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Resource Use Efficiency and Constraint Analysis of Mango Cultivation in Kangra District of Himachal Pradesh

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***Abstract*:** The present study has been designed to investigate the resource use efficiency and problems of mango growers. A sample of 80 farmers cultivating mango was selected using multistage simple random sampling. Area under mango increased at a rate of 1 per cent per annum, but productivity has shown negative growth during this period (2003-04 to 2018-19), indicating poor management of mango orchards in the state. The cropping intensity was 126.59 per cent, which is low due to the greater area under mango plantation. The coefficient of determination (R^2) was 0.94 which indicated that 94.00 per cent variation in mango production. The ratio of MVP/MFC was greater than unity, which indicated that the resource is being under-utilized and increase the use of these inputs will increase the output. The study signifies that there is need to enhance usage for the maximization of profit. The major constraints were shortage of skilled labor, high wage rates, lack of storage facilities, transportation problem, problems in market intelligence. Provision of marketing facilities, fertilizers, pesticides, is made available at subsidized rates and availability of low cost technologies was the major suggestions of the respondents. The study also suggests that there is a need of adoption of improved technologies along with proper utilization of resources like manures and fertilizers, irrigation, and better management practices for improving both yield and net returns among the mango growers. The main reasons for the low productivity were imbalances in nutrient application, alternate bearing and inadequate fertilization.

***Keywords*:** Mango and cropping pattern, Input use, Costs, Returns, Efficiency and problems

Agriculture, forestry, and fishery had a gross value added of Rs 19.48 lac crore (US$ 276.37 billion) in fiscal year 2020. In fiscal year (FY) 2020, agricultural and allied industries accounted for 17.80 per cent of India's gross value added (GVA) at current prices. In 2021, consumer spending in India could rise by up to 6.60 per cent. India's share of global agricultural exports increased to 2.10 per cent in 2019 from 1.71 per cent in 2010 (Ministry of Commerce 2021). Mangoes are now growing in more than 100 countries of which more than 65 countries produce each more than 1,000 MT a year (FAO 2020). Currently, mango ranks third among tropical fruits and has become one of the top five fruits in the world (Galan 2017). In recent years, mangoes have become well established as fresh fruit and processed products in the global market (Mitra 2016). World demand for mango is ascertained to be increasing particularly from temperate countries where mangoes are rapidly gaining popularity. The cultivated in area is 2,291 thousand hectares with a production of 20,444 million tons in India and contributing 40 per cent of total world production of mango (NHB 2020). India is the largest producer of mango in the world followed by Indonesia and China. Approximately, India produces 25 million metric tons of mangos every year contributing to more than 45% of the world's mango production (FAO 2020).

Mango is perishable in nature and should be marketed immediately after picking of the fruits. At present, there are large numbers of intermediaries in this trade between the producer's and the consumer's which has resulted in a wide gap in the producer and consumer price of these commodities. This needs to be normalized to enable farmers receive remunerative price of their produce and boost their production and consumption in the country (Kaur et al 2014). Himachal Pradesh is having the advantage of varied climate ranging from subtropical to dry temperate. The total fruit production in state is 624.48 thousand metric tons from an area of 234.77 thousand hectares. The area under mango cultivation in the state is 42.41 thousand hectares which accounts for 18.06 per cent of total area under fruits in H.P and producing 51.54 thousand metric tons which is 8.00 per cent of total fruit production of Himachal Pradesh (NHB 2020). Mango cultivation is concentrated in Kangra, Una, Bilaspur, Hamirpur and parts of Mandi district of Himachal Pradesh. The Kangra district is the major mango growing district covering an area of 21.28 thousand hectares which is 50.17 per cent of total area under mango cultivation in H.P and producing 24.90 thousand metric tons i.e. 48.31 per cent of total production of Himachal Pradesh (Directorate of Economics and Statistics 2020). The growers are facing a

number of problems during production and marketing of mango. The more serious problems faced by the cultivators are fluctuations in mango yield due to changes in the rainfall and other weather conditions. But the main reason for the lower production of mango is the frequent climatic changes in the production areas and it also shows that mango grower's share in consumer's rupee is less in India because of its perishability and seasonality. Mango growers do not want any risk in marketing and so contract marketing system is popular prevalently. This study was carried out in order to determine resource utilization and also to analyze the cost and returns of mango cultivation and encouraging mango production among marginal and small farmers.

