
# Resource use efficiency and externality associated with banana production in Karnataka, (India)

*S. Sakamma[1]; K.B. Umesh[2]; R. Rangegowda[1]*

*1: University of Agricultural Sciences, Agricultural Economics, India, 2: University of Agricultural Sciences, Department of Agricultural Economics, India*

*Corresponding author email: saksri09@gmail.com*

***Abstract:***

*The study was conducted in Hilly Zones of Karnataka to assess the resource use efficiency and externalities in banana and its competing crop. Cobb-Douglas type of production function (per hectare), was used to assess the resource use efficiency in banana and its competing crops production. Resource use efficiency in banana production was high in case of chemical fertilizer (4.32) followed by sucker (3.25), FYM (2.47) and irrigation (1.93), indicating considerable scope to increase banana production by increasing the level of these inputs. The resources were over utilized in case of competing crops (paddy and ginger). Thus, farmers can reduce the wastage of resources by cultivating banana crop. The externality for resource use in banana and its competing crops was quantified. The results revealed that the cost incurred on fertilizers was more in case of ginger (Rs. 43,200/ha) followed by banana (Rs. 25,450/ha) and paddy (Rs. 9,644/ ha). With respect to PPC also the cost was more in ginger (Rs. 69,519/ha) compared to paddy (Rs.5,630/ ha) and banana (Rs. 3,893/ ha). This clearly indicated that ecologically banana has very less negative impact due to less usage of PPC.*

*Acknowledegment:*

**JEL Codes:** O13, C18

#1396

**Resource use efficiency and externality associated with banana production in Karnataka, (India)**


## Abstract

The study was conducted in hilly zones of Karnataka to assess the resource use efficiency and externalities in banana and its competing crop. Cobb-Douglas type of production function (per hectare), was used to assess the resource use efficiency in banana and its competing crops production. Resource use efficiency in banana production was high in case of chemical fertilizer (4.32) followed by sucker (3.25), FYM (2.47) and irrigation (1.93), indicating considerable scope to increase banana production by increasing the level of these inputs. The resources were over utilized in case of competing crops (paddy and ginger). Thus, farmers can reduce the wastage of resources by cultivating banana crop. The externality for resource use in banana and its competing crops was quantified. The results revealed that the cost incurred on fertilizers was more in case of ginger (Rs. 43,200/ha) followed by banana (Rs. 25,450/ha) and paddy (Rs. 9,644/ ha). With respect to PPC also the cost was more in ginger (Rs. 69,519/ha) compared to paddy (Rs.5,630/ ha) and banana (Rs. 3,893/ ha). This clearly indicated that ecologically banana has very less negative impact due to less usage of PPC.



**Keywords:** Cobb-Douglas production function, Allocative Efficiency, Externality, Sustainable Production


## 1. INTRODUCTION:

India has been principally an agrarian economy since time immemorial. Indian agriculture has undergone a fundamental change from traditional to high-value horticultural crops during recent years. The economy has also witnessed shifting of consumption pattern from traditional cereals to a more holistic and nutritious diet of fruit and vegetables, milk, fish, meat and poultry products. Thus agricultural diversification towards high-value horticulture crops has been instituted within Indian agriculture. Within agriculture, horticulture is the fastest growing sector, and presently contributes 30 per cent of agricultural gross domestic product (Agarwal *et al.,* 2016).

In recent years, horticultural sector received considerable attention as it is recognized as a potentially important source of growth, employment generation and foreign exchange earnings (Singh, 2015). This is evident from the fact that India is the largest producer of fruits and vegetables after China. According to the second estimate of horticulture crops released by Ministry of Agriculture in 2017, the total area under horticulture crops has increased from 24.5 m ha to 24.9 m ha in 2016-17 which is an increase of 1.9 per cent from 2015-16. Horticulture production rose from 146 mt in 2001-02 to 295 mt in 2016-17 (Anonymous, 2016a). The horticulture production grew at a phenomenal pace where, Indian farmers produced more than double the quantity of fruits and vegetables compared to early 2000-01 period (Anonymous, 2016a). This sector encompasses a wide range of crops viz., fruits, vegetables, plantations, ornamental crops, etc.

