

Research Article

Economic analysis and resource use efficiency of carrot production in Chitwan district, Nepal

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ABSTRACT

A study was conducted from February to May 2020 to analyze the cost-benefit economics analysis and resource use efficiency of carrot production in Chitwan, Nepal. Altogether 70 households producing carrot were selected randomly and surveyed through the pre-tested semi-structured interview-based schedule. Data was entered and coded using SPSS 25 and analyzed using STATA 12.1. The study revealed that the total variable cost per hectare for carrot production was US \$1803.1 and a benefit-cost ratio of 1.81 was estimated. Cobb-Douglas production function models the relationship between production output and production inputs. Production function analysis including seven explanatory variables, showed a significant positive effect of seed cost, tractor cost and human labor cost ($P<0.01$), fertilizer and manure cost ($P<0.05$) on gross return but herbicide cost, packaging cost, vitamin and micronutrients cost were found insignificant. The return to scale was found to be 1.42. According to estimated allocative efficiency indices, it is suggested to increase the seed, fertilizer and manure, tractor labor and human labor costs by approximately 45%, 74%, 67%, and 79% respectively and reduce the herbicide and packaging costs approximately by 116% and 246% respectively. The adoption of modern technologies with adjustments to resource use should be suggested to maximize the productivity and profit from carrot production.

Keywords: Allocative efficiency, Benefit-cost ratio, Cobb-Douglas production function, Economics, Return to scale

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INTRODUCTION

Carrot (*Daucus carota L.*) is one of the commercial crops of Nepalese farmers grown throughout the country for its fleshy edible root. It is mostly grown throughout the country from temperate to tropical regions. The total cultivated area of carrot in Nepal is about 3,354 ha with a productivity of 11.18 metric ton (Mt)/ha (MOAD, 2018/19). Having its greater nutritive and economic value, it has been felt needs to improve the production to exploit it to

its maximum potentiality. In the case of Chitwan, a carrot is heavily produced i.e. cultivated on 115 ha with a production of 2121 Mt and productivity of 14.14 Mt/ha (MOAD, 2018/19). Due to the comparative advantage and existence of a favorable climatic condition of Nepal, farmers are on the verge to get attracted to carrot cultivation.

Carrot is a cool-season crop. It consists of an adequate amount of Beta-carotene and has an appreciable amount of thiamine and riboflavin (Dais, 2012). Zhang and Hamauzu (2004) suggested that the consumption of carrot minimizes the risk of heart diseases, stomach diseases, and many types of cancer. It is also reported that carrot has anti-diabetic, cholesterol-lowering, anti-hypertensive, hepatoprotective, cardiovascular disease reducing, and wound healing benefits. In Nepal, people's preference towards carrot consumption is recently flourishing day by day as people are conscious of its constituents like natural antioxidants having anti-cancer properties. Thus, the demand for carrot is increasing and farmers are more attracted to carrot farming.

Carrot cultivation is a lucrative enterprise due to higher market demand and benefit-cost ratio of 1.52 (Adhikari, R.K., 2009). However, the productivity of carrot is subjected to many research questions that includes lack of proper management practices, insufficient use of modern technology, seed sources, and least area cropped for production. The productivity of carrot could be increased by using better scientific technology (Manjunah et al., 2013). Furthermore, due to its perishable nature farmers are compelled to lose a bulk of storage harvest (Bhattarai et al., 2017). Unavailability of quality seeds, improper management of disease, marketing problems like erratic fluctuation in market price, lack of technical knowledge of farmers are the pitfalls in carrot farming. Farmers with intention to get better benefits and to raise the productivity increase the use of resources irrationally since farmers are lacking appropriate management skills and are technically not sound. This is due to the lack of information regarding resource use efficiency (Adhikari et al., 2019). Thus, this study was conducted to analyze the economics of production and resource use efficiency of carrot production in Chitwan. Furthermore, this research would help the policy makers and researchers in identification of potential area for intervention as well.

