

Original Research Article

Economics of Coconut Cultivation using treated sagoindustrial wastewater and fresh water in Salem district of Tamil Nadu

ABSTRACT

The study attempts to examine the socio-economic profile and economic of coconut cultivation using treated sagoindustrial wastewater and fresh water in the Salem district of Tamil Nadu. A sample of 180 farmers receiving treated wastewater from nearby industrial units and another 180 farmers receiving fresh water (control farms) were selected through a multistage purposive sampling technique. The major finding of economic analysis of coconut cultivation revealed that the gross income of the sample farm using treated sagoindustrial wastewater was higher at ₹ 1,31,408.00 as a result of the better yield of nuts (12540) as compared to that obtained by irrigation with fresh water (12245). Then the net income per hectare of coconut was ₹

46,128.64 and ₹ 34,245.72 for the farm using treated wastewater and control farms, respectively. The study, therefore, could establish that using treated industrial wastewater for irrigation will be advantageous in terms of net returns and to an extent substitute use of fresh water for irrigation, besides helping to save on use of and expenditure of organic and inorganic fertilizers.

Keywords: Coconut, Cost and Return, Sagoin units, Salem district, Treated wastewater

INTRODUCTION

Tapioca is cultivated in an area of 183 thousand hectare in India, with the total production of 6940.90 thousand metric tonnes. This tuber crop is largely cultivated in Tamil Nadu (50 percent), Kerala (35 percent), part of Andhra Pradesh (5 percent), Meghalaya (3

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percent), Nagaland (2.5 percent) and Assam (1.8 percent) (Indiastat, 2022). Tamil Nadu stands first both in area and production of 91.51 thousand hectares and 3893.34 thousand metric tonnes with productivity 42.55 MT/ hectare (Indiastat, 2022). Tapioca is mainly processed into starch and sago, which was introduced in India only in 1940's upwards.

In India, more than 70 percent of sago production was contributed by Tamil Nadu.

The sago industry is an agro-based seasonal industry, which is more water-intensive i.e., the extraction of sago from tubers requires 20,000 to 30,000 litres of water per ton of sago. Sago industries generate huge quantities of wastewater ranging from 30,000 to 40,000 litres per day of effluent were generated, which were rich in organic content (Nizy and Kannan, 2014). The untreated effluents have high content of organic load, which when stored for some days results in obnoxious odour, irritating colour, lower pH (4.2-5.7) and higher BOD (840 mg/l-4650 mg/l), COD (1600 mg/l-5500 mg/l) and TDS (2068 mg/l-6864 mg/l) (Sivananda, 2010, Ruban *et al.*, 2013, Nizy and Kannan, 2014, Anbukumar *et al.*, 2014). When this effluent is mixed in the agricultural farm without proper treatment, it is prone to increase soil and water pollution (Periyasamy and Govindaraj, 2017), which pushes the farmer towards non-agriculture. The acidic nature of the untreated effluent and the presence of inorganic constituents such as phosphate, sulphate, chloride, cyanide etc. and metals like sodium, potassium, iron etc. in trace quantities were also harmful to the health of human beings as well as to the aquatic culture. As per the pollution control law enforced by the government and Tamil Nadu Pollution control board to protect the environmental resources, most of the sago units have provided Effluent Treatment Plants (ETP) for the treatment of trade effluents. The sago units have provided Effluent Treatment Plants (ETP) so that the treated wastewater has standard pH (7.5), low BOD (30 mg/l-340 mg/l), COD (200 mg/l-448 mg/l) and TDS (680 mg/l-1750 mg/l), which is permitted disposal to the land for irrigation (Sivananda, 2010). Hence, the treated effluents bring more area under irrigation, reducing the water scarcity problem, avoiding direct pollution of rivers, canals, surface water; conserving water and soil nutrients, reducing the need for an expenditure on chemical fertilizer, thereby helping the small and marginal farmer to retain in agriculture activities. Considering the above aspects, the present study was based on the objectives: 1) To discuss the socio-economic profile of farmers and 2) To estimate and compare the input use pattern, cost of cultivation, yield and returns per hectare of coconut using sago industrial treated wastewater and freshwater in Salem district of Tamil Nadu.