India has retained its status as the second largest producer of fruits in the world. The total fruits production is estimated to be 93 mt in 2016-17, which was 2.9 per cent higher than the 2015-16. The country is first in the production of fruits like mango, banana, sapota, pomegranate and aonla. Among which, Banana is an important fruit crop of tropical and subtropical regions of India.

Banana (Musa sp.) is the second most important commercial fruit crop in India. Banana is the fifth largest agricultural commodity in world trade after cereals, sugar, coffee and cocoa. India, Ecuador, Brazil and China produce half of total bananas of the World. Banana is reported to be grown in 130 countries around the World with an annual production of 103.63 mt (Anonymous, 2015). The major banana exporting countries are India, Ecuador, Colombia, Costa Rica and Philippines and the major importing countries are USA, Belgium, Germany and United Kingdom.

According to FAO estimates in 2016, India occupied the highest area under banana in the World. It may be noted that 23 percent of the total global area under banana belongs to India. India ranks first in banana production, contributing highest in world pool of banana production. Thus, India leads the World in banana production (29%) with an annual output of about 29163 tonne. Banana ranks first in production (39%) and second in area (13%) after mango in the country. In India, Karnataka has a major share in area (102.71 ‘000 ha) and production (2675.63 ‘000 t) of Banana (Anonymous, 2016a).

Banana serves as an ideal and low cost food source for developing country where population relies mostly on banana for food and dietary purpose (Kumar *et al*., 2011). In addition, banana is a rich source of carbohydrate and is rich in vitamins. It is also a good source of potassium, phosphorus, calcium and magnesium. The fruit is easy to digest, free from fat and cholesterol. Eating banana could help lower blood pressure and reduce the risks of cancer and asthma (https://www.medicalnewstoday.com/articles/271157.php). The University of Maryland Medical Center advises eating bananas to prevent kidney stones (https://www.livestrong.com). Banana plants are also used as insecticide, antioxidant and colour absorber. Additionally, banana fiber is used to make items like bags, rope, pots etc. Banana leaves are used as healthy and hygienic eating plates. In addition various products like Banana puree, powder, flour, chips etc., are prepared from banana. Hence it is referred as "Kalpatharu" (plant of virtues) and "Apple of Paradise" because of multifaceted uses. Thus, banana is one of the important fruit crops with its easy reach by common man.

Despite of its importance as dietary, medicinal properties and foreign exchange earner, much information is not available on the efficiency of banana cultivation at micro level. So far, no detailed studies have been conducted on the resource use efficiency by considering its competing crops in Hilly Zone of Karnataka. Hence, a study encompassing the above mentioned issues is a felt need. Keeping these aspects in view, the study makes an attempt to assess resource use efficiency and externalities associated with banana cultivation and its competing crops (paddy and ginger).

## 2. METHODOLOGY

Karnataka is one of the progressive states of India with great potential for development of fruit crops. The state is blessed with ten Agro-Climatic Zones suitable for growing a variety of fruits all-round the year. Of the ten Agro-Climatic Zones, Hilly Zone contribute maximum chunk to fruit production in Karnataka especially in banana. Thus to study the resource use efficiency in Banana crop, survey was conducted in Hilly Zone of Karnataka State (India). The primary data pertaining to the year 2015-16 were collected using a well structured and pre-tested schedule through a survey of sample respondents. Personal interview was used to elicit the data from the respondents, and it was ensured that the data made available by the respondents were relevant, comprehensive and reasonably correct and precise. During preliminary survey, it was observed

that majority of area under banana cultivation was preceded by paddy and ginger. Thereby, paddy and ginger were considered as competing crops for banana.

## 2.1 ANALYTICAL TOOLS

In order to analyse the resource use efficiency of banana and its competing crops (paddy and ginger), Cobb-Douglas production function was employed. The Cobb-Douglas production function was linearized through transformation into log form. Ordinary least square (OLS) was used for estimating the production function (Doll and Orazem, 1985).