MATERIALS AND METHODS

Study area and sampling design

The study was conducted at Chitwan district in Nepal, where the pocket area of carrot under the value chain development project is under implementation. Keeping in view the potentiality of carrot production and most important area for organic production of carrot in Nepal, Fulbari Municipality was purposively selected. Altogether 70 households were selected from the count of 250 carrot producers registered under the Agriculture Knowledge Center, Bharatpur through a simple random sampling technique. Farmers were categorized into 3 categories (namely small farms, medium farms, and large farms) based on the use of the area for carrot cultivation. The categorization was done by using 3 categories viz. mean - standard deviation, mean + standard deviation and range between mean - standard deviation and mean + standard deviation. Small farm (mean -standard deviation), medium farm (range of mean- standard deviation and mean + standard deviation) and large farm (mean + standard deviation). Small farms cultivated carrot in the area less than 14.93 kattha, large farm in area more than 46.01 kattha and medium farm in between 14.93 and 46.01 kattha. Pre- testing of

questionnaire was done in 10 percent of the sample size outside the study area and necessary change was incorporated through the suggestion of experts and farmers and final draft of questionnaire was finalized. Primary data were collected through administering a pre-tested semi-structured face to face household interview schedule, Key Informant Interview, and Focus Group Discussion in March 2020. Secondary data were collected from publications of Agriculture Knowledge Center Chitwan, Agriculture Information and Communication Centre, Central Bureau of Statistics (CBS), Nepal Agriculture Research Council, various Non-Governmental Organizations (NGOs)/International NGOs (INGO), journals, proceedings, books, and websites.

After the collection of the necessary information, it was coded and entered into the SPSS data entry sheet and descriptive analysis was done using SPSS version 25 for socio-economic characteristics such as gender, caste/ ethnicity, and quantitative data analysis was done in STATA 12.1.

Cost and Return Analysis

All the variable inputs incurred in carrot production namely human labor, tractor labor, seed, manure and chemical fertilizer, micronutrients and vitamins, herbicide, and packaging were considered and valued at the current market price to estimate the cost of production.

Variable cost = $C_{\text{labor}} + C_{\text{tractor}} + C_{\text{seed}} + C_{\text{manure and chemical fertilizer}} + C_{\text{micronutrient and vitamins}} + C_{\text{herbicide}} + C_{\text{Packaging}}$

Where, C_{labor} = Cost on human labor used (US \$/ha)¹, C_{tractor} = Cost on the tractor for land preparation (US \$/ha), C_{seed} = Cost on seed (US \$/ha), $C_{\text{manure \& chemical fertilizer}}$ = Cost on manure and chemical fertilizer (US \$/ha), $C_{\text{micronutrient \& vitamins}}$ = Cost on micronutrient and vitamins (US \$/ha), $C_{\text{herbicide}}$ = Cost on herbicide (US \$/ha), $C_{\text{packaging}}$ = Cost on packaging (US \$/ha)

Gross return was calculated by multiplying the quantity of carrot produced (kg) with an average price of carrot during harvesting (US \$/kg)². Furthermore, the undiscounted benefit-cost ratio was estimated as a ratio of gross return and total variable cost. The Benefit cost ratio (BCR) greater than 1 indicates the investment yields profit and feasibility of the business.

BCR was calculated by using the following formula as used by (Tunde *et al.*, 2015)

BCR = Gross return/ Total variable cost

To estimate the difference between gross return and variable costs, the calculation of gross margin was done. Gross margin was estimated by using the method as suggested by (Olukosi *et al.*, 2006) using formula:

Gross Margin (US dollar /hectare) = Gross Return (US dollar /hectare) – Total variable cost (US dollar /hectare)

Production Function Analysis

The production function systematically represents the relationship between the different

