per hectare use of bullock labour was found to be 2.40 pair days. The per hectare bullock labour utilization was observed maximum in case of marginal farmers (4.85 pair days) followed by small (2.99 pair days), medium (4.41 pair days) and large (0.35 pair days) farmers.

Machine labour
As per the table 2, overall uses of machine labour was observed to be 5.95 hrs. for cultivation of potato. The per hectare utilization of machine labour was observed to be maximum in case of large framers (7.54 hrs.) followed by medium (6.73 hrs.), small (5.99 hrs.) and marginal (3.54 hrs.) farmers. Use of machine power shows increasing trend with the increase in size of holdings. The machine labour was mostly used for the operation of ploughing and harrowing of plot.

Seed
Seed *i.e*. tubers of potato was expensive, scare and important input in potato cultivation. On an average, utilization of tubers was 14.69 q./ha. Farmers belonging to large size group of holding had used relatively lower seed rate followed by medium, small and marginal farmers.

Manures
The overall use of manure per hectare for potato was found to be 22.18 q. which was highest for marginal (25.62 q.) farmers followed by small (22.51 q.), medium (20.43 q.) and lowest (20.15 q.) for large farmers. Per hectare use of manure showed decreasing trend from marginal to large farmers because manure is less productive as compared to chemical fertilizers.

Fertilizer
On an average, the per hectare use of chemical fertilizers *i.e.* urea, DAP, MOP and other fertilizers were 97.27 Kg, 57.53 Kg. and 44.15 Kg./ha. and 53.24 Kg./ha., respectively. The use of fertilizers was very less than recommended dose of 120 kg N, 80 kg P_2O_5 and 100 Kg. K_2O for potato cultivation. The large farmers used more fertilizers than medium small and marginal farmers.

Plant protection charges
The overall plant protection charges are observed to be `3959.28. The large farmers used more plant protection chemicals than medium, small and marginal framers. The plant protection charges were highest (`5123.71) in large farmers followed by medium (`4381.08), small (`3390.70) and marginal (`2941.61) farmers, respectively.

Input- output relationship
The knowledge of best use of limited resources is very important for profit making in potato production. Thus, it is necessary to know whether the resources owned by the farmers were used efficiently or not. Keeping this in mind, the input-output relationship and resources use efficiency in potato production had been worked out. The potato production function has been estimated for overall categories using expenditure on human labour, bullock labour, machine labour, seed, plant protection, manure & fertilizer and miscellaneous expenditure as explanatory variables. The results of the estimated production function had been presented in Table 3. The perusal of the table 3 indicated that the machine labour, plant protection and manure & fertilizer were found positive and statistically significant. The estimated value of coefficient of machine labour, plant protection and manure & fertilizer were found to be 0.105, 0.457 and 0.223, respectively. This indicated that one percent change in expenditure on machine labour led to the change in return from potato production by 0.105 per cent. Similarly, one per cent change in expenditure on plant protection resulted in change in return from potato production by 0.457 per cent and one per cent change in expenditure on manure & fertilizer brought change in return from potato production by 0.223 per cent. The value of coefficient of multiple determinations was estimated to be 66.67and implied that these three resources together explained 66.67 per cent variation in the output of potato production.
The value of regression coefficient of machine labour, plant protection and manure & fertilizer, variable were found significant in the production function analysis. Therefore, these variables were selected for estimation of resource use efficiency.

Resource use efficiency in potato production
The marginal value productivity (MVP) of various inputs whose regression coefficient found significant in potato production were compared with their respective unit price to examine the resource use efficiency. To test the significance of deviation of MVP of an input from its unit price, t-statistics was used. The marginal value product (MVP) of significant inputs for potato production had been presented in Table 4.
It is observed from the Table 4 that the marginal value product and marginal factor cost for machine labour, plant protection and manure & fertilizer were positive and statistically significant. This implied that higher efficiency could be achieved through higher quantity of machine labour, plant protection and manure & fertilizer for potato production process. The foregoing analysis revealed that resource use efficiency in potato production could be maximized by increasing the use of these variables i.e. machine labour, plant protection and manure & fertilizer which will increase the productivity of farmers for better return.

Summary and Conclusion
The judicious use of available resources is necessary to ensure that maximum output is obtained from each unit of available resources and they are used effectively and efficiently in the production process. In the study area, the quantity of resources used by the farmers for potato cultivation was below the recommendation. It is also found that the quantity of various resources used by the farmers-producers of study area was less than the quantity used for potato cultivation in other part of India. The functional analysis indicated that the expenditure on machine labour, plant protection and manure & fertilizer had significant effect on potato production. The

two-third of total variation in the potato production was explained by these significant variables. Returns to scale was found to be decreasing in potato production. Thus, measures need to be taken to increase the returns to scale in potato production. Resource use efficiency analysis indicated that, machine labour, plant protection and manure & fertilizer were underutilized. Hence, returns from potato cultivation can be maximized by using more quantity of, machine labour, plant protection and manure & fertilizer.

Table 1: Cropping pattern and cropping intensity of sampled households (ha.)

