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9

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Abstract

As we are aware that contract farming in other produce like Gurkin and Mango is well established and most of the produce are having a good market in other countries. Even the Mangos which is said to be a highly cultivated in Karnataka region the market for the mango is quite complicated. The study reveals that the contract farming will enhance export potential and the likelihood of improving the social and economic condition of the mango farmers particularly the small mango cultivators. It was seen that the market for the Indian mangos that to 1.19% of exports in the world which is said to be low and most of the exports are by the large formers but according to the pilot study there are more number of small farmers who are lack of proper post harvest facilities, lack of bargaining power, lack of motivation and unable to market their produce for fair cost. The strategy to help the small farmers to go for commercialization of the mango cultivation through contract farming this will help in enhancing the living condition of the farmers and a better bargaining capacity. Moreover the contract farming will improve the good link for small and marginal farmers with private sector and exploit the potential of agro-processing sector by supply the raw commodities to agro processing industries. Hence, the title "Contract Farming – A Way to Sustainable Agriculture" further the proposed paper will recommend some of the policy measures to promote the long term sustainable partnerships and to overcome the danger of exclusion of modern supply chains.

Keywords: Sustainable Agriculture Development, Microeconomics, Contract Farming, Cost Benefit Analysis, Cobb Douglas Production Function, Mango cultivation

1. Introduction

It was seen that contract farming and its relevance in mango cultivation is becoming an integral part of the marketing of the mango, now it is important to see the production cost of mango in the Karnataka. Obviously it is clear that mango is considered as king of fruits which is chiefly cultivated in South India and India being the leading exporter of mango to Middle East and European countries. Cultivation of mango and its economic is quite impressive first 3 to 5 year the yield of mango in the field is nil and subsequently 6th year it starts to bear the fruits. From than onward some of the recurring cost will be involved with fixed cost. Of course, this chapter will deals with the economics of mango cultivation in the study area by taking cost and benefit of mango cultivation. Further it was also estimated the cost of cultivation in conventional and contractual cultivation.

By enlarge from the it was found that contract farming is much better that conventional farming since, in contractual farming contractor will take care of the all the activities and possibility that he may use some

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modern technological application. In the conventional cultivation as age old technique in the cultivation and harvesting which shows some post harvesting loss by mishandling the mango and transporting the same to market. In such case farmer has to take all risk. But in the case of contract farming, on behalf of farmer the contractor will handled the risk ensuring the assured income to the farmer. To know all the above it, we need to study the economics of mango cultivation.

Research Question

• What contractual arrangements prevailing are beneficial to farmers?

Objectives of the Study

• To study the cost benefit analysis of mango contract and non-contract farming.

2. Methodology of the Study

2.1 Research Technique: Descriptive research

Sample Size: 350 mango cultivator both contracted and non-contracted farmers. Multi-stage sampling is used for the data collection. The multi-stage sampling, random sampling was used in stage wise the samples are selected directly from the lists of contractors and non-contractors farming.

Study Area: Major mango producing belts of Karnataka; Bangalore Rural, Tumkur, Kolar, Dharwad, Ramanagar and Chikkaballapur districts.

Analytical Tools and Techniques: The statistical techniques which are used in the analysis are Costbenefit analysis, percentage analysis logistic regression and Cobb-Douglas production function.

Cost-Benefit Analyses: A cost benefit analysis finds, quantifies, and adds all the positive factors. These are the benefits. Then it identifies, quantifies, and subtracts all the negatives, the costs. The difference between the two indicates whether the planned action is advisable. The real trick to doing a cost benefit analysis in this study is making sure contract farming is more cost

effective and economical benefit than conventional farming. It properly quantifies them and it gives clear picture to which is best way to follow.

Logistic Regression: Logistic regression measures the relationship between a categorical dependent variable and one or more independent variables, which are usually (but not necessarily) continuous, by using probability scores as the predicted values of the dependent variable. As such it treats the same set of problems as does probit regression using similar techniques.

Cobb-Douglas production function for the production process.

Economics of Mango Orchards in Karnataka Districts: The economics of mango orchards in the selected districts of Karnataka (Ramanagarm and Srinivasapura districts aggregated) is presented in (Table 1).

Taking into account Ramanagaram and Srinivasapura together, the average annual yield of mango stood at 7.5 metric ton per hectare in the age group of 6 to 14 years, while the stabilized yield was recorded at 13.5 metric ton per hectare for orchards having attained the age of 15 to 35 years. Annual gross income in 2017-18 worked out to Rs. 32, 250 per hectare and Rs. 61, 250 per hectare in the lower (6-14 years) and higher age (15.35 years) respectively. The annual net income earned in 2017-18 was Rs.16500 per hectare and Rs. 45500 per hectare respectively. The entire capital cost would be covered in four years after the sixth year, if the borrowers resort to own fund. Otherwise, the amount would be capitalized in the event of institutional finance.