The estimated Cobb-Douglas model is specified as follows.

**Cobb-Douglas model for banana/paddy/ginger**

$Y = a\ X_1^{bl}\ X_2^{b2}\ X_3^{b3}\ X_4^{b4}\ X_5^{b5}\ X_6^{b6}\ X_7^{b7}\ e^{u}$ ……..... (1)

Where,

Y = Gross returns (Rs./ha)

$X_1$ = Sucker in banana (Rs./ha) /Seeds in Paddy/ Rhizome in ginger

$X_2$ = Farm yard manure (Rs./ha)

$X_3$ = Chemical fertilizer (Rs./ha)

$X_4$ = Human labour (Rs./ha)

$X_5$ = Bullock labour (Rs./ha)

$X_6$ = Plant protection chemical PPC (Rs./ha)

$X_7$ = Propping in banana (Rs./ha)/ mulching in ginger (Rs./ha)

$e^u$ = Random/disturbance term

$b_1$ to $b_7$ = Elasticity coefficients of respective inputs

Equation (1) was converted into the logarithmic form to make it a linear form:

$\ln Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + u \log e$ …….(2)

The estimated coefficients were used to compute the MVP. By studying the marginal value product of factors of production, we can assess their relative importance. Marginal Value Product of Xi, the ith input is estimated by the following formula,

$$MVP = b_i * \frac{Geometric\ mean\ of\ output}{Geometric\ mean\ of\ ith\ input}$$

bi is the regression co-efficient of ith input.

To assess the marginal factor cost (MFC) per unit cost of input was taken for those variables expressed in terms of units and 1 was taken for the variables expressed in monetary terms (Rs.).

By using the above said MVP and MFC ratio, the allocative efficiency was analysed to infer about optimal resources use by farmer.

The estimated coefficients were used to compute the efficiency.

The model was estimated as follows

r = MVP/MFC..... (3)

Where,

r = Efficiency ratio

MVP = Marginal value product of variable inputs

MFC = Marginal factor cost, (price per unit input)

Based on economic theory, a firm maximizes profits with regard to resource use when the ratio of the marginal return to the opportunity cost is one. The values are interpreted as,

If r <1; resource is excessively or over utilized hence, decreasing the quantity of resource used, increases profits.

If r > 1; resource is underutilized hence increasing its use will increase profit level.

If r = 1;the resource is efficiently used, that is optimum utilization of resource hence the point of profit maximization

## 3 RESULTS AND DISCUSSION

### 3.1 Resource productivity in banana cultivation in Hilly zone of Karnataka

The Cobb-Douglas type of production function which is explained in the methodology section was used to examine the influence of different inputs on gross returns of banana cultivation. The productivity of resources used in banana cultivation in Hilly Zone of Karnataka is presented in table 1. The results revealed that, among the variable considered in the production function, the variables such as chemical fertilizer (0.215), sucker (0.156), FYM(0.082) and irrigation cost (0.078) indicated significant and positive contribution to increase in gross returns.

**Table 1: Estimates of the Cobb-Douglas production function in banana cultivation in Hilly zone of Karnataka**

| Sl. No. | Independent variable | Parameter | Coefficient | Standard error |
|---|---|---|---|---|
| 1 | Intercept | ln A | 4.243 | 2.560 |
| 2 | Sucker (Rs./ha) | X1 | 0.156** | 0.051 |
| 3 | FYM (Rs./ha) | X2 | 0.082* | 0.028 |
| 4 | Chemical fertilizer (Rs./ha) | X3 | 0.215** | 0.062 |
| 5 | Human labour (Rs./ha) | X4 | 0.041 | 0.142 |
| 6 | Bullock labour (Rs./ha) | X5 | -0.016 | 0.114 |
| 7 | Plant protection chemical (PPC) (Rs./ha) | X6 | 0.512 | 0.352 |
| 8 | Irrigation (Rs./ha) | X7 | 0.078* | 0.039 |
| 9 | Coefficient of multiple determination | $R^2$ | | 0.895 |
| 10 | F value | F | | 209.44 |
| 11 | Number of sample | N | | 180 |

