International Journal of Advance and Applied Research (IJAAR)
Peer Reviewed Bi-Monthly
ISSN – 2347-7075
Impact Factor –7.328
Vol.9 Issue. 3 Jan-Feb-2022

# ESTIMATED COBB-DOUGLAS PRODUCTION FUNCTION FOR DIFFERENT SIZE GROUPS OF KAGZI LIME GROWERS IN DHULE REGION

**Dr. D. B. Dhangar[1], Kunal D. Rajale[2]**
[1]*Department of Chemistry, BSSPM's, Arts, Commerce and Science College, Songir, Dhule, (M.S.) India*
[2]*M.Sc. (Agri.) Ex. Student, Department of Agricultural Economics, SHUATS Prayagraj, India*
*E-mail : dnyanba1967@gmail.com*

**Abstract:**

Dhule district is one of the kagzi lime growing district of Maharashtra. The Dhule district will be purposively selected for the study. Three villages from one tehsil and two villages from second tehsil were selected on the basis of maximum area under kagzi lime. The empirical evidences from previous studies suggest that amongst the many mathematical functions, Cobb-Douglas type of production function is the appropriate one for the study of resource productivity, because it specifies diminishing productivity and diminishing marginal rate of substitution among the factor and gives specific diminishing, increasing or constant returns. All the relevant data required for study purpose were collected by survey method with the help of schedules specially designed for the purpose. Collections of data were done by personal interview with the sample growers. The resource use productivities in kagzi lime cultivation for different size group of farms, it was observed that all eight variables *viz.*, human labour ($X_1$), bullock labour ($X_2$), manures ($X_3$), nitrogen ($X_4$), phosphorus ($X_5$), irrigation ($X_7$) plant protection ($X_8$), included in the production function analysis have jointly explained 76 per cent of the total variation in the output of kagzi lime.

***Keywords:*** *Kagzi lime, Cobb-Douglas production function, Dhule District*

**Introduction:**

Lime is known all over the world for its tart, tangy juice as well as its distinctive flowery aromas. Citrus aurantifolia Swingle (Kagzi limes) belongs to the Rutaceae family. The fruit is a South East Asian native. Kagzi lime has a global region of 1.06 million hectares and a volume of 16.25 million tonnes. The small-fruited kagzi lime, also known as "Mexican or main lime" in the United States and "Kagzi Lime" in India, is one of the most widely

grown lime cultivars. In Maharashtra, improved kagzi lime varieties such as Pramalini, Vikram, Sai Sarbati, Phule Sarbati, PKM1 and Balaji have been added. Kagzi lime is cultivated in Dhule district of Maharashtra State. Cultivated area under kagzi lime was 335 hectares with production of 3777.60 tones during 2018-19 (DAO -2019 Dhule).

In Maharashtra and India, various studies on the cost of production and marketing of various fruit crops have been performed. Nighot *et al. (*1986) studied the economics of production of orange in selected villages of Nagpur district. Mahalle *et al*. (1987) worked out per hectare cost of establishment of Kagzi lime orchard. Anonymous (1989) studied, Production of Kagzi lime in Nagpur district. Raikar (1990) studied production and marketing of Cashew in Karnataka. Anonymous (1997) worked out the economics of cultivation of Pomegranate in western Maharashtra. Gangawar *et al.* (2005) studied economic evaluation of Kinnow mandarin cultivation in Punjab. Bhole *et al.* (1992) conducted study on price spread in marketing of oranges in Amravati and Nagpur district. Adaskar (1998) made economic analysis of marketing of kagzi lime in Akola district. Singh (2006) studied on marketing of Citrus fruits in Mid-hills of Jammu and Kashmir. Patil (1975) in his study on Economics of Pomegranate cultivation in Rahuri region of Ahmednagar district, Maharashtra employed Cobb-Douglas type of production function to examine the resource productivities. Christian *et al.* (2015) studied that major problems felt by lime growers were low market prices, high commission charges, weed infestation, plant protection problems, inadequate transport facilities or high transportation charges, lack of fertilizers, high cost of fertilizer, labour shortage, and so on. Most of the reviews showed Cobb-Douglas production function in resource productivity analysis. In production function land, human labour, bullock labour and fertilizer were considered as important resource in which hired human labour, bullock labour and manure was mostly positive and significant resource.

**Selection of the Study Area:** Dhule district is one of the kagzi lime growing district of Maharashtra. The Dhule district will be purposively selected for the study. Two tehsils Sindkheda and Dhule tehsil of Dhule district contributes major part of area under kagzi lime. Therefore these two tehsils selected for the study.