MATERIAL AND METHODS

Kangra district of Himachal Pradesh was purposively selected for the present study during 2018.Two blocks of Kangra District (Nurpur and Indora) were chosen based on the area under mango cultivation and a list of villages in the selected blocks was created, and eight villages from each block were carefully selected. From the list, 5 mango growers were selected from each village, thus, 80 mango growers were selected for collecting data. The Primary data were collected from the sampled growers by the survey method using well designed and pretested schedule.

Cropping intensity: Cropping intensity was estimated as

$$\text{Cropping intensity} = \frac{\text{Gross cropped area}}{\text{Net sown area}} \times 100$$

Net sown area (NSA) is the area which has been cultivated at least once during a reference year. Gross cropped area (GCA)is the total area under different crops cultivated during that year. Thus if a particular plot is cultivated twice during the year, the area of the plot will be counted twice in GCA but only once in NSA.

Compound growth rate (CGR): The compound growth rates were computed by fitting the exponential function of area, production and productivity total fruits and mango in Himachal Pradesh for the period 2003-04 to 2020-21 to measure the growth rates of area, production and productivity of total fruits and mango in Himachal Pradesh. Data were collected from official website National Horticulture Board from the year (2003-2018). The Compound growth rate (CGR) is calculated by Patil and Yeledhalli (2016). Secondary data were entered into MS Excel and the analysis was performed using SPSS (Statistical Package for Social Sciences). The ordinary least square method was used to fit the exponential function of the following form, which was converted into a log linear function using the logarithmic transformation as follows:

$Y = ae^{bt}$

$\text{Ln } Y = \text{Ln } a + bt.$

Where,

Y = Dependant variable (area, production and productivity)

t = Independent variable (time in year).

Compound growth rate (CGR) was calculated by using the following formula:

$\text{CGR} = b \times 100$

Standard error (SE) of CGR was calculated by using the following formula:

$\text{SE of CGR} = 100 \times \text{SE}(b)$

Test of significance

$$t_{cal} = \frac{\text{Compound growth rate (CGR)}}{\text{Standard error (CGR)}}$$

The t_{cal} values for CGR were compared with t_{table} values at error degree of freedom and at two levels of significance *viz;* 0.01 and 0.05. t_{cal} value greater than t_{table} values were marked as significant and single asrerix (*) were placed on those value which were significant at 1 per cent level of significance and double asrerix(**) were places on those values that were significant at 5 per cent level of significance. Compound growth rate (CGR) was calculated by using SPSS (statistical package for social sciences) statistical software.

Cobb-Douglas production function: The elasticity of inputs/factor used in the production of mango was worked out by fitting Cobb-Douglas production function given by Charles Cobb and Paul Douglas (1928). Cobb-Douglas production function was fitted on the basis of higher value of R^2, theoretical plausibility of sign and magnitude of parameter estimate and severity of multicollinearity. The following variables were used in order to determine the factors affecting the yields of hundred mango trees.

$$Y = aX_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} u_i$$

Log-log equations

$\text{Log } Y = \text{Log } a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + \log u_i$

Y = Yield (Qtl/ha.), X_1= Farm yard manure (Kg/ha.),

X_2= Fertilizer (Kg/ha.), (Kg/ha). X_4= Human labor expenditure (Man days)

u_i= Stochastic error term, a = Intercept, b_1 to b_4 are the elasticity coefficients

Adjusted coefficient of multiple determination: Adjusted R^2 is a modified version of R^2that has been adjusted for the number of predictors in the model. Adjusted R^2 adjusts the statistic based on the number of independent variables in the model. That is the desired property of a goodness-of-fit statistic. The adjusted value of R^2 is calculated as follows (Gujarati et al 2012).