S. No.	Particular	Land holding category				
		Marginal farmers	Small farmers	Medium Farmers	Large farmers	Overall
A	**Kharif**					
1	Paddy	0.12	0.39	0.8	1.12	0.61
2	Buckwheat	0.05	0.2	0.35	0.52	0.28
3	Potato	0.19	0.45	0.76	1.79	0.70
4	Maize	0.15	0.34	0.48	0.97	0.49
	Sub total	**0.51**	1.38	2.39	4.40	2.17
		(73.91)	(71.88)	(71.34)	(71.08)	(72.05)
B	**Rabi**					
1	Linseed	0.07	0.21	0.38	0.45	0.28
2	Maize	0.11	0.33	0.58	1.34	0.59
	Sub total	0.18	0.54	0.96	1.79	0.87
		(26.09)	(28.12)	(28.66)	(28.92)	(27.95)
	Gross Cropped	0.69	1.92	3.35	6.19	3.04
	Area (A+B)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
	Net cropped Area	0.51	1.38	2.39	4.40	2.17
	Cropping Intensity (%)	135.29	139.13	140.17	140.68	139.98

Figures in parentheses indicate percentages to Gross Cropped area

Table 2: Resource utilization pattern in potato production (Per ha.)

S.N.	Costs items	Land holding category				Overall
		Marginal farmers	Small farmers	Medium farmers	Large farmers	
1	Male labour(Days)	36.4	32.79	24.4	22.15	28.94
2	Female labour(Days)	57.98	58.52	63.38	64.45	61.08
3	Total labours(Days)	94.38	91.31	87.78	86.6	90.02
4	Bullock labour(Days)	4.85	2.99	1.41	0.35	2.40
5	Machine labour(Hrs.)	3.54	5.99	6.73	7.54	5.95
6	Seed (q.)	15.63	14.98	14.69	13.45	14.69
7	Manure (FYM) (q.)	25.62	22.51	20.43	20.15	22.18
8	Fertilizer (kg.) - Urea	79.54	87.67	95.89	125.98	97.27
	DAP	36.34	43.58	64.63	85.56	57.53
	MOP	28.42	31.08	52.1	64.98	44.15
	Others	25.57	31.34	73.71	82.36	53.24
9	Plant protection measures (Rs/ha.)	2941.61	3390.7	4381.08	5123.71	3959.28

Table 3: Results of estimated Cobb-Doulas production function

Constant	Human labour	Bullock labour	Machine labour	Seed	Plant protection	Manure & Fertilizer	Misc.	R^2 (%)
5.218	-0.059	-0.009	0.105***	0.022	0.457***	0.223**	0.004	66.66
(3.330)	(0.155)	(0.026)	(0.030)	(0.051)	(0.090)	(0.087)	(3.330)	

Figure in parentheses indicate the standard error of estimate.
*** Significant at 1% level, ** Significant at 5% level

Table 4: Marginal value product (MVP) for potato production

Input	Machine labour	Plant protection	Manure & fertilizer
MVP	2.316	11.605	3.047
Unit price	1.000	1.000	1.000
Difference	1.316	10.605	2.047
Standard error	0.666	2.288	1.191
T- Value	1.977*	4.636***	1.719*

*** Significant at 1% level, * Significant at 10% level

References

1. Acharya N, Acharya B, Dhungana SM, Bist V. Production economics of ginger (*Zingiber officinale* Rose.) in Salyan district of Nepal. Archives of Agriculture and Environmental Science. 2019;4(4):424-427.
2. Anonymous. Food and Agriculture Organization. 2008. (http://www.fao.org/potato-2008/en/aboutiyp/index.html).
3. Anonymous. National Horticulture Board. 2018.

(http://nhb.gov.in/statistics/HorticultureCropsFinal/2019-20 (2nd%20Advance%20Estimates)%20(1)_36.pdf).
4. Anonymous. Department of Horticulture, Government of Chhattisgarh, Raipur. 2015.
5. Bajracharya M, Sapkota M. Profitability and productivity of potato (*Solanum tuberosum*) in Baglung district, Nepal. Agriculture & Food Security 2017;6:47.
6. Dhakal R, Bhandari S, Joshi B, Aryal A. Cost-Benefit analysis and resource use efficiency of rice production system in different agriculture landscapes in Chitwan district, Nepal. Archives of Agriculture and Environmental Science. 2019;4(4):442-448.
7. Geo L, Ariani WOR, Saediman H. Determinants and profitability of small-scale red chili production in Konawe district of Southeast Sulawesi. IOSR Journal of Agriculture and Veterinary Science. 2020;13(3):51-55.
8. Goni M, Umar ASS, Usman S. Analysis of resource use efficiency in dry season vegetable production in Jere, Borno State, Nigeria. Journal of Biology, Agriculture and Healthcare. 2013;3:8-24.
9. Iqbal MA, Ping Q, Adil SA, Nazir A, Rizwan M. An economic analysis of potato production in Okara district, Pakistan. International Journal of Economics, Commerce and Management. 2015;3:229-240.
10. Islam SMF, Anwar MM, Manos B. Potato production system in Bangladesh: Resource use, productivity, efficiency and comparative profitability of true potato seed technology over traditional tuber technology. Acta Horticulture. 2000;536:261-268.
11. Kumar A, Rohila AK, Pal VK. Profitability and resource use efficiency in vegetable cultivation in Haryana: Application of Cobb-Douglas production model. Indian Journal of Agricultural Sciences. 2018;88(7):1137-41.
12. Nath S, Singh R. Relative resource use efficiency in maize cultivation: A study of Banor - Shiva Limestone Mining Region in Himachal Pradesh. Agricultural Situation in India. 2020, 29-36.
13. Somjai S, Chankoson T, Jermsittiparsert K. An economic analysis of agricultural production function on the paddy fields of Thailand. Entrepreneurship and Sustainability Center. 2020;7(3):2012-2025.
14. Wassihun AN, Koye TD, Koye AD. Analysis of technical efficiency of potato (*Solanum tuberosum* L.) production in Chilga district, Amhara National Regional State, Ethiopia. Journal of Economic Structures. 2019;8(1):1-18.
15. Woolfe JA. The potato in the human diet. Cambridge University Press. New York; c1987. p. 10.