DATASOURCEANDMETHODOLOGY

In Tamil Nadu more than 400 sago processing units are functioning and of which 215 units are present in Salem district. Hence, Salem district of Tamil Nadu was purposively selected due to the location of highest concentration of sago processing units in the district — and due to the consequent pollution problem in the district. Attur taluk was purposively selected from within the Salem district, which is based on the location of maximum number of sago industrial units. From these selected taluk, three villages that have maximum number of sago units such as Ammapalayam (12 units), Thulukkanur (9 units) and Kattukkottai (11 units) have been ~~were~~ selected purposively. The number of farmers selected from each village was based on the probability proportional to size. A total of 360 farmers were selected for the present study. This consists of 1) farmers receiving treated wastewater from nearby industrial units (treated wastewater used farms within a 3 km radius from sago units) (180 farmers) and 2) control farms (farmers being distant from the source of industrial wastewater) (180 farmers). The data pertaining to the agricultural year 2021-22 were collected for the study during the month of November 2021–May 2022 with a multistage purposive sampling technique.

Cost of cultivation

Coconut being a perennial crop, the cost of cultivation is to include; fixed and variable cost by considering both the establishment cost and operation and maintenance cost (Raju *et al.*, 2015).

The establishment cost includes cost of digging of pits, value of planting material, cost of gap filling, value of manure (owned and purchased), value of fertilizer, value of human labour, value of machine power, value of plant protection chemicals, rental value of land and land tax. The operation and maintenance cost includes value of human labour, value of machine power, value of insecticides and pesticides, value of manure (owned and purchased), value of fertilizer, irrigation charges, land revenue and miscellaneous expenses. The fixed cost included: the amortized annual share of establishment cost, interest on fixed capital excluding land, rental value of owned land and depreciation. The variable cost includes all the operation and maintenance cost and Interest on working capital

Depreciation means declining in the value of the asset over the period of time, due to the wear and tear of its usage. Annual depreciation on individual items of fixed capital can be worked out by using straight line method and then aggregated to get the total annual depreciation (Reddy *et al.*, 2016).

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Amortization of Fixed Cost(Merritt,2013),=
$$\frac{P \cdot r \cdot [1 + r]^n}{[1 + r]^n - 1}$$

Where, A=Amortization cost,P=Total establishment cost,r=Rate of interest @ 6.25 percent (bank rate) and n=Number of years

Return analysis

Gross Income=(Quantity of main product × Price of main product)+(Quantity of by-product × Price of by-product)

Net Income=Gross Income-Total Cost

Benefit-Cost ratio is the ratio between gross return and total annual expense incurred for the coconut farming.

RESULTS AND DISCUSSION

A. Socio-Economic Status of sampler respondents in study area

The general socio-economic characteristics of the sampler respondents such as age, education, farming experience, farm size and annual income were tabulated and analysed with percentage analysis. The results of the analysis are presented in table 1

Table 1. Socio-Economic status of sampler respondents

| S.No. | Particulars | Treated wastewater irrigated farms | Control farms (Freshwater) |
|-------|---------------------------------------|------------------------------------|----------------------------|
| A | Age in years (Average) | 47.76 | 49.04 |
| B | Education | | |
| 1 | No formal education | - | 2(1.11) |
| 2 | Primary level | 7(3.88) | 20(11.11) |
| 3 | Secondary level | 66(36.67) | 94(52.22) |
| 4 | Higher secondary level | 57(31.67) | 36(20.00) |
| 5 | Collegiate level | 50(27.78) | 28(15.56) |
| C | Farming Experience in years (Average) | 25.88 | 28.79 |
| D | Farm size in hectares (Average) | 1.66 | 1.23 |
| E | Source of Income (₹ per farm) | | |
| 1 | On-farm income | | |
| | Crop income | 1,55,678(47.00) | 1,19,654(45.97) |
| | Livestock income | 87,345(26.37) | 71,267(27.38) |
| 2 | Off-farm income | 55,679(16.81) | 38,957(14.97) |

| | | | |
|---|----------------|---------------|---------------|
| 3 | Non-farmincome | 32,547(9.83) | 30,386(11.68) |
| | Grossincome | 3,31,249(100) | 2,60,264(100) |

Source:FieldSurvey,2022

Note:Figuresinparenthesesindicatepercentagetototal.