$$\overline{R}^2 = 1 - (1 - R^2)\frac{n-1}{n-k}$$

Where, R^2 = Coefficient of multiple determination, n = Number of sample observations

k = Number of parameters estimated, R^2 = Adjusted R^2

Test for overall significance of regression: 'F' test has been used to test the overall significance of explanatory variables whether they affect the dependant variable or not. The expression for the test is as under (Gujarati et al 2012).

$$F(k-1, n-k)df. = \frac{R^2}{1-R^2}\frac{n-k-1}{k}$$

Resource-use efficiency: To ensure maximum profit and efficiency of resources, a cashew farmer must utilize resources at the level where their marginal value product (MVP) is equal to their marginal factor cost (MFC) under perfect competition (Tambo and Gbemu, 2010). The efficiency of a resource would be determined by the ratio of MVP of inputs (based on the estimated regression coefficients) and the MFC.

where, $$r = \frac{MVP}{MFC}$$

$$MVP_{xi} = \left\{ \beta_i \frac{\bar{y}}{\bar{x}_1}(P_y) \right\}$$

Here,

MVPi = Marginal value product of the ith input,

y = Geometric mean of output

x_i = Geometric mean of input

β_i = Estimated coefficient (or) elasticity of the i^{th} input,

I = 1, 2, 3 …n

P_y = Price of mango (Rs/qtl.)

The relative percentage change in MVP of each resource was required to obtain optimal resource allocation estimated:

$$D = \left(1 - \frac{MFC}{MVP}\right) \times 100$$

Where, D is the absolute value of percentage change in MVP of each resource.

The decision rule for the efficiency analysis is if:r = 1; resource is been used efficiently

r >1; resource is under-utilization and increased utilization will increase output.

r <1; resource is over utilized and reduction in its usage would lead to maximization of profit.

Returns to scale are estimate by the sum of the elasticity of the various inputs. The decision rule for the return to scale is that if:

$\Sigma\beta_i = 1$, implies constant returns to scale, $\Sigma\beta_i < 1$, implies decreasing returns to scale, $\Sigma\beta_i > 1$, implies increasing returns to scale

Significance of efficiency ratio

H_0 = resources are efficiently used, H_1 = resources are inefficiently used

t statistic was used to compare with significant t table value at 0.05 level of probability.

The various problems associated with the production and marketing of mango crop it is assumed that the extent of a particular problem varies from place to place and farmer to farmer.

Chi-square test: To test the significant difference for the problems among different farms, Chi-square test was used (Rana and Singhal 2015).

The detail of approximate Chi-square test is given as under:

$$\sum_{j=1}^{L}\sum_{i=1}^{K}\frac{(O-E)^2}{E} \sim \chi 2(L-1)(K-1)d.f.$$

Where, O= Observed values, E=Expected values, K= Number of problem, L = Number of farm size groups

The study is based on the data collected for one year only i.e. 2018-2019, which may not essentially hold true for other periods as well. The data were collected by survey method through personal interview with the sample farmers. Generally, the farmers were not maintaining the proper farm records and estimates were provided by the recall memory. However, sincere efforts have been made to elicit accurate and reliable information as far as possible by cross questioning. The degree of discrepancy, if any, would be negligible as the estimates presented are in averages.

RESULTS AND DISCUSSION

Status of mango production in India and Himachal Pradesh: The area under total fruits has increased from 182.44 thousand hectare to 230.85 thousand hectare during the period 2003-04 to 2018-19 (Table 1). The area of total fruits in Himachal Pradesh was increased at 1.60 per cent per annum, during last 15 years. The area under mango cultivation in the state is 42.41 thousand hectares which accounts for 18.19 per cent of total area under fruits in H.P and producing 37.62 thousand metric tons of mangos which is 8.79 per cent of total fruit production of Himachal Pradesh. Area under total fruits was increasing significantly, but production and productivity was not increasing significantly. In mango, area was increasing at the rate of 1.00 per cent per annum but productivity has shown negative growth during this period, which indicates the poor management of mango orchards in the state. Moreover the procurement price for the crop under market intervention scheme is also low with limited number of procurement centers and processing units in the mango growing areas. The maturity of the crop coincides with the onset of rainy season which results in the low yields. The yield has fluctuated over the years due to its alternate/irregular bearing habit. Mango productivity cannot

be determined based on a single year's data and must be based on an average of at least five years. Furthermore, when compared to other tropical and subtropical fruits, mango yield is generally low.