¹ US \$/ha= US dollar per ha,

² US \$/kg= US dollar per kilogram

amounts of inputs that can be used to produce a product and its corresponding output. It describes the Laws of proportion, i.e., the transformation of factor inputs into factor output at any particular time period. The production function represents the technology of firm, or an industry or the economy as whole, and it includes all the technically efficient methods of production (Chowdhury & Islam, 2015). A large number of agricultural researches used the Cobb-Douglas production function for determining the production function analysis (Prajneshu, 2008). The following form of Cobb-Douglas production function was fitted to analyze resource productivity, efficiency, and return to scale (Saha *et al.*, 2004).

$$Y = aX_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_7^{b_7} e^u$$

To estimate the parameters, the usual procedure is to assume a multiplicative error $\exp(\varepsilon)$ so that the model may be linearized by means of logarithmic transformation and the method of least squares was used and goodness of fit is assessed by computing coefficient of determination (Prajneshu, 2008).

Taking log on both sides,

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7$$

Where, Y=Gross return (NRs/ha), X_1 = Cost on seed (US \$/ha), X_2 =Cost on manure/fertilizer (US \$/ha), X_3 = Cost on micronutrient and vitamins (US \$/ha), X_4 =Cost on herbicide (US \$/ha), X_5 =Cost on tractor labor (US \$/ha), X_6 = Cost on human labor (US \$/ha), X_7 =Cost on packaging (US \$/ha), e = Base of the natural logarithm, u =Random disturbance term, \ln = Natural log, b_1, b_2, \dots, b_7 represent Coefficients of respective variables.

For the calculation of return to scale on carrot production, coefficients from linearized Cobb-Douglas production function was used and calculated by summing coefficients of all explanatory variables. If the sum of the coefficients is larger than one, the production function has increasing returns to scale. If the sum of the coefficients is less than one, returns to scale are decreasing, while the sum of coefficient equal to one indicates constant returns (Cobb & Douglas, 1928).

Resources use efficiency

The allocative efficiency of a resource used was determined by computing the ratio of the Marginal Value Product (MVP) of the input variable and the Marginal Factor Cost (MFC) for the input and tested for its equality to one viz. $(MVP/MFC)=1$. The marginal fixed cost was considered as 1 for all the input's cost. The marginal value products (MVPs) of the input used were estimated by multiplying the Average value product (AVP) of an input with its elasticity of production (b_i). Elasticity of production was obtained in production function analysis. AVP was obtained by dividing the geometric mean of output to the geometric mean of input. The efficiency of resource use was calculated as suggested by (Goni *et al.*, 2013).

$$r = MVP/MFC$$

Where, r = Efficiency Ratio, MVP= Marginal value product of variable input, and MFC= Marginal factor cost. Furthermore, $MVP = dy/dx$, which is the product of the regression coefficient with the ratio of a geometric mean of gross return to the level of use of the respective resource.

Percentage adjustment required or Divergence (%) was calculated as adopted by (Mijindadi, 1980) Or, $D = (1-1/r) \times 100$

Where D = absolute value of percentage change in MVP required in each resource

RESULTS AND DISCUSSION

Socio-economic characteristics of the sampled respondents

Out of 70 respondents, 71.4% of the respondent were male and 28.6% of the respondent were female in the study area. The study revealed, 60% of the respondent belonged to Brahmin ethnicity followed by 18.8% Chettri, and 12.5% Janjati/Indigenous. The majority of the respondent in the study area have completed SLC i.e. 26% followed by respondent below SLC (20.8%), intermediate level (17.1%), Literate (15.7%), Bachelor (14.3%), Illiterate (4.7%), and Master (1.4%). Similarly, 91.4% of the respondent have agriculture as the main occupation followed by 5.7% employed as teachers and 2.9% employed in the private/government office.