Note: **&* indicates significant at one per cent and five per cent, respectively

The coefficient of chemical fertilizers (0.215) indicates for one per cent increase in the use of chemical fertilizer above the geometric mean, increases the gross returns by 2.15 per cent. The coefficient of multiple determination ($R^2$) was 0.895 which indicates 89.50 per cent variation in

banana gross returns was explained by all the independent variables included in the model. The calculated F value is greater than the table F value. Hence, the results are significant, indicating that each explanatory variable on its own was not very important, but together they explained a significant part of variation in gross returns of banana cultivation in Hilly zone of Karnataka.

### 3.2 Allocative efficiency in banana cultivation in Hilly zone of Karnataka

Allocative (price) efficiency refers to the ability of the firm to combine inputs and outputs in optimal proportions in the light of prevailing prices and is measured in terms of behavioral goal of the production unit like observed vs optimum cost or observed profit vs optimum profit. The allocative efficiency was estimated using the geometric mean levels of the output as well as inputs. The allocative efficiency indicated the price response of the farmers.

The ratio of marginal value product to marginal factor cost indicated that resource use efficiency was high in chemical fertilizer (4.32) followed by sucker (3.25), FYM (2.47) and irrigation (1.93). These ratios were considerably higher than unity, which indicates considerable scope to increase banana production by increasing the level of these inputs. MVP of human labour, bullock labour and PPC were found less than unity indicating their excess use (Table 2). This implied that, human labour, bullock labour and PPC were not efficiently used to achieve desired level of production. The results are in line with the findings reported by Bhatia (1999).

**Table 2: Allocative efficiency in banana cultivation in Hilly Zone of Karnataka**

| Sl. No. | Variable | Coefficient | MVP | MFC | MVP/MFC | Inference |
|---|---|---|---|---|---|---|
| 1 | Sucker (Rs./ha) | 0.156** | 3.25 | 1 | 3.25 | Under utilized |
| 2 | FYM (Rs./ha) | 0.082* | 2.47 | 1 | 2.47 | Under utilized |
| 3 | Chemical fertilizer(Rs./ha) | 0.215** | 4.32 | 1 | 4.32 | Under utilized |
| 4 | Human labour (Rs./ha) | 0.041 | 0.85 | 1 | 0.85 | Over utilized |
| 5 | Bullock labour (Rs./ha) | -0.016 | -1.58 | 1 | -1.58 | Over utilized |
| 6 | Plant protection chemical (PPC) (Rs./ha) | 0.512 | 0.47 | 1 | 0.47 | Over utilized |
| 7 | Irrigation (Rs./ha) | 0.078* | 1.93 | 1 | 1.93 | Under utilized |

Note: **&* indicates significant at one per cent and five per cent, respectively

### 3.3 Resource productivity of competing crops of banana in Hilly zone of Karnataka

The resource productivity in the cultivation of competing crops (paddy and ginger) of banana revealed that, inputs such as, PPC, fertilizer, human labour and FYM were found to have positive influence on gross returns of paddy with significant co-efficient of 0.257, 0.182, 0.086 and 0.043, respectively (Table 3). The resource productivity of input used in the ginger cultivation in Hilly Zone of Karnataka is presented in table 4. The regression coefficients of seed material (rhizome), FYM, human labour and mulching were positive and significant in contributing to increased gross returns. The coefficient of determination ($R^2$) for paddy and ginger cultivation was 76 and 84 per cent, respectively.