To estimated cost of mango Orchards and to study the annual net income accrued per hectare in Bangalora and Alphonso varieties of mango in Ramanagaram and Kolar districts, respectively. Further, the study also concentrated on the cost of production of mango under two situation namely contract farming and non contract farming. In the both the cases the production cost will be remain almost same but the risk factors will be minimized to maximum extent to the producer the following estimation show the cost and returns of mango cultivation under two situation one with contract farming and other without contract farming.

Cost and Income from Mango Cultivation

Prior to measure the efficiency, scrutinizing the cost and return per acre will give insights the economics of scope of the farm. Because the heterogeneity nature of crop and region, there are various methodological issues involved in the estimation process in cost and cultivation. The following analysis adopts the farm management studies in the study area (Sen and Bhatia, 2004). The cost of cultivation includes all element or inputs involved in the production of mango from the stage or preparatory village to the final stage of collecting produce in the form of grains and their by products.

Value of own land is estimated on the basis of prevailing rents in the study area for identical type of land, and also as reported by the sample farmers subject to the ceilings on fair rents in the land legislation of the concerned. There are two ways for estimating the value of family labor; a) the wages paid to attached farm labor, b) by imputing the wage paid to hired labor, if attached farm labor is absent. The present study has followed the second method to estimate the value of labor. Value of other source is estimated by imputing the payment made to hire the resources. Value of farm produced manure is evaluated at the prices/rate prevailing in the study area.

The cost of growing per acre of non contract mango and their returns are presented in (Table 1). It is observed that there is a variation in the cost of cultivation between the types of mango.

A glance at the statistics reveals that out of the total costs of cultivations, a total of Rs. 3500 was spent on the planting material per unit it cost about Rs. 100 and in an acre up 30 to 40 plant can be planted thus for estimation only average of 35 plant was taken for the estimation purpose (Table 2).

The major factors of production that is to be consider is the manures which itself contributes about 27.08

| Particulars/Age (years) | 1-5 | 6-14 | 15-35 |
|---|---------|-------|-------|
| Yield (MT/ha) | 0 | 7.5 | 13.5 |
| Selling price (Rs./MT) | 0 | 6500 | 6500 |
| Gross income (Rs./ha) | 0 | 32250 | 61250 |
| Cost of investment/capital Cost (Rs./ha) | 67,500 | 0 | 0 |
| Cost of Maintenance (Rs./ha) | 0 | 15750 | 15750 |
| Net Income (Rs./ha) | -67,500 | 16500 | 45500 |

| Table 1. | Yield, | cost of | f investme | nt, cost | of ma | aintenance | and ne | ŧ |
|----------|--------|---------|------------|----------|--------|------------|--------|---|
| income o | f man | ao per | hectare in | Karnata | aka in | 20017-18 | 3 | |

Source: Field data 2017-18.

per cent of production costs within five years of the planting (Rs 13000) other factors that we can take as the major contributor to production function will be the labor (K) in the study area particularly for the Bangalora type of mango it requires Rs. 11000 as the labour cost and it constitute to 22.92 per cent. Other major non recurring expenses are like Fencing, intercropping and investment on planting materials are contributing to 10.42 per cent each but planting material is contributing to 7.29 per cent.

Thus the production function we can consider two factors namely the labour and manure in the study area.

Table 2a, reveals that the production function for selected factors, it was considered the main production function P = f(K,P,M,P,I,F,R,C) of this production function two function namely the manures and the labours are having high impact on the profitability of the cultivation. Table 2a, reveals the production co efficiency and standard Error with t ratio with upper and lower significance as confidence.

The projected income and cash flow in the cultivation of mango Bangalora type is depicted in (Table 3), which shows the quantity, the gross value and the net income over the period of 15+ years of cultivation. It is obviously first five year the net income is negative in nature as the there is no production of mango in these years. The yield of mango will starts only after 6th year and at the time of maturity it will yield maximum of 60 kgs of mango in the study area which is having a good quality of yield. And it will be last for long years. On the other hand the value per tree is up to Rs. 15/kg
 Table 2. Cost and returns from mango cultivation (Rs. per Acer) estimated cost of mango Orchards (Bangalura verity) under non contract farming

| Plant Population: 40 | | | | | | | | | | | |
|--|-------|------|------|------|------|-------|-------------|--|--|--|--|
| Derticulare | | | Year | | | Total | Dorcontorio | | | | |
| Particulars | 1 | 2 | 3 | 4 | 5 | Iotai | Percentage | | | | |
| Planting material (35 plant X Rs 100 each) | 3500 | | | | | 3500 | 7.29 | | | | |
| Manures | 4000 | 1500 | 1500 | 3000 | 3000 | 13000 | 27.08 | | | | |
| Plant protection | 1100 | 600 | 600 | 600 | 600 | 3500 | 7.29 | | | | |
| Sprayer & implements | 1500 | | | | | 1500 | 3.13 | | | | |
| Fencing | 5000 | | | | | 5000 | 10.42 | | | | |
| Irrigation | 2000 | 500 | 500 | 500 | 500 | 4000 | 8.33 | | | | |
| Labour | 5000 | 1500 | 1500 | 1500 | 1500 | 11000 | 22.92 | | | | |
| Intercropping | 1500 | | | | | 1500 | 3.13 | | | | |
| Miscellaneous | 1000 | 1000 | 1000 | 1000 | 1000 | 5000 | 10.42 | | | | |
| Total | 24600 | 5100 | 5100 | 6600 | 6600 | 48000 | 100.00 | | | | |

Note: Cost of mango planting in any variety will be all most similar. **Source:** Field data 2017-18.