Socio- economic characteristics of mango growers: The demographic profile is given in Table 2. The family labour-based occupation at the village level influenced the size and structure of the sampled farmers' families. The size and structure of the family among the sampled households has a significant impact on farm production. These factors determine the family's socioeconomic well-being, which is important in farm business and marketing activities. The average size of land holding per sampled households was found to be 2.26 hectare. The orchard and cultivated area occupied 24.70 per cent and 58.47 per cent, respectively. Net sown area was 1.88 ha out of which 1.18 ha area under mango cultivation i.e. mango is major fruit crop in the study area. The change in per cent share of area under different crops in the gross cropped area has revealed the extent of agriculture diversification on sample farms.The cropping intensity was 126.59 percent, indicating that farm efficiency could be improved lower cropping intensity is due to the maximum area under fruit crop, which accounted for more than 50 per cent of gross cropped area.

Production function and resource use efficiency: Production function merely provides general indication of overall productivity of mango orchards. Therefore, it tried to identify the factors affecting the mango production as a part of the study using high precision methods and measures of resource use with the help of production function analysis (Table 3). The Cobb- Douglas production function was used and the appropriate functional form was chosen based on the value of R^2, the theoretical plausibility of the sign and magnitude of parameter estimates, and the severity of multicollinearity. The farm yard manure, fertilizers and plant protection chemicals were identified as the main factors affecting the productivity and production of mango. It was hypothesized that farm yard manure, chemical fertilizers, and plant protection chemicals has positive impact on the productivity of mango crop

Wagale et al (2007), Sharma and Kumar (2019) also observed that FYM and fertilizer has positive impact on productivity of kinnow and mango crop R^2 was 0.94, indicating that the explanatory variable explained 94 per cent of the variation in the model. The sum of the elasticity coefficient (bi) was 1.01, indicating increasing returns to scale and cultivators are operating under sub optimal level, to increase the use of input level has to achieve the profit

Table 1. Trends in area, production and productivity of total fruits and mango in Himachal Pradesh

Year	Total fruits			Mango		
	Area (000'ha)	Production (000' MT)	Productivity (MT/ha)	Area (000'ha)	Production (000'MT)	Productivity (MT/ha)
2003-04	182.44	559.98	1.18	35.14	22.11	0.63
2004-05	186.90	692.01	2.61	36.21	59.73	1.65
2005-06	191.67	695.52	3.07	37.4	63.09	1.69
2006-07	197.45	369.10	3.70	38.37	40.15	1.05
2007-08	200.50	712.84	3.63	37.84	29.25	0.77
2008-09	204.63	628.08	1.87	38.44	38.75	1.01
2009-10	208.15	382.24	3.56	38.68	24.16	0.62
2010-11	211.30	1027.82	3.07	39.19	31.46	0.80
2011-12	214.57	372.82	1.84	39.56	28.97	0.73
2012-13	218.30	555.71	4.86	39.92	50	1.25
2013-14	220.71	866.34	1.74	40.29	25.4	0.63
2014-15	224.35	751.94	2.55	41.10	47.61	1.16
2015-16	226.80	928.83	3.93	41.52	37.62	0.91
2016-17	228.75	825.78	3.60	41.79	42.62	1.01
2017-18	230.85	565.30	2.44	41.98	31.35	0.74
2018-19	232.13	495.36	2.13	42.24	43.54	1.03
CGR (%)	1.60 (0.10)	1.10 (1.80)	1.20 (2.10)	1.10* (0.10)	0.10 (1.80)	-1.10 (1.70)

Source: National Horticulture Board, Note: *, ** significant at 1 and 5 per cent level, respectively

maximization. Similar results showed by Singh et al (2018). FYM and plant protection chemical were positive and statistically significant and which was in line with Ali et al (2019). The fertilizer was also positively related with the output and was highly significant. Chand et al (2017) also mentioned similar result. The 1 per cent change in FYM and fertilizer; will change yield by 0.39 and 0.48 per cent, respectively. The elasticity coefficient for human labour showed that one per cent increase would result 0.16 per cent decrease in the yield. This indicated irrational use of this inputs by the mango growers. This may be due to the availability of sufficient farm labour and strong financial power to hire more labour and similar results showed by Ali et al (2019).