Cost of Production of carrot in Chitwan district of Nepal

Economics has a paramount role in the sustainability and development of carrot cultivation. Table 1 represents the items of the variable cost incurred during the cultivation process among the farmer's category. The total variable cost or the production cost for carrot cultivation was estimated to be US \$1803.1 per hectare. The total variable cost per hectare was estimated US \$1803.1 in the study area, which was statistically higher and significant ($P < 0.01$) in large farms compared to small and medium farms. Among the various items of variable cost, cost difference was significant ($P < 0.01$) with seed cost, fertilizer/manure cost, micronutrient and vitamin cost, tractor cost, and human labor cost. Packaging cost had significant difference ($P < 0.05$) and herbicide cost had no significant difference at all depicting all the three categories had uniform herbicide use.

Table 1: Average cost of various variable cost for carrot cultivation

Variable cost item (US \$/hectare)	Small farms(n=11)	Medium farms(n=43)	Large farms(n=16)	Overall(N=70)	F-value
seed cost	US \$713.86	US \$853.74	US \$881.99	US \$838.22	9.272***
Fertilizer/manure cost	US \$207.71	US \$249.65	US \$261.92	US \$245.87	11.76***
Micronutrient and vitamin cost	US \$41.77	US \$61.40	US \$82.03	US \$63.03	8.563***
Herbicide cost	US \$15.81	US \$15.78	US \$17.50	US \$16.35	0.234
Tractor cost	US \$262.45	US \$215.64	US \$290.77	US \$240.1	4.98***
Packaging cost	US \$97.2	US \$100.9	US \$120.2	US \$104.7	2.512**
Human labor cost	US \$243.1	US \$290.3	US \$350.1	US \$296.5	19.66***
Total variable cost	US \$1580.2	US \$1785.7	US \$2002.7	US \$1803.1	21.00***

Notes: *** and ** represent 1% and 5% levels of significance respectively.

Source: Field survey 2020

Among the variable cost items, the cost of seed per hectare amounted to US \$838.22. The cost of seed amounted 46.49% to total variable cost in carrot production. This is corroborated by the fact that major portion of seed were imported from the Japan. The cost of fertilizer/manure was US \$245.87 per hectare and it contributed 13.63% to total variable cost. The cost of the tractor was US \$240.1 per hectare and cost of human labor amounted to US \$296.5 per hectare with the percent share of 13.31% and 16.44% respectively. However, the cost of micronutrients and vitamins was US \$63.03 per hectare, cost of herbicide was US \$16.35 per hectare, and cost of packaging was US \$104.7 per hectare with a minimal share of

3.49%, 0.9%, and 5.8% respectively to the total variable cost.

Table 2: Percentage share of items of variable cost on total variable cost

Items of variable cost	Mean	Percent on variable cost
seed cost	US \$838.22	46.49
Fertilizer/manure cost	US \$245.87	13.63
Micronutrients and vitamin	US \$63.03	3.49
Herbicide cost	US \$16.35	0.9
Tractor labor cost	US \$240.1	13.31
Packaging cost	US \$104.7	5.8
Human labor cost	US \$296.5	16.44
Total variable cost	US \$1803.1	

Field survey: 2020

Returns from the Carrot Production

Total variable cost per hectare, gross return per hectare, gross margin per hectare, and benefit-cost ratio from carrot production among the farmer's category were presented (Table 2). The gross return per hectare from carrot production was estimated as US \$3297.62 which was found to be significantly different ($P < 0.01$). The gross margin per hectare was found to be US \$1607.32 which was significantly different ($P < 0.01$) among the farmer's category. The undiscounted BCR is simply the ratio of gross return to the total variable cost incurred during the production process. The BCR was estimated to be 1.81 considering overall variable cost which was significantly different ($P < 0.01$) among the farmer's category. Thus, it was found that carrot production was profitable in the study area. This finding was in line with Adhikari, R.K., (2009), where author had found benefit-cost ratio of 1.52 in organic carrot cultivation and benefit-cost ratio of 1.44 in inorganic carrot cultivation.