Table 2a The Selection Function

| Variables | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% |
|----------------------|--------------|----------------|--------|---------|-----------|-----------|
| Planting material | -0.7 | 0.404 | -1.73 | 0.18 | -1.99 | 0.59 |
| Manures | -0.05 | 0.395 | -0.13 | 0.91 | -1.31 | 1.21 |
| Plant protection | -0.1 | 0.058 | -1.73 | 0.18 | -0.28 | 0.08 |
| Sprayer & implements | -0.3 | 0.173 | -1.73 | 0.18 | -0.85 | 0.25 |
| Fencing | -1 | 0.577 | -1.73 | 0.18 | -2.84 | 0.84 |
| Irrigation | -0.3 | 0.173 | -1.73 | 0.18 | -0.85 | 0.25 |
| Labour | -0.7 | 0.404 | -1.73 | 0.18 | -1.99 | 0.59 |
| Intercropping | -0.3 | 0.173 | -1.73 | 0.18 | -0.85 | 0.25 |

and the income per tree is estimated to Rs. 900 for the acre an average of 40 trees can be planted. Of which a farmer under non contract farming will earn about Rs. 36,000/- in from one acre and for one hectare it would be nearly Rs. 1 lakh. However, maintenance cost will also have its role in the income the maintenance cost for one acre is ranging from 6600 to 9000 over the period of 15 years the maintenance cost will increase constantly. Hence, net income at the initial stage is negative with (-) 6600 and the net income will be Rs. 27000 when the plant reaches its maturity of 15 years. Were the farmers will get the maximum income, thus, for one acre it would be Rs. 67500/-.

The cost of mango cultivation per acre under contract farming and their returns are presented in (Table 4). It is observed that there is a variation in the cost of cultivation between the types of mango. A glance at the statistics reveals that out of the total costs of cultivations, a total of Rs. 48000 was incurred to cultivate mango in one acre. Among the high expenditure only two factors of production namely the Manures and the labour is consider as the recurring expenses and this two factors contributes major portion in the production of mango. The production of mango which is depicted in the previous non contract farming in an acre up to 30 to 40 plants can plant. The planting material per unit it cost about Rs. 100,

Spacing: 10m x 10m

Table 3. Projected incomes from the mango cultivation year-wise

| Vield | | Year | | | | | | | | | | |
|--|--------|------|-------|-------|-------|-------|-------|-------|-------|-------|--------------|--|
| Ticiu | 1 to 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15th onwards | |
| Tree yield (in Kgs) | 0 | 15 | 25 | 30 | 35 | 45 | 50 | 50 | 60 | 60 | 60 | |
| value @ Rs. 15 / kg (per tree) | 0 | 225 | 375 | 450 | 525 | 675 | 750 | 750 | 900 | 900 | 900 | |
| Gross value (per acre average 40 trees) | 0 | 9000 | 15000 | 18000 | 21000 | 25000 | 30000 | 30000 | 36000 | 36000 | 36000 | |
| Maintenance (Rs/ha) | 6600 | 6600 | 6800 | 7200 | 7200 | 7500 | 8000 | 8000 | 8500 | 9000 | 9000 | |
| Net Income (Rs/ha) | -6600 | 2400 | 8200 | 10800 | 13800 | 17500 | 22000 | 22000 | 26500 | 27000 | 27000 | |

Source: Field data 2017-18.

Table 4. Estimated cost of mango tree plantation (Bangalura verity) under contract farming

| Particularo | | | Year | | | Total | Percentage | |
|---|-------|------|------|------|------|-------|------------|--|
| | 1 | 2 | 3 | 4 | 5 | IOLAI | | |
| Planting material (35 plant X Rs 100 each) | 3500 | | | | | 3500 | 7.29 | |
| Manures | 4000 | 1500 | 1500 | 3000 | 3000 | 13000 | 27.08 | |
| Plant protection | 1100 | 600 | 600 | 600 | 600 | 3500 | 7.29 | |
| Sprayer & implements | 1500 | | | | | 1500 | 3.13 | |
| Fencing | 5000 | | | | | 5000 | 10.42 | |
| Irrigation | 2000 | 500 | 500 | 500 | 500 | 4000 | 8.33 | |
| Labour | 5000 | 1500 | 1500 | 1500 | 1500 | 11000 | 22.92 | |
| Intercropping | 1500 | | | | | 1500 | 3.13 | |
| Miscellaneous | 1000 | 1000 | 1000 | 1000 | 1000 | 5000 | 10.42 | |
| Total | 24600 | 5100 | 5100 | 6600 | 6600 | 48000 | 100.00 | |

Source: Field data 2017-18.