Table 2. Farm specific characteristics of sampled households

Particulars	Value
Number of the family	80
Joint family (%)	43.75
Nuclear family (%)	56.25
Average family size (No.)	5.28
Male (%)	52.60
Female (%)	47.40
Sex ratio	901.14
Literacy rate (%)	93.90
Literacy index	2.81
Agriculture (%)	74.61
Service (%)	16.89
Business (%)	8.50
Average No. of workers	4.26
Average No. of dependents (< 14yrs &>65)	1.02
Dependency ratio w.r.t family size	0.19
Average cultivated area (ha)	0.55
Average orchard area (ha)	1.33
Average area under mango (ha)	1.18
Gross cropped area	2.38
Net sown area	1.88
Total land holding (ha)	2.26
Cropping intensity (%)	126.59

Table 3. Estimated production function for mango cultivation

Particulars	Coefficients	Standard error
Intercept	0.47	0.08
FYM	0.39**	0.11
Fertilizer	0.48*	0.11
Plant protection	0.14**	0.06
Labour	-0.16	0.10
$\sum_i^b$	1.01	
R^2	0.94	
F	416.67	
Adjusted	0.93	

Note: * and ** significant at 1 and 5 per cent level

Resource use efficiency: Resource use efficiency determines the efficiency with which a resource is used as mandated by its economically optimal level. When efficiency ratio is less than one, the resource is over utilized; when the ratio is greater than one, the resource is underutilized.

The MVP to MFC ratio is greater than one which indicates that the farmers are underutilizing the resource (Table 4). The efficiency ratio for FYM was (2.08) followed by fertilizers (1.39) and plant protection chemical (1.07) being was positive and greater than unity which means under utilization of resources and in usage would lead to profit maximization. Wagaleet al (2007) and Sharma and Kumar (2019) also observed that FYM and fertilizers was greater than unity indicating that these inputs were under-utilized and is due to the absence of technical knowledge. Farmers don't have proper knowledge about the particular disease affecting the crop. Labour however had a negative coefficient (-1.46) Efficiency ratio for human labour (-1.46) was less than unity which indicates that there was a need to reduce the use of human labour to get the optimum level of output. Wongnaa and Ofori (2012) obtained similar results for human labour. The adjustment in the MVPs for optimal resource use indicates that for optimum allocation of resources more than 51. 92 per cent increase in FYM was required, while approximately 28.06 per cent increase in fertilizer was needed. Similarly, over 6.54 per cent increase in plant protection chemical was needed. Human labour was over utilized and required approximately 168.49 per cent reduction for optimal use in mango production. Eze et al (2010) obtained similar results for human labour.

Constraints faced by mango growers: Due to wide fluctuation in prices, high wage rates, lack of technical knowledge, non-arability of healthy plant material, spurious chemicals and lack of irrigation and storage facilities, growers faced many problems in production and marketing (Table 5). The problems were categorized in two subgroups viz; production related problems and marketing related problems. Shortage of skilled labour and lack of technical knowledge were also intimated by more than 31 per cent and 33 per cent, respectively, High rates of chemicals were considered as the main problems by 31.25 per cent of average sampled farmers and small farmers were worst hit by these problems than the medium farm farmers. Irrigation is one of the critical inputs which directly affect the