Table 1: Comparison of variable cost, gross return, gross margin and b:c ratio among farmer's category

Particulars(US \$/ha)	Small farms(n=11)	Medium farms(n=43)	Large farms(n=16)	Overall(N=70)	F-value
Total variable cost	US \$1580.2	US \$1787.7	US \$2002.7	US \$1803.1	21.00***
Gross Return	US \$2431.83	US \$3181.2	US \$4206	US \$3297.62	39.574***
Gross margin	US \$1545.7	US \$1401.37	US \$2203.2	US \$1607.32	16.16***
B:C ratio	1.54	1.78	2.1	1.81	22.91***

*Notes: *** represent 1% level of significance*

Source: Field survey 2020

Resources Use Efficiency on carrot production

The estimated value of the coefficients and related statistics of the Cobb-Douglas production function is presented in table 3. The coefficient of determination (R^2) was 0.67, which depicts that the model as fitted explained 67% of the variability in gross return from carrot production was due to independent variables considered in the model. The value of adjusted R^2 was 0.634 portraying that 63% of the variation in the dependent variable was explained by the explanatory variables included in the model while accounting degree of freedom. The F-value was found to be 18.00, which is highly significant ($P < 0.01$) which depicts that all the inputs included in the model were important for explaining the variation in gross return obtained from carrot production in the study area.

Out of 7 independent variables included in the regression analysis, seed cost, tractor cost, and human labor were significant at a 1% level of significance; fertilizer and manure cost was significant at a 5% level of significance, and micronutrient & vitamin cost was found significant at 10% level of significance while herbicide cost and packaging cost were found insignificant. The regression coefficient of seed cost was 0.474 which had depicted that with a 100% increase in seed cost, the gross return could be increased by 47% keeping all other factors constant. The finding was consistent with Dhakal *et al.*, (2015) who have reported seed amount had a positive and significant contribution to mustard production in the Chitwan district. The regression coefficient of fertilizer and manure cost was 0.285 which indicates that with a 100% increase in fertilizer and manure cost, the gross return could be increased by about 28.5%. The result was in harmony with Wongnaa & Ofori (2012), who have reported fertilizer and manure cost had a positive and significant contribution to Cashew production in Wenchi Municipality, Ghana. The regression coefficient of tractor cost was found 0.209, which signifies a 100% increase in tractor, gross return could be increased by 21%, keeping other factors constant. The regression coefficient of human labor cost was 0.405 which indicates that with a 100% increase in human labor cost, the gross return could be increased by about 40.5%. The finding aligned with Dhakal *et al.*, (2015), who have reported positive and significant contribution of human labor and tractor labor on mustard production in the Chitwan district. The regression coefficient of micronutrient & vitamin cost was found 0.073, which signifies a 100% increase in micronutrient & vitamin cost, gross return could be increased by about 7.3%, keeping other factors constant.

The sum of the regression coefficients of different inputs was found 1.425 for carrot production. This signifies that the production function exhibited an increasing return to scale indicating that if all the inputs specified in the function are increased by 100%, income will increase by about 142%. A similar finding was found in Wongnaa & Ofori, (2012); Goni *et al.*, (2007).

The estimated MVP of different inputs used in carrot production is presented in (Table 4). The study revealed that the ratio of MVP to MFC of the seed cost, fertilizer and manure cost, micronutrient & vitamin cost, tractor cost, and human labor cost was positive and greater than one indicating their underutilization. The finding was consistent with Wongnaa & Ofori (2012), who have reported underutilization of fertilizer in Cashew production in Wenchi Municipality, Ghana. A similar finding was found in Dhakal *et al.* (2015), who have reported underutilization of seed, human labor, and tractor labor in mustard production in Chitwan district. The finding was also aligned with Awunyo-Vitor *et al.*, (2016), who reported underutilization of seed, fertilizer and manure among maize growers in Ghana. Similarly, for herbicide cost ratio is negative indicating the overutilization of resource. The finding was aligned with (Stephen *et al.*, 2015), who have reported overutilization of pesticide and herbicide in tomato production in Kogi state, Nigeria. Likewise, packaging cost's ratio of MVP to MFC is positive and less than one indicating overutilization of resources.

