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Conversion of upland open vacant areas for profitable cultivation of cardamom by agroforestry approaches

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INTRODUCTION

Cardamom (*Elettaria cardamom* Maton) popularly known as the queen of spices is a native of high ranges of western ghats in South India. It is a ecofriendly and high value spice crop. Being pseophyte (shade loving), it is invariably cultivated beneath the ever green forest tree species. As there has been an alarming pressure on land in the recent years, it is imperative to bring the open vacant and uncultivated area by establishing the fast growing shade tree species for profitable cultivation of high value and low gestation spice crops like cardamom. Due to heavy rainfall and undulating nature of the topography of the lands situated in high ranges of western ghats, it is most important to minimise the soil erosion by adopting and establishing fast growing shade tree species.

Silveroak (*Grevillea robusta*), which belongs to the family proteacea is an exotic species, native of Australia. It has become very popular as an over head shade tree in coffee and tea estates. Besides afforestation in the vacant and open areas, it is also grown as avenue tree and in the gardens. Silver oak has adopted so well particularly to the high ranges of western ghats, now it looks as a native of India. With the favourable weather conditions, the trees grow as tall as 25 m and attain a girth of even as high as 2.5 m. The lower surface of leaves of this tree has light ash colour with silvery shining, hence the name silver oak (Krishnaswamy, 7). The tree is grown for dual purpose mainly as a shade for the plantation crops and also for manufacturing of light furnitures and other household purposes.

Cardamom has been by and large cultivated as an undergrowth beneath the mixed ever green shade tree species. As there is no published information available on the performance of cardamom exclusively beneath the shade of silver oak trees, a field investigation was undertaken to study the performance and productive potentiality of cardamom to work out the economic viability and ecologically sustainability in the vacant open marginal land afforestating with silver oak.

MATERIAL AND METHODS

An open vacant area devoid of any trees but with bushy growth of shrubs with an area of 4 ha was selected at Kadagadal village, Madikeri, Coorg, Karnataka for the study. The land which was uncultivated (called locally as *Bane)* was the site of the investigation. It is a flat land with gentle slopes and adequate natural drainage. The area receives a well distributed rainfall of 2500-2800 mm in about 125-140 rainy days. The soils are sandy loam, acidic, rich in available nitrogen, low in phosphorus and medium in potash.

The land was cleared by uprooting the bushes/shrubs. Silver oak saplings (10 months old) raised in the poly bags were planted during June, 1989 at a spacing of 30 m. Adequate care and attention was provided for the proper establishment and growth of silver oak.

After getting adequate shade provided by silver oak, cardamom was planted during June 1993 at a spacing of 1.5 m x 1.5 m. The High Production Technology followed for the cultivation of cardamom consisted of removing the lower branches of silver oak trees from time to time so as to allow adequate (60 to 65 per cent) of solar radiation; opening and filling of pits (45x45x30 cm) with forest top fertile soil and organic wastes like coffee husk; planting with 10 months old seedlings of CL-37; providing 8-10 rounds of irrigation during the summer - first week of January to last week of May (till the commencement of monsoon showers) by using the over head sprinkler irrigation; application of fertilizers @ 120:120:240 kg N, P_2O_5; K_2O per ha in four splits at quarterly intervals; application of farm yard manure @ 10 kg/ plant/year; adequate plant protection measures viz., application of 4 rounds of insecticides, 2 rounds of fungicides; regular schedule of after care namely weeding, mulching, earthing up, 3 rounds of trashing to facilitate better pest control, aeration and light infiltration; picking at right stage; drying and processing to retain green colour. Besides these cultural operations and input management, various other routine and need based operations were also carried out during pre-bearing and bearing periods (Korikanthimath and Venugopal, 5).

The data relating to various farm operations and inputs used during pre-bearing (establishment) and bearing periods were computed based on actual mandays employed and expenditure incurred on various other inputs. The total expenditure was calculated on the basis of prevailing wage rates as per the plantation act of Karnataka state during the corresponding years. The analysis was carried out as per methodology suggested by Prafulla Das (8).

RESULTS AND DISCUSSION

Planting of silver oak was done during 1989 and the cost analysis was carried out for it as shown in the table 1. A total cost of Rs. 3546/ha was incurred, which includes both maintenance as well as material cost to an extent of Rs. 1,311/ha (36.98 per cent) and Rs. 2,234/ha (63.02 per cent), respectively. Of the various operations carried out, the opening pits accounted a major cost share of 11.88 per cent, while in material costs, seedlings purchased accounted a higher per cent share of 51.92 of the total costs.

In the initial years of establishment of the cardamom plantation, the total cost on labour for 1993-94 and 1994-95 put

Table 1. Establishment of silver oak shade trees (1989-90 to 1992-93).