Table 4a. The selection function

| Variables | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% |
|----------------------|--------------|----------------|--------|---------|-----------|-----------|
| Planting material | -0.7 | 0.404 | -1.73 | 0.18 | -1.99 | 0.59 |
| Manures | -0.05 | 0.395 | -0.13 | 0.91 | -1.31 | 1.21 |
| Plant protection | -0.1 | 0.058 | -1.73 | 0.18 | -0.28 | 0.08 |
| Sprayer & implements | -0.3 | 0.173 | -1.73 | 0.18 | -0.85 | 0.25 |
| Fencing | -1 | 0.577 | -1.73 | 0.18 | -2.84 | 0.84 |
| Irrigation | -0.3 | 0.173 | -1.73 | 0.18 | -0.85 | 0.25 |
| Labour | -0.7 | 0.404 | -1.73 | 0.18 | -1.99 | 0.59 |
| Intercropping | -0.3 | 0.173 | -1.73 | 0.18 | -0.85 | 0.25 |

the major factors of production that is to be consider are the manures which itself contributes about 27.08 per cent of production costs within five years of the planting (Rs. 13000) other factors that we can take as the major contributor to production function will be the labor (K) in the study area particularly for the Bangalura type of mango it requires Rs. 11000 as the labour cost and it constitute to 22.92 per cent. Other major non recurring expenses are like Fencing, intercropping and investment on planting materials are contributing to 10.42 per cent each but planting material is contributing to 7.29 per cent. Thus the production function we can consider two factors namely the labour and manure in the study area.

| | | Year | | | | | | | | | | | |
|--|--------|------|-------|-------|-------|-------|-------|-------|-------|-------|-----------------|--|--|
| Yield | 1 to 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15th onwards | | |
| Tree yield (in Kgs) | 0 | 15 | 25 | 30 | 35 | 45 | 50 | 50 | 60 | 60 | 60 | | |
| value @ Rs. 16 / kg (per tree) | 0 | 240 | 400 | 480 | 560 | 720 | 800 | 800 | 960 | 960 | 960 | | |
| Gross value (per acre average 40 trees) | 0 | 9600 | 16000 | 19200 | 22400 | 28800 | 32000 | 32000 | 38400 | 38400 | 38400 | | |
| Maintenance (Rs/ha) | 6600 | 7100 | 7100 | 7750 | 7750 | 8500 | 9000 | 9000 | 9500 | 10500 | 10500 | | |
| Net Income (Rs/ha) | -6600 | 2500 | 8900 | 11450 | 14650 | 20300 | 23000 | 23000 | 28900 | 28900 | 28900 | | |

Table 5. Projected incomes from the mango cultivation year-wise

Source: Field data 2017-18.

Table 4a reveals that the production function for selected function it was considered the main production function P = f(K,P,M,P,I,F,R,C) of this production function two function namely the manures and the labour are having high impact on the profitability of the cultivation. Table 4 reveals the production co efficiency and standard Error with t ratio with upper and lower significance as confidence.

The projected income and cash flow in the cultivation of mango Bangalura type is depicted in (Table 5) which shows the quantity of gross value and the net income over the period of 15+ years of cultivation. It is obviously first five year the net income is negative in nature as the there is no production of mango in these years. The yield of mango will starts only after 6th year and at the time of maturity it will yield maximum of 60 kgs of mango in the study area which is having a good quality of yield. And it will be last for long years. On the other hand the value per tree is upto Rs. 16/kg and the income per tree is estimated to Rs. 960 and for the acre an average of 40 trees can be planted of which a farmer under non contract farming will earn about Rs. 38,400/in from one acre and for one hectare it would be nearly Rs. 1 lakh. However, maintenance cost will also have its role in the income the maintenance cost for one acre is ranging from Rs. 6600 to Rs. 10500 over the period of 15 years the maintenance cost will increase constantly. Hence, net income at the initial stage is negative with (-) Rs. 6600 and the net income will be Rs. 28900 when the plant reaches its maturity at 15th years. Where the farmers will get the maximum income, thus, for one acre the farmer will earn Rs. 28,900/- and for an one hectare it would be Rs. 72, 250/-.

The cost of growing alphonso mango per acre of non contract mango and their returns are presented in (Table 6). It is observed that there is a variation in the cost of cultivation between the types of mango. A glance at the statistics of production reveals that, Rs. 54900 is required to produce alphonso mango during five years. Major cost incurred in the production of mango are manures, during first five years the total cost required is Rs. 18,750 which accounts to the major portion in the production with 34.15 per cent of overall production cost. Another, factors of production is labour which itself contributes to 20.49 per cent of production cost up to first five years. Some of the factors which may consider as fixed factors like fencing, intercropping, purchase of sprayer, plant material and implements invested once and its amounts to Rs. 11,500. While under variable factors of production, like plant protection and irrigation and other expenses which itself contributes to Rs. 13,400. Thus the production function we can consider mainly two factors namely the labour and manure in the study area for the production of Alphonso mango.