The averageageofthesamplerespondentsusingtreatedwastewaterwas47.76years whichareislightlylower as comparedtothatofcontrol farms(49.04years).Mostofthe respondents in treated wastewater irrigated farms have secondary level of education constituteconstitutingabout36.67per cent followedbyhighersecondarylevelwith31.67 percent, collegiatelevelwith27.78percent)andprimaryschoolwith3.88percent. Amongtherespondentsofthe controlfarms,52.22percenthada secondarylevelofeducation,20percent hasdhighersecondarylevel education,15.56per centhasdcollegiatelevel,11.11per centhad primary schoolofeducation,andonly1.11per centwereilliterate.Theaveragefarming experienceofthesamplerespondentsintreated wastewaterirrigatedfarmswas25.88years whichareislightlylowerascompared tothatofrespondents incontrol farms with28.79 years,whichimpliedthatmostoftheyoungfarmersinthestudyareaareareadytogowith usingtreatedwastewaterintheir farms. Theaveragefarmsizeofthesamplerespondentsin treated wastewaterirrigated farmswas1.66hectarewhichwasslightlyhigherthan thatof respondentsincontrolfarms(1.23).Theavailabilityofexcessquantityofwaterencourages thefarmerstousemoreunutilizedlandforperennial crops likecasuarina,eucalyptus,fodder cropsand coconut inthestudyarea.The averagegrossincomeofsamplerespondentsusingtreated wastewater irrigated farmwashighwith₹3,31,249 andincontrolfarms itwasabout₹ 2,60,264.

B. CostofcultivationofCoconut

i. InputsusepatternforthecultivationofCoconut

Thetotal input utilizedforthe cultivationof coconutincludingboth establishment and maintenancewaspresentedintable2.

Table2.InputsusepatternforthecultivationofCoconut(perha)

| S.No. | Inputs | Treatedwastewater irrigatedfarms | Controlfarms (Freshwater) |
|-------|----------------------------|----------------------------------|---------------------------|
| 1 | Seedling(numbers) | 153 | 176 |
| 2 | Gapfilling(no.ofseedlings) | 25 | 7 |
| 3 | Manures(tons) | 43.54 | 35.15 |
| 4 | Fertilizer(kg) | | |

| | | | |
|---|-------------------------------|--------|--------|
| | i.N(kg) | 196.43 | 367.56 |
| | ii. P(kg) | 203.12 | 316.3 |
| | iii.K(kg) | 64.43 | 85.2 |
| 5 | Plantprotectionchemicals(lit) | 5.3 | 2.2 |
| 6 | Totalhumanlabour(mandays) | 350 | 276 |
| | i. Familylabour | 160 | 167 |
| | ii.Hiredlabour | 190 | 109 |
| 7 | Machinepower(hrs) | 22 | 13 |

Source:FieldSurvey,2022

It could be seen from the table 2 that the average number of trees per hectare was found to be 153 for the farms using treated wastewater and 176 for the control farms. The treated wastewater irrigated farm used 43.54 tons of farm yard manure, 196.43 kg of nitrogen, 203.12 kg of phosphorous, 64.43 kg of potassium, 5.3 litres of plant protection chemical, 350 mandays man-days of total human labour and 22 hours of machine power. The total inputs utilized for the cultivation of coconut in the control farms were found to be 35.15 tons of farm yard manure, 367.56 kg of nitrogen, 316.30 kg of phosphorus, 85.20 kg of potassium, 2.2 litres of plant protection chemical, 276 mandays of total human labour and 13 hours of machine power.

ii. Cost of Establishment of coconut

The establishment cost of coconut crop upto the bearing stage included all the costs incurred for the initial establishment: like land preparation, digging of pits, planting material, gap filling, cost of manure, fertilizer, plant protection chemicals, human labour, irrigation cost, rental value of owned land and land tax. The total establishment cost of coconut crop was worked out to be ₹1,30,926.09 for the farms using treated wastewater and ₹1,09,576.61 for the control farms. Out of which, rental value of owned land contributed more with 37.26 per cent and 33.54 per cent for the farms using treated wastewater and fresh water, respectively.