**Selection of Villages:** Three villages from one tehsil and two villages from second tehsil were selected on the basis of maximum area under kagzi lime. Thus, in all villages were selected from these tehsils. The details are given in Table 1,

**Table 1: Distribution of Selected Kagzi Lime Growers in Different Groups**

| Sr. No. | Name of village | Marginal | Semi-medium | Medium | Large | Total |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| **1** | **Dhule** | | | | | |
| i. | Songir | 5 | 5 | 5 | 5 | 20 |
| ii. | Kapadne | 5 | 5 | 5 | 5 | 20 |
| iii. | Devbhane | 5 | 5 | 5 | 5 | 20 |
| **2** | **Shindkheda** | | | | | |
| i. | Betawad | 5 | 5 | 5 | 5 | 20 |
| ii. | Chimthane | 5 | 5 | 5 | 5 | 20 |
| | **Total** | 25 | 25 | 25 | 25 | 100 |

**Selection of Kagzi Lime Cultivators**

The list of cultivators having kagzi lime orchards from these villages was arranged in ascending order. The cultivator was categorized into four groups on the basis of the actual area under kagzi lime orchard.

**Group I :** Marginal = Below 1.00 ha.

**Group II :** Semi-medium = 1.00 – 2.00 ha

**Group III :** Medium = 4.00 – 10.00 ha

**Group IV:** Large = 10.00 ha and above

25 sample cultivators from each of these groups (Table 1) were selected. 20 cultivators were selected from each village. Thus, in all 100 sample cultivators was selected randomly from all the categories.

**Functional Analysis**

Production of kagzi lime involved relationship between inputs and their outputs. It provides a tool by mean of which the problems of production analyzed. The empirical evidences from previous studies suggest that amongst the many mathematical functions, Cobb-Douglas type of production function is the appropriate one for the study of resource productivity, because it specifies diminishing productivity and diminishing marginal rate of substitution among the factor and gives specific diminishing, increasing or constant returns. The data were therefore, subjected to functional analysis by using the following type of Cobb-Douglas production function

$$Y = a X_1^{b1} X_2^{b2} \text{---------- } Xn + e^{u}.$$

In this functional formula 'Y' is dependent variable, Xi's are independent resource variables, 'a' is constant representing intercept of the production function and bi's are the regression coefficients. In logarithmic terms, this function transforms into a linear form of the following type.

$$\text{Log } Y = \log a + b_1 \log X_1 + b_2 \log X_2 + \text{-------- } + bn \log Xn + u \log e.$$

For fitting the production function, eight inputs *viz.*, human labour, bullock labour, manure, nitrogen, phosphorus, potassium, irrigation and plant protection have been considered as

important factors in the production of crop. The output of the crop has been used as dependent variable. The equation fitted was at the following from

$Y = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}X_7^{b7}X_8^{b8}$

Where,

Y = Output of main produce (q/ha)

$X_1$ = Human labour (man days/ha)

$X_2$ = Bullock (pair days/ha)

$X_3$ =Manures (q/ha)

$X_4$ = Nitrogen (kg/ha)

$X_5$ = Phosphorus (kg/ha)

$X_6$ = Potassium (kg/ha)

$X_7$ = Irrigation (₹/ha)

$X_8$ = Plant protection (₹/ha)

u = Error term

a = Intercept

bi's = Regression coefficient

**Marginal Farmers Groups:** The value of coefficient of multiple determinations ($R^2$) was found to be 0.89 per cent that means 89 per cent variation in output was jointly explained by the eight independent resource variables under consideration. The regression coefficient of nitrogen ($X_4$) and irrigation ($X_7$) was positive at 1 per cent level of significance. Bullock labor ($X_2$), manures ($X_3$) was positive and significant at 5 per cent level of significance. The regression coefficient of potassium ($X_6$) was positive and significant at 10 per cent level of significance. This indicates that there is scope to increase the use of these resources to increase the production. As we consider at the small size group, positive and significant coefficients indicated that, one per cent increase in the use of bullock labour ($X_2$), manures ($X_3$), nitrogen ($X_4$), potassium ($X_6$), irrigation ($X_7$) and plant protection ($X_8$) will increase the yield by 0.17, 0.10, 0.24, 0.10, 0.09 and 0.20 respectively. The increase in the use of manures by one percent yield will increase the output by 0.10 per cent.

