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Prospects of conversion of marshy areas — a techno-economic feasibility for cardamom cultivation

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INTRODUCTION

Till the late seventies, India was enjoying a near monopoly position in the world trade of cardamom. But situation since then has changed, as the share of the Indian cardamom in the world trade has declined due to intensive competition from Gautemala. The rate of growth of production in Gautemala during the late seventies has been over 14% compared with that in India of 0.7%. Thus, India's competitiveness in the world market has also suffered (Chandrasekhar, 3). In India 69% of cardamom plantations are below 2 ha, which are the main source of employment to small and marginal farmers (Anon, 1). Hence, adoption of intensive cultivation practices for higher yields especially in small holdings and efficient utilization of natural resources and creation of gainful employment are needed urgently (Bavappa, 2; Korikanthimath *et al.*, 12). As international market becomes increasingly competitive, only high productivity and low cost of production per unit area would ensure the survival of cardamom industry in India.

As there has been alarming pressure on land, it is imperative to put all the available land for the productive use by harnessing the natural resources effectively. The availability of land per head (caput) has gone down from 0.48 ha in 1951 to 0.20 ha in 1981 and is expected to go down still further to 0.15 ha in 2000 AD (Ghosh, 4). As cardamom is native of India and location specific, it is invariably cultivated in the high ranges of Western Ghats on the hills, hill slopes, flat lands and valley bottoms. In some plantations, it is not uncommon to come across a few patches of marshy low-lying areas that are not fit for cultivation of any of the commercial plantation crops. As cardamom is a moisture- and shade-loving crop, such marshy areas situated in the valley bottoms (ravines) covered on either side with natural forest ecosystem–planted either with other commercial crops like coffee and tea can be very well utilized for profitable cultivation of cardamom by providing adequate drainage and establishment of fast-growing shade tree species. A quite useful information in this regard has already been generated on the prospects of growing cardamom on swamp lands in Kerala located in the valley bottoms of tea gardens (Krishna, 14). A number of patches of such swamp lands also exist in the valley bottoms of the coffee plantations. As no published information is available on the utilisation of such swampy areas located in the coffee estates, an attempt was made to study the production potentiality of cardamom in Kodagu district of Karnataka.

MATERIAL AND METHODS

A low-lying marshy area of 1.3 ha was selected at M/s Boikeri Estate, Kedakal, Somwarpet taluk, North Coorg, Karnataka for the study. The marshy area is located in the valley bottom covered on either side with the hill slopes planted

Table 1. Labour requirement during pre-bearing (establishment) period of cardamom.

No.	Particulars	Expenditure (Rs/ha)			
		1992-93	1993-94	Total	(%)
1	Jungle clearing	1,976.0	-	1,970.0	2.98
2	Prepartion of peg and peg marking	592.50	-	592.80	0.89
3	Opening of pits	6,586.67	-	6,586.67	-
4	Filling of pits with fertile soil	4,940.0	-	4,940.0	7.45
5	Application of manure	4,940.0	5,281.68	10,221.68	15.42
6	Transportation of cardamom seedlings to the cardamom site	592.80	-	592.80	0.89
7	Planting of seedlings and staking	592.80	-	592.80	0.89
8	Mulching	237.12	253.52	490.64	0.74
9	Application of kaolin, castrol and neem cake	592.80	633.72	1,226.52	1.85
10	Weeding	790.40	845.07	1,635.47	2.47
11	Application of fertilizers	711.36	760.56	1,471.92	2.23
12	Plant-protection measures	790.40	845.07	1,635.47	2.47
13	Irrigation	1,976.0	2,112.67	4,088.67	6.17
14	Planting of fast-growing trees	197.60	-	197.60	0.30
15	Light digging	988.0	1,056.34	8,044.34	3.09
16	Opening and filling of pits for gap filling	39.52	42.25	81.77	0.12
17	*Katte* tracing	2,371.20	2,535.20	4,906.40	7.40
18	Opening of drainage channels/maintenance	3,952.0	105.63	4,057.63	6.13
	Total labour charges	32,867.47	14,471.71	47,339.18	71.43
	40% benefits of labour	13,146.99	5,788.68	18,935.69	28.57
	Total cost	46,014.46	20,260.39	66,274.85	100.00

with robusta coffee (*Coffea rolusta*) and pepper. This estate receives a well-distributed rainfall of 2,000 to 2,250 mm in about 125 to 145 rainy days. The soils are moderately acidic, rich in available nitrogen, low in phosphorus and medium in potash. In general, the soil of the marshy area is sandy loam in texture. Since the area was laden with excess moisture, adequate drainage was provided by opening the leader (main) and lateral (subsidiary) drains to remove the excess soil moisture during 1993. Adequate overhead shade was established by the fast-growing shade tree species. The seedlings of cardamom (Malabar type) Clone-37, which is a popular variety in Karnataka were

Table 2. Material input requirement during prebearing (establishment) period of cardamom.

Particulars	Expenditure (Rs/ha)			
	1992-93	1993-94	Total	(%)
Seedlings	9,880.00	450.00	10,330.00	27.95
Compost	4,940.00	5,969.33	10,909.33	29.51
Fertilizers (NPK)	3,518.93	3,518.93	7,037.86	19.04
Castor cake	757.47	757.47	1,514.94	4.10
Neem cake	757.47	757.47	1,514.94	4.10
Kaolin 82.33	82.33	164.66	0.45	
Plant-protection chemicals	2,726.88	2,763.11	5,489.99	14.85
Total cost	22,663.08	14,298.64	31,961.72	100.00

Table 3. Year-wise yield of cardamom.