Table 3. Cost of establishment of coconut farm for eight years (per ha)

| S.No. | Particulars | Treated wastewater irrigated farms | Per cent | Control farms (Freshwater) | Percent |
|-------|------------------|------------------------------------|----------|----------------------------|---------|
| 1 | Land Preparation | 2130.34 | 1.63 | 3120.45 | 2.85 |
| 2 | Digging of pits | 3855.67 | 2.94 | 4320.75 | 3.94 |

| | | | | | |
|----|----------------------------------|------------------|---------------|------------------|---------------|
| 3 | Plantingmaterial | 3060.00 | 2.34 | 3520.00 | 3.21 |
| 4 | Gapfilling | 500.00 | 0.38 | 140.00 | 0.13 |
| 5 | Manure | 8687.50 | 6.64 | 6427.50 | 5.87 |
| 6 | Fertilizercost | 5275.08 | 4.03 | 8795.91 | 8.03 |
| 7 | Plantprotectionchemical | 1325.00 | 1.01 | 550.00 | 0.50 |
| 8 | Humanlabour | | | | |
| | i. Family Labour (Imputed value) | 21304.50 | 16.27 | 20494.50 | 18.70 |
| | ii.Hiredlabour | 32958.00 | 25.17 | 20490.00 | 18.70 |
| 9 | Irrigation | 2450.00 | 1.87 | 4367.00 | 3.99 |
| 10 | Rentalvalueofownedland | 48780.00 | 37.26 | 36750.50 | 33.54 |
| 11 | Landtax | 600.00 | 0.46 | 600.00 | 0.55 |
| | Totalestablishmentcost | 130926.09 | 100.00 | 109576.61 | 100.00 |

Source:FieldSurvey,2022

Note:Figuresinparenthesesindicatepercentagetototal.

iii. OperationandMaintenancecostofcoconut

Theoperation andmaintenancecostswere workedout andtheresults arepresentedin table4. Thetotaloperationandmaintenancecostperyear afterattainingbearingageforthe farms using treated wastewater and control farms were found to be ₹ 33,905.26 and ₹31,239.65,respectively. Outofwhich,hired labourcontributedmorewith33.46percentin treatedwastewaterirrigatedfarmwhereasfamilylabourcontributedmorewith34.03percent incontrolfarms.However,manureandchemical fertilizercostwasfoundtobemoreforthe sample respondents using fresh water in control farms when compared with treated wastewaterirrigated farm.Thismaybebecauseof thepresenceoforganicandinorganic constituentsinthetreatedsagoindustrialwastewaterdischargedfromthesagounits.

Table4.OperationandMaintenanceCostofcoconutfarm(perha)

| S.No. | Particulars | Treated wastewater irrigatedfarms | Per cent | Controlfarms (Freshwater) | Percent |
|-------|-------------------------------|-----------------------------------|----------|---------------------------|---------|
| 1 | Fertilizercost | 5936.09 | 17.51 | 8994.56 | 28.79 |
| 2 | Humanlabour | | | | |
| | i.FamilyLabour(Imputed value) | 6289.50 | 18.55 | 10629.50 | 34.03 |

| | | | | | |
|---|--|----------|--------|----------|--------|
| | ii.Hiredlabour | 11344.50 | 33.46 | 2947.50 | 9.44 |
| 3 | Manure | 4834.50 | 14.26 | 5192.00 | 16.62 |
| 4 | Machinepower | 1875.50 | 5.53 | 1397.00 | 4.47 |
| 5 | Plantprotectionchemical | 960.17 | 2.83 | 554.09 | 1.77 |
| 6 | Landtax | 75.00 | 0.22 | 75.00 | 0.24 |
| 7 | Miscellaneouscharges | 2590.00 | 7.64 | 1450.00 | 4.64 |
| | Total operational and maintenancecost | 33905.26 | 100.00 | 31239.65 | 100.00 |

Source:FieldSurvey,2022

Note:Figuresinparenthesesindicatepercentagetototal.

iv. Costandreturnanalysisofcoconut

The total cost of cultivation, gross return, net returns and B:C analysis were worked out and results are presented in table 5.