**Semi-Medium Farmers Group**

The estimated parameters of human labour ($X_1$), manure ($X_3$), nitrogen ($X_4$) , potassium ($X_6$), irrigation ($X_7$) and plant protection charges ($X_8$) were significant indicating there by that for every one unit increase in the expenditure on these resources would results in increased gross return by 0.32 per cent, 0.12 per cent, 0.20 per cent, 0.11 per cent, 0.04 per cent, 0.16 per cent respectively. The value of coefficient of multiple determinations ($R^2$) was

found to be 0.82 per cent that means 82 per cent variation in output was jointly explained by the eight independent resource variables under consideration. In case of medium size group, positive and significant coefficients indicated that, one unit increase in the use of manures($X_3$) and nitrogen ($X_4$) will increase the yield by 0.12 and 0.20 per cent, respectively. However, bullock labour ($X_1$), irrigation($X_8$) were not significant but positive, it indicate that they have positive impact on output. But phosphorus ($X_5$) was negative and not significant.

**Medium Farmers Group**

The estimated parameters of human labour ($X_1$), manure ($X_3$), nitrogen ($X_4$) , potassium ($X_6$), irrigation ($X_7$) and plant protection charges ($X_8$) were significant indicating there by that for every one unit increase in the expenditure on these resources would results in increased gross return by 0.32 per cent, 0.12 per cent, 0.20 per cent, 0.11 per cent, 0.04 per cent, 0.16 per cent respectively. The value of coefficient of multiple determinations ($R^2$) was found to be 0.82 per cent that means 82 per cent variation in output was jointly explained by the eight independent resource variables under consideration. In case of medium size group, positive and significant coefficients indicated that, one unit increase in the use of manures($X_3$) and nitrogen ($X_4$) will increase the yield by 0.12 and 0.20 per cent, respectively. However, bullock labour ($X_1$), irrigation($X_8$) were not significant but positive, it indicate that they have positive impact on output. But phosphorus ($X_5$) was negative and not significant.

**Large Farmers Group**

In case of large size group of holding, the value of coefficient of multiple determinations $R^2$ was found to be 0.76 per cent that means 76 per cent variation in output was jointly explained by the eight independent variables under consideration. The regression coefficient of human labour($X_1$), manures ($X_3$), nitrogen ($X_4$) and irrigation ($X_7$) were positive and significant at 1 per cent level of significance. Potassium ($X_6$) was positive and significant at 5 per cent level of significance. If we increase one unit of human labour ($X_1$), manures ($X_3$) nitrogen($X_4$) and irrigation ($X_7$) will increase the yield by 0.29, 0.12, 0.29 and 0.12 percent, respectively. However bullock labour ($X_2$), and plant protection ($X_8$) were positive and not significant but phosphorous was negative and non-significant.

**Overall Level**

At the overall level, coefficient of multiple determinations ($R^2$) was found to be 0.79 indicating that 79 per cent variation in output is jointly explained by the above considered independent variables. The regression coefficient of human labour ($X_1$) and plant protection ($X_8$) were positive and non-significant at the overall level but phosphorus was negative and non-significant. The regression coefficient of bullock labour ($X_2$), manures ($X_3$) and nitrogen

($X_4$) were positive and significant at 1 percent level of significance. The regression coefficient of potassium ($X_6$) and irrigation ($X_7$) were positive and significant at 5 per cent level of significance. The positive and significant coefficients indicated that, one per cent increase in the use of bullock labour ($X_2$), manures ($X_3$), nitrogen ($X_4$), potassium ($X_6$) and irrigation ($X_7$) will increase the yield by 0.10, 0.17, 0.18, 0.09, and 0.04 per cent, respectively. The increase in the use of manures by one per cent will increase the yield by 0.17 percent.