**Table 3: Estimates of the Cobb-Douglas production function in paddy cultivation in Hilly zone of Karnataka**

| Sl. No | Particular | Parameter | Co-efficient | Standard error |
|---|---|---|---|---|
| 1 | Intercept | Ln A | -3.450 | -1.933 |
| 2 | Seeds (Rs./ha) | X1 | -0.268 | -0.313 |
| 3 | Farm yard manure (Rs./ha) | X2 | 0.043** | 0.015 |
| 4 | Chemical fertilizer (Rs./ha) | X3 | 0.182* | 0.092 |
| 5 | Human labour (Rs./ha) | X4 | 0.086** | 0.027 |
| 6 | Bullock labour (Rs./ha) | X5 | 0.152 | 0.070 |
| 7 | Plant protection chemicals (Rs./ha) | X6 | 0.257** | 0.041 |
| 8 | Irrigation charges (Rs./ha) | X7 | 0.514 | 0.379 |
| 9 | Coefficient of multiple determination | $R^2$ | | 0.762 |
| 10 | F value | F | | 25.613 |
| 11 | Number of sample | N | | 64 |

Note: **&* indicates significant at one per cent and five per cent, respectively

**Table 4: Estimates of the Cobb-Douglas production function in ginger cultivation in Hilly zone of Karnataka**

| Sl. No. | Particular | Parameter | Co-efficient | Standard error |
|---|---|---|---|---|
| 1 | Intercept | Ln A | -5.451 | -3.586 |
| 2 | Rhizome (Rs./ha) | X1 | 0.052** | 0.012 |
| 3 | Farm yard manure (Rs./ha) | X2 | 0.142* | 0.073 |
| 4 | Chemical fertilizer (Rs./ha) | X3 | 0.392 | 0.281 |
| 5 | Human labour (Rs./ha) | X4 | 0.135** | 0.026 |
| 6 | Mulching (Rs./ha) | X5 | 0.092* | 0.048 |
| 7 | Plant protection chemicals (Rs./ha) | X6 | 0.286 | 0.198 |
| 8 | Irrigation charges (Rs./ha) | X7 | 0.085 | 0.542 |
| 9 | Coefficient of multiple determination | $R^2$ | | 0.847 |
| 10 | F value | F | | 47.450 |
| 11 | Number of sample | N | | 68 |

Note: **&* indicates significant at one per cent and five per cent, respectively

### 3.4 Allocative efficiency of competing crops (paddy and ginger) in Hilly zone of Karnataka

The MVP/MFC ratio in case of paddy was highest in the case of chemical fertilizer (1.95) followed by FYM (1.45) and bullock labour (1.02). This indicated that use of more fertilizer, FYM and bullock labour under paddy cultivation would result in higher gross returns. For instance, FYM (1.45) indicates for every additional rupee spent on FYM would give return of Rs.1.45. The resource use efficiency was high in case of ginger cultivation, in seed (rhizome) material (3.69) followed by mulching (2.89) and FYM (2.54). There was no over use of resources in Banana cultivation. Where as in paddy, human labour and PPC were over utilized. In ginger cultivation, human labour was found to be over utilized.

**Table 5: Allocative efficiency in paddy cultivation in Hilly Zone of Karnataka**

| Sl. No. | Variable | Coefficient | MVP | MFC | MVP/MFC | Inference |
|---|---|---|---|---|---|---|
| 1 | Seeds (Rs./ha) | -0.268 | -0.38 | 1 | -0.38 | Over utilized |
| 2 | FYM (Rs./ha) | 0.043** | 1.45 | 1 | 1.45 | Under utilized |
| 3 | Chemical fertilizer (Rs./ha) | 0.182* | 1.95 | 1 | 1.95 | Under utilized |
| 4 | Human labour (Rs./ha) | 0.086** | 0.36 | 1 | 0.36 | Over utilized |
| 5 | Bullock labour (Rs./ha) | 0.152 | 1.02 | 1 | 1.02 | Under utilized |
| 6 | Plant protection chemical (Rs./ha) | 0.257** | 0.47 | 1 | 0.47 | Over utilized |
| 7 | Irrigation | 0.514 | 0.93 | 1 | 0.93 | Over utilized |