Particulars	Man (days)	Women (days)	Total	Amount (Rs.)	Percentage
a. Maintenance cost					
Jungle clearing	18	-	18	270	7.64
Pegs and peg marking	8	4	12	180	5.09
Opening of pits	28	-	28	421	11.88
Planting and staking	12	9	21	296	8.37
Application of fertilizer	2	6	8	142	4.00
Sub total	68	19	87	1311	36.98
b. Material costs					
Cost of seedling				1841	51.92
Cost of fertilizers				393	11.10
Sub total				2234	63.02
Total cost (Maintenance cost + material cost)				3546	

together was Rs. 11,685/ha. The per cent share of expenditure made towards weeding was highest to an extent of 17.37 followed by opening and filling of pits (16.25) and likewise. About 55.9 per cent of men labour force were involved with comparative low use of women labour, since strenuous operations are involved in this period. It is unlike in other large scale plantations wherein benefits other than the actual wages are paid. Hence, benefit like bonus, provident fund etc. are not taken into account (Table 2).

For the establishment of cardamom a total cost of Rs. 49,654/ha was invested on various inputs of which leaving depreciation value, labour charges of Rs. 11,685/ha followed by cardamom seedlings of Rs. 11360/ha costs accounted for higher per cent share of 23.53 and 22.88 per cent, respectively (Table 3).

A moderate maiden high crop yield of 1025 kg/ha was obtained in the third year after planting (1995-96). A subsequent decline in the yield was noticed in the following years reaching as low as 300 kg/ ha in 1998-99 (Korikanthimath *et al.,* 6). An average of 681.75 kg/ha was obtained (Table 4), which is 4.5 times more than the national average yield of 149 kg/ha. The tendency of low in the yield after peak yield could be attributed to the fact that the most of the vegetative buds would have already expressed their full potentiality due to conversion of majority of the suckers into bearing suckers in that particular year of peak yield, which is also due to the fact that the cardamom is a rhizomatous crop.

Table 2. Labour requirement during pre-bearing (establishment) period of cardamom (1993-94 and 1994-95) per ha.

Operation	Men (days)	Women (days)	Expenditure (Rs.)	Percentage
Preparation of pegs and peg marking	12	8	513	4.39
Opening and filling of pits	74	-	1,898	16.25
Opening and regular maintenance of drainage	16	-	424	3.63
Cost of planting	16	10	667	5.71
Slash weeding (3 rounds)	-	77	2,030	17.37
Mulching (2 rounds)	-	55	1,462	12.51
Light digging and earthing	55	-	1,411	12.08
Shade covering	10	5	384	3.29
Fertilizer and manure application	13	22	932	7.98
Plant protection measures	20	30	1,325	11.34
Irrigation assembling of pipelines	16	8	636	5.45
Total	232	215	11,685	

Table 3. Input requirement during pre-bearing (establishment) period of cardamom (1993-94 and 1994-95) per ha.

Input	I year (Rs.)	II year (Rs.)	Total	Percentage
Cardamom seedlings	11,110	250	11,360	22
Fertilizers	928	3,327	4,256	8
Manures (neem cake)	3,000	-	3,000	6
Pesticides	85	2,082	2,167	4
Electricity charges for irrigation	560	700	1,260	2
Labour (actual wages) charges	8,211	3,474	11,685	23
Maintenance of irrigation pump, sprayer etc.	450	495	945	1
Depreciation	8,500	6,480	14,980	30
Total	32,844	16,809	49,654	

In the course, the suckers which would have already undergone production die/ decay during the following season by giving rise to sister/daughter suckers, the yield of cardamom comes down drastically subsequently and then attains an average productivity (Korikanthimath, 3). It is a common phenomenon in the case of Malabar type in Karnataka. The yield of cardamom depends on the formation of adequate number of tillers and storage of source (photosynthates) in the rhizomes. Hence, the first 10 months is very important and it is imperative to follow the appropriate operations methodologically (Korikanthimath, 1).

Table 4. Yield of cardamom during various stages.

Year after planting/crop	Yield (kg/ha)(dry)	Percent of yield
1995-96	1025	41.41
1996-97	485	19.60
1997-98	665	26.87
1998-99	300	12.12
Total	2475	

It is evident from the table 5, that out of the various farm operations carried out, labour charges for harvesting/picking accounted for major costs of Rs. 17,724/ ha (60.50 per cent) followed by other operations. Normally 6-7 rounds of picking is done in a crop season. Harvesting involves picking of matured (ripened) and physiologically mature fruits from the

Table 5. Labour requirements during bearing period of cardamom (average of 4 crop seasons: 1995-96 to 1998-99) per ha.