**Estimated results Cobb-Douglas production function for different size groups of kagzi lime growers:**

| Sr. No. | Particulars | Unit | Group | | | | |
|---|---|---|---|---|---|---|---|
| | | | Marginal | Semi-medium | Medium | Large | Overall |
| 1 | Intercept | | 0.981 | 1.148 | 1.148 | 1.261 | 1.132 |
| 2 | Human Labour ($X_1$) | Days | 0.062 (0.116) | 0.328** (0.157) | 0.328** (0.157) | 0.295*** (0.106) | 0.20325*** (0.13) |
| 3 | Bullock Labour ($X_2$) | Days | 0.178** (0.069) | 0.010 (0.101) | 0.010 (0.101) | 0.004 (0.096) | (0.05) (0.3115) |
| 4 | Manure ($X_3$) | q | 0.107** (0.041) | 0.126** (0.057) | 0.126** (0.057) | 0.125*** (0.034) | 0.1185*** (0.04) |
| 5 | Nitrogen ($X_4$ ) | kg | 0.248*** (0.082) | 0.204** (0.101) | 0.204** (0.101) | 0.293*** (0.104) | 0.23975** (0.09) |
| 6 | Phosphorus ($X_5$) | kg | -0.024 (0.032) | -0.021 (0.041) | -0.021 (0.041) | -0.031 (0.018) | -0.02433 (0.03) |
| 7 | Potassium ($X_6$) | kg | 0.083* (0.043) | 0.005 (0.112) | 0.005 (0.112) | 0.041** (0.020) | 0.0335** (0.06) |
| 8 | Irrigation charges ($X_7$) | ₹ | 0.097*** (0.030) | 0.012 (0.022) | 0.012 (0.022) | 0.124*** (0.040) | 0.06125 (0.02) |
| 9 | Plant protection charges ($X_8$) | ₹ | 0.021 (0.111) | 0.164** (0.08) | 0.164** (0.08) | 0.009 (0.041) | 0.0795 (0.07) |
| 10 | $R^2$ | | | 0.89 | 0.82 | 0.76 | 0.79 |

Indicate significant at 1 ,5 and 10 per cent level respectively.

(Figures in the parenthesis are the standard errors of the respective regression coefficient)

This indicated that one unit increased in the bullock labour ($X_2$), manures ($X_3$), nitrogen ($X_4$), potassium ($X_6$), irrigation ($X_7$) and plant protection ($X_8$) would result into 0.10 per cent, 0.17 per cent, 0.18 per cent, 0.13 per cent, 0.04 per cent and 0.13 per cent increase in the output, respectively, other resources like human labour ($X_1$) and phosphorous ($X_5$) were found non-significant.

**Result and Discussion:**

Data for the present study were collected from two tahsils of Dhule district *viz.*, The tahsils were selected purposively according to area under kagzi lime. In all six

villages, three villages from each tahsil were selected randomly and from six villages 90 kagzi lime farmers were selected on the basis of actual area under kagzi lime orchard. All the relevant data required for study purpose were collected by survey method with the help of schedules specially designed for the purpose. Collections of data were done by personal interview with the sample growers. The resource use productivities in kagzi lime cultivation for different size group of farms, it was observed that all eight variables *viz.*, human labour ($X_1$), bullock labour ($X_2$), manures ($X_3$), nitrogen ($X_4$), phosphorus ($X_5$), irrigation ($X_7$) plant protection ($X_8$), included in the production function analysis have jointly explained 76 per cent of the total variation in the output of kagzi lime.

**References:**

1. Acharya, S. S. and Aggarwal, N. L. 1999 Agricultural marketing in India. Third edition, Oxford and IBH publishing company, New Delhi
2. Adaskar, R.J. 1998. Economic analysis of production and marketing of Kagzi lime in Akola district. Unpublished M.Sc. (Agri.) Thesis submitted to Dr. P.D.K.V,Akola.
3. Anonymous, 1989. Production of Kagzi lime in Nagpur district. Joint Agresco and research report, Dr .P.D.K.V. Akola,:21-29.
4. Anonymous, 1997. Economics of cultivation of pomegranate and banana in western Maharashtra. Agresco Report, Dept. of Agril. Econ. M.P.K.V, Rahuri: pp. 87- 99.
5. Bansode, S.D. 2001. Economics of production of fig in Aurangabad district. Unpublished M.Sc. (Agri.) thesis, submitted to VNMKV, Parbhani.
6. Bhat, A., Kachroo, J., Sharma, M. 2015. Constraints in production and marketing of citrus fruit in Jammu region of J&K State.
7. Bhat, A., Kachroo, J., Singh, S. P. and Sharma R. 2015. Marketing costs and price spread analysis for citrus in Samba district of Jammu region (M.S.). An International J. of Agro Economist Vol. 2, No. 1, 41-46.
8. Bhole, B.D., Mahale, Y. P., Khode, M.D. and Choudhari, M.H. 1992. Price spread in marketing of oranges. Maharashtra J. of Agri. Econ., 4(1): pp. 33.
9. Dongre, C.S. 2014. Economic analysis of production and marketing of sweet orange in Ahmednagar district of Maharashtra. Unpublished M.Sc. (Agri.) thesis submitted to M.P.K.V., Rahuri.
10. Hadawale, V.V. 2005. Production and marketing management of grapes in Junnar tahsil of Pune district (Maharashtra). Unpublished M.Sc. (Agri.) thesis submitted to M.P.K.V., Rahuri.