productivity of mango. 33.75 per cent of the farmers reported lack of irrigation facilities in the study area. Majority of the growers reported that they remain unaware of exact information in respect of prices and supply available in different markets. The 53.75 per cent of the farmers in the study area reported the wide fluctuations in the price of mango as a major problem. The information regarding the market demand, arrival and prices prevailing in the market are very important as the same can affect the income of the growers. Mango produce being perishable, require immediate disposal. Due to lack of cool chain system, huge losses are borne by the participants of marketing process. The 43.75 per cent of the farmers face the problems of non-availability of storage facilities in the market. The producers got the inadequate and misleading in formations about the market prices spread showed by the market functionaries. Lack of proper transportation facility was significant in the study area as revealed by significant chi-Square value (6.06). These results are similar with those of Bharamappanavara et al (2013) and Sharma (2019).The Chi square test was also used to determine whether the problems identified by mango growers are farm category specific or farm category independent. Among these production problems, shortage of skilled labour and higher wages rates pointed out the mango growers differ significantly between the different farm categories. In case of marketing problems, lack of market information and harassment by middleman differs significantly in the farm categories. All other marketing

Table 4. Efficiency of resource use in mango cultivation

Particulars	Coefficients	APP	MPP	PY	MVP	MFC	r	Percent adjustment required
FYM	0.39	0.43	0.16	3500	584.50	280	2.08	51.92
Fertilizers	0.47	0.85	0.39	3500	1396.50	1000	1.39	28.06
Plant protection chemical	0.14	0.29	0.04	3500	140.00	130	1.07	6.54
Human labour	-0.16	0.92	-0.14	3500	-514.50	350	-1.46	-168.49

*APP= Average Physical Product, MPP= Marginal Physical Product, MVP=Marginal value product, MFC = Marginal Factor Cost

Table 5. Constraints faced by mango growers in the study area (Multiple response %)

Problems	Farm size				
	Marginal (35)	Small (24)	Medium (21)	Overall (80)	Chi square
Production constraints					
Shortage of skilled labour	17.14	33.33	52.38	31.25	11.78**
Higher wages rates	22.86	25.00	47.62	30.00	6.60**
Lack of technical knowledge	37.14	33.33	28.57	33.75	0.72
High Input cost	34.29	29.17	28.57	31.25	0.55
Desired brand not available	25.71	29.17	33.33	28.75	0.64
Non availability of healthy plant material	42.86	37.50	40.00	40.00	0.23
Lack of Irrigation facility not available	31.43	33.33	38.10	33.75	0.41
Diseases management	40.00	41.67	42.86	41.25	0.07
Marketing constraints					
Fluctuation in prices	62.86	58.33	33.33	53.75	5.54
Lack of storage facility	51.43	45.83	28.57	43.75	3.93
High commission charges	37.14	37.50	28.57	35.00	0.83
Lack of transportation facilities	44.29	35.42	19.05	35.00	6.06**
Lack of market information	34.29	37.50	38.10	36.25	0.19
Markets very far-off	31.43	29.17	23.81	28.75	0.65
Delay in payments	25.71	20.83	14.29	21.25	2.06
High dominance of market intermediaries	45.71	41.67	19.05	37.50	6.57**
Lack of market facility for processed products	37.14	33.33	19.05	31.25	3.50

Note: ** significant at 5 per cent level

problems do not differ significantly between the farm categories.

CONCLUSIONS

The resource use efficiency of mango cultivation has been estimated by Cobb-Douglas production function. The study has shown that FYM, fertilizers and plant protection chemicals were significantly affecting the mango production. These resources were under-utilized thus there is need for proper utilization of the resources for optimum level of output. The balanced use of these inputs by the orchardists can boost the mango productivity. Also, it was observed that the most important difficulty faced by the mango growers were shortage of skilled labour after that high wage rate, lack of transportation facilities, high dominance of market intermediaries, fluctuation in prices, etc. Mango has specific problem of alternate bearing leading many times to low yields or no yield. Short term training programs should be organized in the mango producing areas regarding the diseases management, timely application of fertilizers and insecticides and scientific methods of cultivation in order to enhance the skill of producers to maximize the net profit. Government subsidies can also help reduce the marginal input cost and hence improve efficiency. Mango production is a profitable enterprise in Himachal Pradesh and is in its mature state as depicted by positive and increasing returns to scale.