Table 5. Cost and Return Analysis of coconut (per ha)

| S.No. | Particulars | Treated wastewater irrigated farms | Per cent | Control farms (Freshwater) | Percent |
|------------|--|------------------------------------|----------|----------------------------|----------|
| I | Fixed cost | | | | |
| 1 | Amortized Annual share of establishment cost | 26834.97 | 31.47 | 22459.12 | 31.22 |
| 2 | Depreciation | 4640.00 | 5.44 | 3298.76 | 4.59 |
| 3 | Interest on fixed capital | 3760.00 | 4.41 | 1947.67 | 2.71 |
| 4 | Rental value of owned land | 9689.13 | 11.36 | 7671.45 | 10.66 |
| | Total Fixed cost | 44924.10 | 52.68 | 35377.00 | 49.18 |
| II | Variable cost | | | | |
| 1 | Total operational and maintenance cost | 33905.26 | 39.76 | 31239.65 | 43.43 |
| 2 | Interest on working capital | 6450.00 | 7.56 | 5320.13 | 7.40 |
| | Total Variable cost | 40355.26 | 47.32 | 36559.78 | 50.82 |
| III | Total cost (I+II) | 85279.36 | 100.00 | 71936.78 | 100.00 |
| | Yield (in nuts) | | 12540.00 | | 12245.00 |
| | Price per unit | | 10.20 | | 8.50 |

| | | | |
|-----------|---------------------------|-----------|-----------|
| | Value of main-product | 127908.00 | 104082.50 |
| | Total by-product income | 3500.00 | 2100.00 |
| IV | Gross income | 131408.00 | 106182.50 |
| V | Net income | 46128.64 | 34245.72 |
| VI | Benefit cost ratio | 1.54 | 1.48 |

Source: Field Survey, 2022

Note: Figures in parentheses indicate percentage to total.

The total cost of cultivation of coconut crop per hectare per year was worked out to be ₹ 85,279.36 and ₹ 71,936.78 for the farms using treated wastewater and control farms, respectively. In treated wastewater irrigated farm, the total fixed cost was found to be ₹ 44,924.10 per hectare which contributes 52.68 percent of total cost. Out of which, the amortized annual share of establishment cost was contributed the maximum share with ₹ 26,834.97 per hectare. The total variable cost was found to be ₹ 40,355.26 per hectare which contributes 47.32 percent. In control farms, the total fixed cost and total variable cost were found to be ₹ 35,377 per hectare and ₹ 36,559.78 per hectare which contributed about 49.18 percent and 50.82 percent, respectively. The yield obtained was 12,520 nuts per hectare for treated wastewater irrigated [farm farms](#) and 12,245 nuts per hectare for the control farms. The price per nut was found to be ₹ 10.20 for the farms using treated wastewater and ₹ 8.50 for the control farms. The total value of main product was found to be ₹ 1,27,908 for the farms using treated wastewater and ₹ 1,04,082.50 for control farms. The total gross return ~~includes~~ including both the income from main product and by-product realised per hectare was ₹ 1,31,408 and ₹ 1,06,182.50 for the farms using treated wastewater and control farms, respectively. The net income per hectare of coconut was ₹ 46,128.64 and ₹ 34,245.72 for the farm using treated wastewater and control farms. The B:C ratio was found to be 1.54 and 1.48 for the farm using treated wastewater and control farm, respectively. The result of the B:C analysis clearly establishes the advantages of the farms receiving treated agro industrial wastewater for irrigation.

CONCLUSION

The major finding of economic analysis of coconut cultivation revealed that the gross income of the respondents of the sample farm using treated agro industrial wastewater was high at ₹ 1,31,408.00 as a result of the better yield of nuts (12540) as compared to that obtained by irrigation with fresh water in control farms (12245). The net income per hectare

of coconut was ₹46,128.64 and ₹34,245.72 for the farm using treated wastewater and control farms, respectively. The study, therefore, could establish that using treated industrial waste water for irrigation will be advantageous in terms of net returns and to an extent substitute use of fresh water for irrigation, besides helping to save on [the](#) use of and expenditure on organic and inorganic fertilizers. However, coconut is a perennial crop and the treated wastewater is used for irrigation continuously in the long run, it is necessary to take investigations for the presence of heavy metals in the soil, water and crop plants and their produce. This will allow for necessary further action in terms of [changes](#) in crops cultivated and [method](#) [methods](#) of irrigation. Thus, Government may also bring in policies to encourage the use of treated sewage wastewater for irrigation of seasonal or annual crops instead of perennial crops.

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