Table 6a reveals that the production function for selected function it was considered the main production function P = f(K,P,M,P,I,F,R,C) of this production function two function namely the manures and the labour are having high impact on the profitability of the cultivation. Table 6a reveals the production coefficient and standard Error with t ratio with upper and lower significance at 95% confidence.

The projected income and cash flow in the cultivation of mango alphonso type is depicted in (Table 7) which Table 6. Estimated cost of mango tree plantation (Alphonso verity) under non contract farming

| Cr. No. | Dortiouloro | | | Year | | | Total | Porcontago | |
|---------|--|-------|------|------|------|------|-------|------------|--|
| 5r. NO. | Particulars | 1 | 2 | 3 | 4 | 5 | Total | Percentage | |
| 1. | Planting material (35 plant X Rs 100 each) | 3500 | | | | | 3500 | 6.38 | |
| 2. | Manures | 6000 | 2500 | 3250 | 3500 | 3500 | 18750 | 34.15 | |
| 3. | Plant protection | 1100 | 600 | 650 | 650 | 650 | 3650 | 6.65 | |
| 4. | Sprayer & implements | 1500 | | | | | 1500 | 2.73 | |
| 5. | Fencing | 5000 | | | | | 5000 | 9.11 | |
| 6. | Irrigation | 2000 | 500 | 500 | 500 | 750 | 4250 | 7.74 | |
| 7. | Labour | 5000 | 1500 | 1500 | 1500 | 1750 | 11250 | 20.49 | |
| 8. | Intercropping | 1500 | | | | | 1500 | 2.73 | |
| 9. | Miscellaneous | 1000 | 1000 | 1000 | 1000 | 1500 | 5500 | 10.02 | |
| | Total | 26600 | 6100 | 6900 | 7150 | 8150 | 54900 | 100.00 | |

Source: Field data 2017-18.

Table 6a. The selection function

| Variables | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% |
|----------------------|--------------|----------------|----------|----------|-----------|-----------|
| Planting material | -0.7 | 0.404145 | -1.73205 | 0.18169 | -1.98617 | 0.58617 |
| Manures | -0.4 | 0.424264 | -0.94281 | 0.415333 | -1.7502 | 0.950198 |
| Plant protection | -0.085 | 0.057951 | -1.46675 | 0.238718 | -0.26943 | 0.099426 |
| Sprayer & implements | -0.3 | 0.173205 | -1.73205 | 0.18169 | -0.85122 | 0.251216 |
| Fencing | -1 | 0.57735 | -1.73205 | 0.18169 | -2.83739 | 0.837386 |
| Irrigation | -0.25 | 0.189297 | -1.32068 | 0.278319 | -0.85243 | 0.352427 |
| Labour | -0.65 | 0.419325 | -1.55011 | 0.218894 | -1.98448 | 0.684479 |
| Intercropping | -0.3 | 0.173205 | -1.73205 | 0.18169 | -0.85122 | 0.251216 |

Table 7. Projected income from the mango cultivation year-wise

| Viold | | Year | | | | | | | | | | | |
|--|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------------|--|--|
| TICIU | 1 to 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15th on-wards | | |
| Tree yield (in Kgs) | 0 | 15 | 20 | 30 | 35 | 45 | 50 | 55 | 55 | 60 | 60 | | |
| value @ Rs. 20 / kg (per tree) | 0 | 300 | 400 | 600 | 700 | 900 | 1000 | 1100 | 1100 | 1200 | 1200 | | |
| Gross value (per acre average 40 trees) | 0 | 12000 | 16000 | 24000 | 28000 | 36000 | 40000 | 44000 | 44000 | 48000 | 48000 | | |
| Maintenance (Rs/ha) | 6600 | 6600 | 6800 | 7200 | 7200 | 7500 | 8000 | 8000 | 8500 | 9000 | 9000 | | |
| Net Income (Rs/ha) | -6600 | 5400 | 9200 | 16800 | 20800 | 28500 | 32000 | 36000 | 35500 | 39000 | 39000 | | |

Source: Field data 2017-18.