Table 4: Estimated value of the coefficients and related statistics of Cobb-Douglas production function from Carrot Production

Factors	Coefficient	Standard error	t-value
Constant	-2.59*	1.52	-1.70
Seed cost (US \$/hectare)	0.474***	0.132	3.58
Fertilizer and manure cost (US \$/hectare)	0.285**	0.127	2.25
Micronutrient and vitamin cost (US \$/hectare)	0.073*	0.044	1.65
Herbicide cost (US \$/hectare)	-0.025	0.065	-0.39
Tractor cost (US \$/hectare)	0.209***	0.044	4.73
Human labor cost (US \$/hectare)	0.405***	0.107	3.76
Packaging cost (US \$/hectare)	0.009	0.06	0.15
R ² value	0.6702		
Adjusted R ²	0.634		
F ratio	18.00***		
Return to scale	1.425		

Notes: ***, ** and * represent 1%, 5% and 10% level of significance respectively.

Source: Field survey 2020

Table 5: Estimates of measures of allocative efficiency of inputs used in carrot production

Inputs (NRs/hectare)	Geometric mean	Coefficient	MV P	MF C	MVP/M FC	Efficiency	Percent adjustment(D)
Seed cost	97028.70	0.474	1.83	1	1.83	under utilized	45.25
Fertilizer and manure cost	28498.45	0.286	3.79	1	3.79	under utilized	73.62
Micronutrient and vitamin cost	6711.83	0.074	4.15	1	4.15	under utilized	75.90
Herbicide cost	1534.1	-0.025	6.13	1	-6.13	over utilized	116.31
Tractor cost	26160	0.209	3.79	1	3.79	under utilized	66.82
Human labor cost	34089.20	0.405	4.47	1	4.47	under utilized	77.82
Packaging cost	11684.62	0.009	0.28	9	0.289	over utilized	246

Source: Field survey 2020

The adjustment in the MVPs for optimal resource use in Table 5 suggested that for optimal allocation of resources, seed, fertilizer & manure, micronutrient & vitamin, tractor labor and human labor costs were required to increase by approximately 45%, 74%, 76%, 67%, and 79% respectively. On the other hand, herbicide and packaging cost were required to be reduced by approximately 116% and 246% respectively.

CONCLUSION

The study showed that carrot production in the study area is a lucrative enterprise though productivity is yet to be realized to its maximum potential. The analysis of the resource use efficiency indicated that none of the resources were utilized to the optimum level which might be the reason for not acquiring the potential benefits from the enterprise. Thus,

optimum economic advantage from per hectare of land could be realized by increasing the level of under-utilized resources principally seed, fertilizer & manure, micronutrient & vitamin, tractor labor, and human labor, and by decreasing the levels of over-utilized resources namely herbicide and packaging. Thus, if a judicious use of resources could be assured, carrot production could be a more viable and entrancing commercial enterprise for people seeking self-sufficiency in food and income.

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Authors Contribution

B.S designed and performed experiments; B.S, S.P, S.G, G.A, B.S and S.B analyzed the data and B.S. prepared the manuscript in consultation with K.M.T. and S.B; K.M.T. approved the final manuscript.

Conflict of authors

The authors declare that there is no conflict of interest regarding the publication of this paper.