Note: **&* indicates significant at one per cent and five per cent, respectively

**Table 6: Allocative efficiency in ginger cultivation in Hilly zone of Karnataka**

| Sl. No. | Particular | Co-efficient | MVP | MFC | MVP/MFC | Inference |
|---|---|---|---|---|---|---|
| 1 | Rhizome (Rs./ha) | 0.052** | 3.69 | 1 | 3.69 | Under utilized |
| 2 | FYM (Rs./ha) | 0.142* | 2.54 | 1 | 2.54 | Under utilized |
| 3 | Fertilizer (Rs./ha) | 0.392 | 0.74 | 1 | 0.74 | Over utilized |
| 4 | Human labour (Rs./ha) | 0.135** | 0.92 | 1 | 0.92 | Over utilized |
| 5 | Mulching (Rs./ha) | 0.092* | 2.89 | 1 | 2.89 | Under utilized |
| 6 | PPC (Rs./ha) | 0.286 | 0.17 | 1 | 0.17 | Over utilized |
| 7 | Irrigation (Rs./ha) | 0.085 | 0.64 | 1 | 0.64 | Over utilized |

Note: **&* indicates significant at one per cent and five per cent, respectively

It was found that there was over utilization of plant protection chemicals and human labor across production of paddy and overutilization of human labor in ginger, thus an attempt has been made to quantify the externality for resource use in banana and its competing crop.

### 3.5 Externalities in banana and its competing crops

The quantified externality for resource use in banana in comparison to its competing crops revealed that the cost incurred on fertilizers was more in case of ginger (Rs. 43,200/ha) followed by banana (Rs. 25,450/ha) and paddy (Rs. 9,644/ ha). With respect to PPC also the cost was more in ginger (Rs. 69,519/ha) compared to paddy (Rs.5,630/ ha) and banana (Rs. 3,893/ ha).

This clearly indicates that ecologically banana has very less negative impact due to less usage of PPC.

**Table 7: Quantified externality for resource used in the production of banana and its competing crops**

| Sl. No. | Resources | Banana (Rs./ha) | Paddy (Rs./ha) | Ginger (Rs./ha) |
|---|---|---|---|---|
| 1. | Fertilizer (Rs./ha) | 25450 | 9644 | 43200 |
| 2. | Plant protection chemical (Rs./ha) | 3893 | 5630 | 69519 |
| 3. | Irrigation charges (Rs./ha) | 7150 | 10650 | 7417 |
| 4. | Total (1+2+3) | 36493 | 25924 | 120136 |
| Net returns (Rs./ha) | | 304475 | 3829 | 118598 |

The irrigation charges is at the higher end in the case of paddy which accounted Rs. 10,650/ ha followed by ginger (Rs. 7,417/ha) and banana (Rs. 7,150/ha). It is a known fact that paddy cultivation requires large amount of irrigation. On overall basis, the cost of resources i.e. fertilizers, PPC and irrigation together accounted for Rs. 1,20,136/ha in ginger with net returns of Rs. 1,18,598/ha whereas in paddy the cost accounted to Rs. 25,924/ ha with net returns of Rs. 3,829/ ha. The cost incurred on banana was less (Rs. 36,493/ ha) but with higher net returns (Rs.3,04,475/ ha) in comparison to ginger and paddy.

The qualitative parameters depicting the externalities of banana over its competing crops reveals that banana has many positive impacts over paddy and ginger. Firstly, because of its high canopy, banana stands out in aesthetic value. Regarding the growing requirements, banana being grown in aerobic conditions does not produce methane gas as well as restores soil bio-mass to a greater extent and also provides ample opportunity for taking up water saving technologies and crop intensification through micro-irrigation and intercropping respectively. The nutritive value of banana is higher than its competing crops. On the other hand, paddy and ginger have few negative externalities over banana. Both, paddy and ginger affect the soil texture as soil puddling is required for paddy and fine tilth soil is must for ginger cultivation. They also require higher content of PPC, fertilizers and more number of labors in comparison to banana which directly affects the soil health and even the successive crops.

There is not much opportunity for taking up water saving technologies because of which salinity problem and nutrient leaching losses is seen in paddy. Accordingly, paddy and ginger are more prone to pest attacks. The major negative externality from paddy is, it adds to global warming by releasing greenhouse gases especially methane.