shows the quantity the gross value and the net income over the period of 15+ years of cultivation. It is obvious that first five year the net income is negative in nature as the there is no production of mango in these years. The yield of mango will starts only after 6th year and at the time of maturity it will yield maximum of 60 kgs of mango in the study area which is having a good quality of yield. And it will be last for long years. On the other hand the value per tree is up to Rs. 20/kg and the income per tree is estimated to Rs. 1200 and for the acre an average of 40 trees can be planted of which a farmer under non contract farming will earn about Rs. 48,000/- from one acre and for one hectare it would be nearly Rs. 1.2 lakh. However, maintenance cost will also have its role in the income. The maintenance cost for one acre is ranging from 6600 to 9000 over the

| Sr. | Particulara | | | Year | | | Total | Percentage |
|-----|--|-------|------|------|------|------|-------|-------------|
| No. | raiuculais | 1 | 2 | 3 | 4 | 5 | IUldi | reiceillage |
| 1. | Planting material (35 plant X Rs. 100 each) | 3500 | | | | | 3500 | 6.38 |
| 2. | Manures | 6000 | 2500 | 3250 | 3500 | 3500 | 18750 | 34.15 |
| 3. | Plant protection | 1100 | 600 | 650 | 650 | 650 | 3650 | 6.65 |
| 4. | Sprayer & implements | 1500 | | | | | 1500 | 2.73 |
| 5. | Fencing | 5000 | | | | | 5000 | 9.11 |
| 6. | Irrigation | 2000 | 500 | 500 | 500 | 750 | 4250 | 7.74 |
| 7. | Labour | 5000 | 1500 | 1500 | 1500 | 1750 | 11250 | 20.49 |
| 8. | Intercropping | 1500 | | | | | 1500 | 2.73 |
| 9. | Miscellaneous | 1000 | 1000 | 1000 | 1000 | 1500 | 5500 | 10.02 |
| | Total | 26600 | 6100 | 6900 | 7150 | 8150 | 54900 | 100.00 |

Table 8. Estimated cost of mango tree plantation (Alphonso verity) under contract farming

Source: Field data 2017-18.

period of 15 years the maintenance cost will increase constantly. Hence, net income at the initial stage is negative with (-) 6600 and the net income will be Rs. 39,000 when the plant reaches its maturity of 15 years. Were the farmers will get the maximum income, thus, for one acre the farmer will earn Rs.39,000/- and for an one hectare it would be Rs. 97500/- .

The cost of growing alphonso mango per acre of noncontract mango and their returns are presented in the Table 8. It is observed that there is a variation in the cost of cultivation between the types of mango. A glance at the statistics of production reveals that, Rs. 54900 is required to produce alphonso mango during five years. Major cost incurred in the production of mango are manures, during first five years the total cost required is Rs. 18,750 which accounts to the major portion in the production with 34.15 per cent of overall production cost. Another, factors of production is labour which itself contributes to 20.49 per cent of production cost up to first five years. Some of the factors which may consider as fixed factors like fencing, intercropping, purchase of sprayer, plant material and implements invested once and its amounts to Rs. 11,500. While under variable factors of production, like plant protection and irrigation and other expenses which itself contributes to Rs. 13,400. Thus the production function we can consider mainly two factors namely the labour and manure in the study area for the production of Alphonso mango.

Table 8a reveals that the production function for selected function it was considered the main production function P = f(K,P,M,P,I,F,R,C) of this production function two function namely the manures and the labour are having high impact on the profitability of the cultivation. Table 8a reveals the production coefficient and standard Error with t ratio with upper and lower significance at 95% confidence.

The projected income and cash flow in the cultivation of mango alphonso type is depicted in (Table 9) which shows the quantity the gross value and the net income over the period of 15+ years of cultivation. It is obvious that first five year the net income is negative in nature as the there is no production of mango in these years. The yield of mango will starts only after 6th year and at the time of maturity it will yield maximum of 60 kgs of mango in the study area which is having a good quality of yield. And it will be last for long years.

On the other hand the value per tree is up to Rs. 22/kg and the income per tree is estimated to Rs. 1,320 and for the acre an average of 40 trees can be planted of which a farmer under non contract farming will earn about Rs. 52,800/- from one acre and for one hectare it would be nearly Rs. 1.32 lakh. However, maintenance cost will also have its role in the income. The maintenance cost for one acre is ranging from 6,600 to 9,000 over the period of 15 years the maintenance cost will increase constantly.

Table 8a. The selection function

| Variables | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% |
|----------------------|--------------|----------------|----------|----------|-----------|-----------|
| Planting material | -0.7 | 0.404145 | -1.73205 | 0.18169 | -1.98617 | 0.58617 |
| Manures | -0.4 | 0.424264 | -0.94281 | 0.415333 | -1.7502 | 0.950198 |
| Plant protection | -0.085 | 0.057951 | -1.46675 | 0.238718 | -0.26943 | 0.099426 |
| Sprayer & implements | -0.3 | 0.173205 | -1.73205 | 0.18169 | -0.85122 | 0.251216 |
| Fencing | -1 | 0.57735 | -1.73205 | 0.18169 | -2.83739 | 0.837386 |
| Irrigation | -0.25 | 0.189297 | -1.32068 | 0.278319 | -0.85243 | 0.352427 |
| Labour | -0.65 | 0.419325 | -1.55011 | 0.218894 | -1.98448 | 0.684479 |
| Intercropping | -0.3 | 0.173205 | -1.73205 | 0.18169 | -0.85122 | 0.251216 |