11. Jadhav, B.B. 2007. Economics of production and marketing of custard apple in Solapur district. Unpublished M.Sc. (Agri.) thesis submitted to M.P.K.V., Rahuri, Ahmednagar, (MS), India.
12. Kalamkar, P.B. 2012. Economics of production and marketing of sweet orange in Nagpur district. Unpublished M.Sc. (Agri) thesis submitted to Dr. P.D.K.V., Akola.
13. Ladaniya, M.S. and Wanjari, V. 2003. Marketing pattern of '*Mosambi*' sweet orange in selected district of Maharashtra. Ind.J. Agril. Mktg. 17(I) : pp. 52-62.
14. Latpate, R.J. 2004. Economics of production and marketing of sweet orange in Ahmednagar district. Unpublished M.Sc. (ABM) thesis submitted to M.P.K.V., Rahuri.
15. Mahakalkar, Y.N. 2010. Economics of Production and Marketing of orange in Nagpur district. Unpublished M.Sc.(Agri.) thesis submitted to Dr. P.D.K.V., Akola.
16. Mahalle, Y.P. and Galgilkar U.D. 1987. Cost of establishment of kagzi lime orchard. Ind. J. Agril. Econ.. 42(3) : pp. 469.
17. Manjula, N., Sheikh, M.K. and Kunnal, L.B.. 2011. Constraints faced and suggestion given by pomegranate growers of Bijapur district. Ind. J. Agril. Mktg., 35 (2): pp.320-327.
18. Murthy S., Gajanan, T.M., Sudha, M. and Dakshinmoorthy, V. 2009. Marketing and post harvest losses in fruits: Its implications on availability and economy. Ind. J. Agril. Econ. 64 (2): pp. 259-274.
19. Naikwadi, D.J., Sabale, R.N. and Khare, Y.A. 2004. Economics of production and marketing of Fig in Pune district. AGRESCO Report Deptt. of Agril. Econ. M.P.K.V, Rahuri. pp.199-213
20. Nighot, M.N., Alshi, M.R. and Joshi, C.K. 1986. Economics of production of Nagpur oranges. Ind. J. of Agril. Econ. 12(4): pp.583-585.
21. Pandey, D., Kumar A. and Singh, R. 2011. Marketing of Sweet Orange (malta) in Kumao region of Uttarkhand J. of recent advances in applied Science (JRAAS). 26 : pp 6-11.
22. Parihar, K.S, Kumar, A., Mourya, A., Shilpi, Joliya, P. and Kamalvanshi. 2016. Marketing paradigm of apple growers in Nainital district of Uttarakhand. Ind. J. of Econ. and Dev. Vol. No. 12, (1a) : pp. 113-116.
23. Patil, S.J. 1975. The economics of pomegranate cultivation in Rahuri region of Ahmednagar district. M.Sc. (Agri.) thesis submitted to M.P.K.V., Rahuri.
24. Pawar, B.R., Kolambkar, R.A. and Kauthekar, P.U. 2015. Resource productivity and resource use efficiency in cashewnut production. International Res. J. Agril. Econ. & Stat., 6 (2): pp. 317-320.

25. Raikar, N.A. 1990. Investment in production and marketing of cashew in Karnataka. An unpublished M.Sc. (Agri.) thesis submitted to University of Agricultural Science, Dharwad.
26. Ravikumar, K.T., Hosamani S.B. and Mamledesai N.R. 2014. Resource use efficiency and marketing channels for Pomegranate in Chitradurga district of Karnataka, India: an economic analysis. Unpublished M.Sc. (Agri.) thesis submitted to Department of Agricultural Economics, University of Agricultural Sciences, Dharwad.
27. Rohile, V.V., Naik, V.G. and Talathi, J.M. 2006. Resource use efficiency in banana production in sindhudurg district. International J. of Agril. Sci. 2(1) : pp.198-200.
28. Shennewad, B.A., and Shelke, R.D. 2013. Constraints and suggestions of papaya growers in Marathwada region of Maharashtra state, International Res. J. agril. Econ. & Stat., 4 (1) : pp. 30-32.
29. Singh, R.S. 2006. Marketing of citrus fruits in midd hills of Jammu and Kashmir. Encyclopedia of Agriculture Marketing. X : pp. 289-296.
30. Sonawane, K.G. 2008. Production and marketing of pomegranate in Satana tahsil of Nashik district. Unpublished M.Sc. (Agri.) thesis submitted to M.P.K.V., Rahuri, Ahmednagar, (MS), India.