REFERENCES

- Adhikari, R.K. (2009). Economics Of Organic Vs Inorganic Carrot Production in Nepal. *The Journal of Agriculture and Environment*, 9, 23-28. DOI: <https://doi.org/10.3126/aej.v10i0.2127>
- Awunyo-Vitor, D., Wongnaa, C.A., & Aidoo, R. (2016) Resource use efficiency among maize farmers in Ghana. *Agric & Food Secur* 5, 28. DOI: <https://doi.org/10.1186/s40066-016-0076-2>
- Bhattarai, D.R., Subedi, G.R., Gautam, I.P., & Chauhan, S. (2017). Postharvest Supply Chain Study of Carrot in Nepal. *International Journal of Horticulture*, 7, 39-43. DOI: <https://doi.org/10.5376/ijh.2017.07.0026>
- Chowdhury, M.S.R., & Islam, M.T. (2015). An Analysis of the Production Function of Ready-Made Garments Industry in Bangladesh: A Case of Tex-Town Group Limited. *International Journal of African and Asian Studies*, 14, 1-6
- Cobb, C.W., & Douglas, P.H. (1928). A theory of Production . *American Economic Review*, 139-165.
- Dais, J. (2012). Nutritional Quality and Health Benefits of Vegetables: A Review. *Food and Nutrition Science*, 3(10), 1354-1374. doi:10.4236/fns.2012.310179
- Dhakal, S.C., Regmi, P.P., Thapa, R.B., Sah, S.K., & Khatri-Chhetri. D.B. (2015). Resource use efficiency of mustard production in Chitwan district of Nepal. *International Journal of Applied Sciences and Biotechnology*, 3(4), 604-608. DOI: <https://doi.org/10.3126/ijasbt.v3i4.13525>
- Goni, M., Mohammed, S., & Baba, B. A. (2007). “Analysis of Resource-Use Efficiency in Rice Production in the Lake Chad Area of Borno State, Nigeria. *Journal of Sustainable Development in Agriculture & Environment* , 31-37.
- Goni, M., Umar, M.S.S., & Usman, S. (2013). Analysis of Resource-Use Efficiency in Dry Season Vegetable. *Journal of Biology, Agriculture and Healthcare*, 18-32.

- Manjunah, K., Dhananjaya Swamy, P.S., Jamkhandi, B.R., & Nadomi, N.N. (2013). Resource use efficiency of Bt. cotton and non-Bt. cotton in Haveri District of Karnataka. *International Journal of Agriculture Food Science and Technology*, 4(3), 253–258
- Mijindadi, N.B. (1980). Production efficiency on farms in northern Nigeria. Cornell University.
- MOAD. (2018/19). Statistical information on Nepalese Agriculture. Singhadurbar, Kathmandu: Agri Business Promotion and Statistics Division.
- Olukosi, J.O., Isitor, S.U., & Ode M.O. (2006). Introduction to agricultural marketing and prices: principle and application. *American J. Agri and Forestry*, 199-205.
- Prajneshu. (2008). Fitting of Cobb-Douglas Production Function: Revisted. *Agricultural Economics Research Review*, 21(2), 289-292. doi: <https://doi.org/10.22004/ag.econ.47684>.
- Raut, R. (1996). *Consultancy report on vegetable seed quality control (Field Inspection)* . Kathmandu: HMG/FAO Fresh vegetable and vegetable seed production project.
- Saha, N.C., Alam, J., Al-Imran, M., & Islam, M.S. (2004). Comparative economic analysis of pond fish production in Mymensingh and Jessore District, Bangladesh. *Bangladesh Journal of Fish Research*, 8(2), 151-156.
- Stephen, I., Shaibu, U., & Omole, B. (2015). Analysis of Resource Use Efficiency in Tomato (*Solanum lycopersicum*) Production in Kogi State, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology*, 6, 220-229. DOI: <https://doi.org/10.9734/AJAEES/2015/18112>.
- Tunde, A.B., Kuton, M.P., Oladipo, A.A., & Olanikanmi, L.R. (2015). Economic Analyze of Costs and Return of Fish Farming in Saki-East Local Government Area of Oyo State, Nigeria. *Journal of Aquaculture Research & Development*, 6(2). Retrieved from <https://doi.org/10.4172/2155-9546.1000306>.
- Wongnaa, C.A., & Ofori, D. (2012). Resource-use Efficiency in Cashew Production in Wenchi Municipality, Ghana. *Agris on-line Papers in Economics and Informatics*, 73-80.
- Zhang, D., & Hamauzu, Y. (2004). Phenolic compound and their antioxidant properties in different tissues of carrots (*Daucus carota* L.). *Journal of Food, Agriculture and Environment*, 95-100.