**Table 8:Externalities in banana and its competing crops (qualitative parameters)**

| Positive externality of banana over paddy and ginger | Negative externality of paddy over banana | Negative externality of ginger over banana |
|---|---|---|
| Aesthetic value - Banana is high canopy crop<br>Banana is grown under aerobic condition there by there is no emission of methane gas<br>Banana restores soil bio-mass, as well as minimal damage to the soil structure.<br>Water requirement of banana is less (39 acre inch) and also water saving technologies (micro irrigation) can be easily adopted. Thus, water use efficiency is higher<br>Crop intensification through intercrop is possible<br>Nutritive value is relatively higher in case of banana compared to paddy | Paddy accelerates for global warming by way of emission of greenhouse gases (majorly methane).<br>Paddy cultivation will affect the soil structure and texture, as cultivation of paddy requires puddling of soil.<br>Majorly paddy is cultivated under anaerobic condition, where water requirement is relatively higher (45 acre inch) and it is highly cumbersome to adopt any water saving technologies.<br>Salinity problem and nutrient leaching losses is high<br>Labour intensive crop<br>More Susceptible to immediate pest out break<br>There is higher application of pesticides which not only affects the soil health but also affects the health of the farmer. | Being a nutrient exhaustive crop cultivation of successive crops is affected<br>Highly susceptible to pest and diseases as a result there is higher application of plant protection chemicals.<br>Less water use efficiency.<br>Cultivation of ginger will affect the soil structure and texture, as it requires fine tilth of soil.<br>Labour intensive crop<br>There is higher application of pesticides which not only affects the soil health but also affects the health of the farmer. |

## 4 CONCLUSION

Resource use efficiency in banana production indicated that sucker, FYM, chemical fertilizer and irrigation were the most productive inputs. The study also showed that, there is a scope for reorganizing inputs usage of these were departed from optimality as indicated by MVP to MFC ratio. There was no over use of resources in Banana cultivation. Where as in paddy cultivation, human labour and PPC were over utilized. In ginger cultivation, human labour was found to be over utilized. On overall basis, banana has many positive externalities with respect to both environment and the farmer, over paddy and ginger. Hence, farmers should take advantage of these positive aspects of the crop while deciding the cropping pattern. There is a need to educate farmers regarding the efficient and sustainable use of the scarce resources which helps in increasing the crop productivity there by returns. Extension activities are needed to educate the farmers regarding the optimum and timely use of scarce resources. Optimizing the use of resources reduces cost on one hand and increases returns on the other hand and sustainable production process is possible if the resources are used optimally.

## REFERENCES:


Agarwal, Yadav, P., Kumar, S. and Pandey, D., 2016, Horticultural crops in India-Growth, instability and decomposition approach.*Agric. Situation in India,* **3(**2): 26-30.

Anonymous, 2015, FAO *Statistical Pocketbook WORLD Food and Agriculture 2015*. FAO, Rome, p. 228-236.

Anonymous, 2016a, *Horticultural Statistics at a Glance 2015-16.*Horticulture Statistics Division Department of Agriculture, New Delhi, p. 28-30.

Bhatia, A. P., 1999, Economics of production and marketing of banana in Nepal.*M.Sc. (Agri.) Thesis(Unpub.),*MarathwadaAgric.Univ., Parbhani.

Kumar, A., Singha, H., Kumara, S., and Mittalb S., 2011, Agricultural commodities and their role in food security and poverty alleviation-A synthesis.*Agric. Econ. Res. Rev.,* **24** (2): 169-181.

Saraswati, P. A., Basavaraja, H., Kunnal, L. B., Mahajanashetti, S. B. and Bhat, A. R. S., 2012, Growth in area, production and productivity of major crops in Karnataka. *Karnataka J. Agric. Sci.,* **25** (4): 431-436.

Singh, R., 2015, An analysis of spatio-temporal changes in the pattern of crop diversification in Indian agriculture. *Int. Res. J. of Soc. Sci.,* **4** (12): 15-20.

https://www.medicalnewstoday.com/articles/271157.php

(https://www.livestrong.com)