Nature of work	Men (days)	Women (days)	Amount (Rs.)	Percentage
Mulching (2 rounds)	-	27.3	1,172	4.00
Trashing (3 rounds)	-	40.8	1,707	5.83
Cleaning the base of clumps	-	27.8	1,179	4.03
Maintenance of drainage	9.0	-	382	1.30
Slash weeding (2 rounds)	-	21.8	918	3.14
Shade regulation	7.5	-	320	1.09
Earthing up	57.3	-	2,438	8.33
Application of fertilizers & manures	10.0	11.0	894	3.05
Plant protection measures	10.0	14.3	1,036	3.54
Irrigation-assembling of pipelines	10.0	5.8	673	2.30
Picking/harvesting	-	441.8	17,724	60.50
Processing and grading	9.0	15.0	845	2.89
Total	112.8	605.6	29,294	

Table 6. Partitioning of total input requirement during bearing period of cardamom (average of 4 crop seasons) 1995-96 to 1998-99 per ha.

Input	Amount (Rs.)	Percentage
Fertilizers	3,578	8.17
Manures (neem cake + coffee compost)	2,150	4.91
Pesticides	2,356	5.38
Electricity charges for irrigation	830	1.89
Labour (actual daily wages) charges	29,294	66.87
Maintenance of drying kiln, irrigation pump, sprayer etc.	583	1.33
Total	43,805	

panicles. Delay in harvesting results in splitting up of capsules and damage by rodents and birds. Studies carried out on the influence of stage of harvesting on recovery indicated that percentage of recovery was 29 when harvested at ripened stage and 24 at physiologically mature stage as against 14 at immature stage (Korikanthimath *et al.,* 4; Korikanthimath, 3). Hence, for obtaining a higher recovery and performance, minimisation of splitting up of capsules by rodents and birds etc is required and cardamom capsules should be picked at a mature stage at intervals of 10-12 days. Thus, mobilising skilled and experienced labourers for timely harvesting is an important factor to get high crop recovery and returns.

The labour costs was highest to an extent of 66.87 per cent (Rs.29,294/ha) compared to other input costs. On an average of Rs. 43,805/ha was the total cost found to be incurred for the four crop seasons (1995-96 to 1998-99).

A total investment of Rs. 64,807/ha was made in cardamom plantations of

Table 7. Economics of cultivation of cardamom (per ha. basis).

Expenditure/returns	Amount (Rs.)
Investment/establishment	49,654
Compound interest on investment @ 14%	15,153
Total investment	64,807
Annuity value @ 14%	16,703
Total cost/year	60,508
Average production/ha (618.75 kg (dry)/ha)	1,85,975
Net returns	1,25,466
Cost of production/kg (dry) cardamom	97

Table 8. Financial feasibility measures (per ha. basis).

Particulars	Value (Rs.)
Net Present Worth (NPW)	2,72,029
Benefit Cost Ratio (BCR)	2.93
Pay Back Period (PBP) (Years)	2.30
Internal Rate of Return (IRR) (%)	80.73

which actual investment was Rs. 49,654/ ha while compound interest on investment @ 14% was Rs. 15153/ha (Table 6). A total cost of Rs. 60,508/ha was observed with an average yield level of 618 kg/ha amounting to Rs. 1,85,975/ha as average production and Rs. 1,25,466/ha as net returns. An average cost of production stood at Rs. 97/kg. Higher yields are known to bring down the cost of cultivation in cardamom (Korikanthimath *et al.,* 6; Korikanthimath, 1; Korikanthimath, 3) (Table 7).

The discounting cash flow measures viz., Net Present Worth (NPW) of Rs. 2,72,029/ha; Benefit Cost Ratio (BCR) of 2.93; Pay Back Period (PBP) of 2.30 years and Internal Rate of Return(IRR) of 80.73 suggested that investment on introducing cardamom in agri-silviculture is one of the agro-forestry approaches in conversion of upland, open, vacant areas for profitable cultivation of cardamom, a successful venture.

SUMMARY

The trial was carried out at Kadagadal village, Madikeri, Coorg, Karnataka to study an agro-forestry approach in conversion of upland, open vacant by resorting to afforestation with silveroak for profitable cultivation of cardamom. It was observed that a total cost of Rs. 3546/ha was incurred on establishing silver oak for shade. About 55.9 per cent of men and remaining 44.1 per cent of women labourers were involved in pre bearing period amounting for total establishment cost of Rs. 11,685/ha. (material costs + labour + depreciation) for cardamom. An average of 681 kg/ha was the yield obtained for the four crop seasons, which is more than 4.5 times than the national average yield of 149 kg/ha. The labour costs was highest to an extent of 66.87 per cent (Rs. 29,294/ha) in bearing period. A total investment of Rs. 64,807/ha was made with an average of Rs. 1,25,466 /ha as net returns. The discounting cash flow measures viz NPW (Rs. 2,72,029/ha); BCR (2.93); PBP (2.3 years), IRR (80.73) suggested the success of cultivation of cardamom in upland, open, vacant areas with agri-silviculture-agro-forestry approach (Table 8).

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