REFERENCES

Ali J, Kachroo J, Bhat DJ, Rizvi SEH, Sharma BC and Dwivedi S 2019a. Analysis of resource use efficiency in apple production on outer Himalayan range of Chenab valley. *Economic Affairs* **64**(1): 69-76.

Bharamappanavara SC, Mundinamani SM, Nail BK and Kiresur VR 2013. Resource use efficiency and constraints in farming in the tank commands: The case of North Eastern Karnataka. *Journal of Rural Development* **32**(3): 311-320.

Chand H, Guleria C, Guleria A and Kasyap R 2017. Resource use efficiency and marketing analysis of apple crop in Shimla district of Himachal Pradesh. *International Journal of Farm Sciences* **7**(1):154-159.

Cobb CW and Douglas PH 1928. A theory of production. supplement, papers and proceedings of the fortieth annual meeting of the American Economic Association. *American Economic Review* **8**(1): 139-165.

Directorate of Economics and Statistics 2019. *Statistical Outlines of Himachal Pradesh 2019*. Directorate of Economics and Statistics, Government of Himachal Pradesh.

Eze CC, Amanze B and Nwankwo O 2010. Resource use efficiency in arable crop production among smallholder farmers in Owerri agricultural Zone of Imo state, Nigeria. *Researcher* **2**(5): 14-20.

FAO 2019. *Food and Agriculture Organization of the United Nations.* FAOSTAT database. Website: http://www.fao.org.

Galan SV 2017. Trends in world mango production and marketing. *Acta Horticulturae* **5**(1): 351-364.

Gujarati DN, Porter DC and Gunasekar S 2012. *Basic Econometerics*, Tata McGraw Hill Education Pvt. Ltd., New Delhi, India, p87.

Kaur M, Sekhon MK and Joshi A 2014. Marketing pattern and price spread of guava in Punjab. *Indian Journal of Economic Development* **10**(1): 77-85.

Ministry of Commerce 2021. *Agriculture in India: Information about Indian Agriculture and Its Importance*. Available online at: https://www.ibef.org/ industry/agriculture-india.

Mitra SK 2016. Mango production in the world-present situation and future prospect. *Acta Horticulturae***11**(2): 287-296.

National Horticulture Board 2019. *Horticultural Data Base 2019*. National Horticulture Board, New Delhi.

Patil NA and Yeledhalli RA 2016. Growth and instability in area, production and productivity of different crops in Bengaluru division. *International Journal of Agriculture, Environment and Biotechnology* **9**(4): 599-611.

Rana R and Singhal R 2015. Chi-square test and its application in hypothesis testing. *Journal of the Practice of Cardiovascular Sciences* **1**(1): 69.

Sharma D 2019. *Economics of farming systems in Chamba district of Himachal Pradesh*. Ph.D. Thesis, University of Agriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya Palampur, Himachal Pradesh, India.

Sharma RR and Kumar S 2019a. Resource use efficiency of kinnow production in North-Western Himalayas: An economic study from Himachal Pradesh. *International Journal of Agriculture Sciences* **15**(1): 156-162.

Sharma RR and Kumar S 2019b. Resource use efficiency of kinnow production in North-Western Himalayas: An economic study from Himachal Pradesh. *International Journal of Agriculture Sciences* **15**(1): 156-162.

Singh P, Vaidya MK and Guleria A 2018. Economic efficiency of input use in peach cultivation in Himalayas. *Economic Affairs* **63**(3): 605-610.

Tambo JA and Gbemu T 2010. Resource use efficiency in tomato production in the Dangme district of Ghana. **In***: Conference on International Research on Food Security, Natural Resource Management and Rural Development*, Sep 14-16, 2010, ETH Zurich, Switzerland.

Wagale SA, Talathi JM, Naik VG and Malave DB 2007a. Resource use efficiency in Alphonso mango production in Sindhudurg district. *International Journal of Agricultural Sciences* **3**(1): 28-34.

Wongnaa CA and Ofori D 2012. Resource use efficiency in cashew production in Wenchi municipality, Ghana. *Agris on-line Papers in Economics and Informatics* **6**(2): 73-80.

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