Table 9. Projected incomes

| Viold | | Year | | | | | | | | | |
|--|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------------|
| tiela | 1 to 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15th on-wards |
| Tree yield (in Kgs) | 0 | 15 | 20 | 30 | 35 | 45 | 50 | 55 | 55 | 60 | 60 |
| value @ Rs. 22 / kg (per tree) | 0 | 330 | 440 | 660 | 770 | 990 | 1100 | 1210 | 1210 | 1320 | 1320 |
| Gross value (per acre average 40 trees) | 0 | 13200 | 17600 | 26400 | 30800 | 39600 | 44000 | 48400 | 48400 | 52800 | 52800 |
| Mainte-nance (Rs/ha) | 6600 | 6600 | 6800 | 7200 | 7200 | 7500 | 8000 | 8000 | 8500 | 9000 | 9000 |
| Net Income (Rs/ ha) | -6600 | 6600 | 9200 | 19200 | 23600 | 32100 | 36000 | 40400 | 39900 | 43800 | 43800 |

Source: Field data 2017-18.

Hence, net income at the initial stage is negative with (-) 6600 and the net income will be Rs. 43,800 when the plant reaches its maturity of 15 years. Were the

farmers will get the maximum income, thus, for one acre the farmer will earn Rs.43, 800/- and for an one hectare it would be Rs. 1, 09, 500/- .

Production function using Cobb Douglas

Estimate the Cobb-Douglas production function for the production process for manure

| Regression Statistics | | | | | | | | | |
|-----------------------|--------------|----------------|----------|----------|----------------|-----------|-------------|--|--|
| Multiple R | 0.478091 | | | | | | | | |
| R Square | 0.228571 | | | | | | | | |
| Adjusted R Square | -0.02857 | | | | | | | | |
| Standard Error | 1.341641 | | | | | | | | |
| Observations | 5 | | | | | | | | |
| ANOVA | | | | | | | | | |
| | df | SS | MS | F | Significance F | | | | |
| Regression | 1 | 1.6 | 1.6 | 0.888889 | 0.415333 | | | | |
| Residual | 3 | 5.4 | 1.8 | | | | | | |
| Total | 4 | 7 | | | | | | | |
| | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% | Lower 95.0% | | |
| Intercept | 4.95 | 1.407125 | 3.517812 | 0.038978 | 0.471901 | 9.428099 | 0.471901 | | |
| X Variable 1 | -0.4 | 0.424264 | -0.94281 | 0.415333 | -1.7502 | 0.950198 | -1.7502 | | |

The R-squared on 0.228 indicates that the formula is accurate. The R-square shows how much of the output (dependent variable) is explained by Manure in our model. A number of 0.228 indicates that there is a strong relation and that our model is valid. Certainly, also the high value of F-statistic (0.888), the small p-value (0.038), high t-values of the individual estimates and the small probability to get those t-values or a larger value supports this finding. Indeed, in a further

microeconomic context the Cobb-Douglas production function should be maximized with respect to the both inputs.

Therefore the output elasticity of manure is 4.95; the output elasticity of labor is (-) 0.4, while the returns to scale in the industry are 4.95 + (-) 0.4 = 4.55 which represents diminishing returns to scale.

| Regression Statistics | | | | | | | | |
|-----------------------|--------------|----------------|----------|----------|----------------|-----------|-------------|--|
| Multiple R | 0.666886 | | | | | | | |
| R Square | 0.444737 | | | | | | | |
| Adjusted R Square | 0.259649 | | | | | | | |
| Standard Error | 1.326022 | | | | | | | |
| Observations | 5 | | | | | | | |
| ANOVA | df | SS | MS | F | Significance F | | | |
| Regression | 1 | 4.225 | 4.225 | | | | | |
| Residual | 3 | 5.275 | 1.758333 | 2.402844 | 0.218894 | | | |
| Total | 4 | 9.5 | | | | | | |
| _ | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% | Lower 95.0% | |
| Intercept | 4.2 | 1.390743 | 3.019968 | 0.056761 | -0.22597 | 8.62596 | -0.22597 | |
| X Variable | -0.65 | 0.419325 | -1.55011 | 0.218894 | -1.98448 | 0.68447 | -1.98448 | |

| Estimate the | Cobb-Douglas | production | function | for the | production | process for | labour |
|--------------|--------------|------------|----------|---------|------------|-------------|--------|
| | | | | | | | |

The R-squared on 0.444737 indicates that the formula is accurate. The R-square shows how much of the output (dependent variable) is explained by Manure in our model. A number of 0.44737 indicates that there is a strong relation and that our model is valid. Certainly, also the high value of F-statistic (2.402844), the small p-value (0.056), high t-values of the individual estimates and the small probability to get those t-values or a larger value supports this finding.

Indeed, in a further microeconomic context the Cobb-Douglas production function should be maximized with respect to the both inputs. Therefore the output elasticity of manure is 4.2; the output elasticity of labor is (-) 0.65, while the returns to scale in the industry are 4.2 + (-) 0.65 = 3.55 which represents diminishing returns to scale.

Hence economic interpretation, based on micro- and macro-economic theory, is, for being able to add

output, it gives us greater response adding manure than labour (0.44 vs. 0.22), i.e., the distribution of the input goods. The manure contributes with 44% to the total output and labour with 22%.

However, at one given point in time, adding labour without manure will not do any good but rather decrease the output. We may trace this interpretation to higher variable costs and a lower productivity by every added entity (Table 10).

The regression of the data for the mango production indicates that there is a strong relation between the two input goods, manures and labour and the output (production).

By this, it can state that it is possible to run a regression of the Cobb-Douglas production function and get a statistically valid result.

| SI. No. | Variables | Contract | Non-contract |
|---------|-------------------------------|----------|--------------|
| 1. | Constant (a) | 4.21 | 4.21 |
| 2. | Planting material (β) | -0.7 | -0.7 |
| 3. | Manures (β) | -0.05 | -0.05 |
| 4. | Plant protection (β) | -0.1 | -0.1 |
| 5. | Sprayer & implements (β) | -0.3 | -0.3 |
| 6. | Fencing (β) | -1 | -1 |
| 7. | Irrigation (β) | -0.3 | -0.3 |
| 8. | Labour (β) | -0.7 | -0.7 |
| 9. | Intercropping (β) | -0.3 | -0.3 |

 Table 10.
 OLS estimates of average performance using Cobb

 Douglas Production Function for Bangalora mango in the study area

Source: Field data 2017-18.

The cost of growing per acre of contract and noncontract crop and their returns are presented (Table 11). It is observed that there is a known variation in cost of cultivation between these two contract and non-contract farming up to first five years. A glance at the statistics reveals that out of the total costs of cultivation, the manure and value of labour value around 34 per cent and 20 per cent for both contract and for non-contract. There is not much variation of factors of production across farm.

Cost of irrigation, Plant protection and miscellaneous constitutes the major costs of total variable costs and also total cost for both type of cultivation. If one compares the share of manure to total cost, no such difference is observed between contract and non-contract farming. Furthermore, the cost of chemicals and manure per acre use for contract crop is 34 per cent. The high expenditure on this particular component for contract crop raises concern over heavy use of and pesticide for contract crop, which would adversely affect the soil health as well as the environment. Since contractor procures farming directly from field, and hence such transaction cost is zero for contract farming, there is around 0.4 per cent of total cost for non-contract farming.

Per acre gross return from contract cultivation is observed to be more than that of non-contract crop. Further, net return from contract cultivation is much higher than that of non-contract crop. In addition, the benefit costs ratio over total costs is higher for contract

| SI. No. | Variables | Contract | Non-contract |
|---------|----------------------------------|----------|--------------|
| 1. | Constant (a) | 2.61 | 2.61 |
| 2. | Planting Material (β) | -0.7 | -0.7 |
| 3. | Manures (β) | -0.4 | -0.4 |
| 4. | Plant protection(β) | -0.085 | -0.085 |
| 5. | Sprayer & implements (β) | -0.3 | -0.3 |
| 6. | Fencing (β) | -1 | -1 |
| 7. | Irrigation (β) | -0.25 | -0.25 |
| 8. | Labour (β) | -0.65 | -0.65 |
| 9. | Intercropping(β) | -0.3 | -0.3 |

| Table 11. | OLS estim | ates of ave | erage perfo | rmance | using | Cobb- | |
|-----------|-------------|-------------|-------------|----------|---------|-------|------|
| Douglas P | roduction F | unction for | r Alphonso | mango il | n the s | studv | area |

Source: Field data 2017-18.

crop. The net return per quintal of output is very high for contract and for non-contract crop it is less.

3. Summary

To sum up, contract farmers are more efficient in growing the contract farming compared to noncontract farming. A small variation in cost of growing contract and non-contract cultivation has observed, however large variation observation in turns of return per acre. For instance, cost of growing contract crop per acre is 31 per cent higher than non-contract crop but gross return is two times more over non-contract crop. Further, net return from contract crop is eleven times higher than that of non-contract crop.

Cost of labor, animal and machine power constitutes the major parts of variable costs and also total costs for contract crop, only cost of animal and machine power is the major cost component for non-contract crop. However, it is observed that cost of organic manures per acre use for contract crop is higher than that of noncontract crop.

It is evident that in contract farming which is proved that it is more efficient than going with non-contract this will enhance the farmer's profitability and increases the living standard of the farmers without taking much risk on his part. This will enable the sustainable development of the agriculture. It was noted in sample collection processes, most of the small and marginal farmers are not having more bargaining power but contractual agreement he will ensure him with good price for his produce. Hence, the title "Contract Farming – A Way to Sustainable Agriculture" A Case of Mango Contract Farming in Karnataka.

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