Year after planting/crop		Yield (kg/ha)	Per cent of yield
2	(1993-94) I crop	135.0	3.25
3	(1994-95) II crop	1,510.0	36.38
4	(1995-96) III crop	747.0	18.0
5	(1996-97) IV crop	715.0	17.23
6	(1997-98) V crop	543.40	13.09
7	(1998-99) VI crop	500.0	12.05
	Total	4,150.40	100.0
	Average	691.67	16.67

planted at a spacing of 1.8 x 1.8 m.

As marshy areas selected for the study were devoid of any tree flora a mixture of multi-purpose fast-growing evergreen shade tree species comprising *balangi* (*Acrocarpus fraxinifolius*), *neeli* (*Bioscopia javanica*), *nogomara* (*Cidrella toona*) etc. were planted to provide adequate overhead filtered sunlight for cardamom.

The high production technology was followed in the plantations (study area), which consisted of periodical cleaning and deepening of leader and lateral drains to avoid water stagnation and regulating the overhead shade to allow 60-65% filtered sunlight; opening and filling of pits (45 x 45 x 30 cm) with forest top soil and organic wastes like coffee husk. Then 10 months old seedlings of Cl-37 were planted provided with 8-10 rounds of irrigation during the summer, from the first week of January to last week of May (till the commencement of monsoon showers) by using the overhead sprinkler irrigation system, where the water was conveyed through natural gravitational force from the farm pond located at the top of the

Table 4. Labour requirement during bearing (yielding) period of cardamom (average of 6 crop seasons: 1993-94 to 1998-99).

No.	Particulars	Amount (Rs)	(%)
1	Opening and filling of pits for gap filling	7.04	0.01
2	Weeding	725.28	1.17
3	Mulching	339.14	0.55
4	Earthing up	2,573.44	4.17
5	Compost application	6,437.75	10.42
6	Application of fertilizers, castor and neem cakes	1,131.56	1.83
7	Shade regulation	480.92	0.78
8	Plant-protection measures	1,251.91	2.03
9	Trashing, cleaning the base and exposing of panicles	4,414.48	7.15
10	Irrigation	3,152.50	5.10
11	Maintenance of drainage channels	297.65	0.48
12	Harvesting (picking)	19,925.99	32.26
13	Processing and grading	1,169.42	1.89
14	*Katte* tracing	2,214.64	3.59
	Total labour charges	44,121.72	71.43
	40% benefits of labour	17,643.69	28.57
	Total costs	61,770.41	100.00

estate. Fertilizers were applied @ 120:120:240 kg $N:P_2O_5:K_2O$ per ha in four splits at quarterly intervals and coffee compost was applied @ 10 kg/plant/year. Adequate plant-protection measures were taken viz., application of four rounds of insecticides, two rounds of fungicides, tracing and removal of *katte*-infested plants every months. A regular schedule of aftercare was adopted viz., weeding, mulching, light earthing up, three rounds of trashing to facilitate better pest control, aeration and light inflitration; 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, 12).

The data relating to various farm operations and inputs 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 year). Tabular analysis was performed to arrive at the cost of cultivation of cardamom. Annual depreciation on irrigation structure (drip irrigation) and other capital items used for cardamom were calculated at a fixed rate of 10 %. Apportioned establishment cost was computed by dividing the total establishment cost

Table 5. Partitioning of total input requirement during bearing (yielding) period of cardamom (average of 6 crop seasons: 1993-94 to 1998-99).

No.	Particulars	Amount (Rs)	(%)
1	Seedlings	75.00	0.08
2	Compost/FYM	6,895.44	7.31
3	Fertilizers	3,578.05	3.79
4	Neem and castor cakes	1,213.05	1.29
5	Plant-protection chemicals	3,239.50	3.43
6	Kaolin	150.94	0.16
7	Fuel for drying cardamom	2,274.03	2.41
8	Labour charges		
	Total labour charges	44,121.72	
	40% of other benefits	17,648.69	
	Total labour costs	61,770.41	65.47
9	Interest on working capital	5,543.75	5.88
10	Depreciation costs	1,000.00	1.06
11	Apportioned establishment cost	8,603.02	9.12
12	Total maintenance cost	94,343.19	100.00

Table 6. Economics of cultivation of cardamom over the years.

Year	Yield (kg/ha)	Gross return (Rs/ha)	Cost of cutlivation (Rs/ha)	Net returns (Rs/ha)
1992-93	-	-	68,677.2	-68,677.2
1993-94	135.0	40,500.0	46,713.3	-6,213.3
1994-95	1,510.0	528,500.0	102,465.3	+426,034.6
1995-96	747.0	156,997.0	78,002.7	+78,994.2
1996-97	715.0	143,021.45	88,536.1	+54,485.2
1997-98	543.4	164,998.0	82,400.0	+82,598.0
1998-99	500.0	175,000.0	101,905.3	+65,961.2
Average	691.67	172,716.78	77,522.1	+ 95,194.4

Table 7. Financial feasibility measures.

No.	Particulars	Value (per ha)
1.	Net Present Value (NPV)	387,655.82
2.	Benefit: Cost ratio (BCR)	4.47
3.	Payback Period (PBP)	2.14 years
4.	Internal Rate of Returns (IRR)	84.14%

with its life period of 12 years. The working capital includes the costs incurred for maintaining cardamom plantation. Since this investment was made during different periods of the year in cardamom production, the interest was calculated on 50% of the working capital. The returns were computed by multiplying each crop output with respective year's average realised prices of crops. Financial feasibility measures viz., NPW and BCR were computed at 14% discount rate to know the feasibility of investment.

RESULTS AND DISCUSSION

In the initial years of establishing the cardamom plantations, the total cost incurred on labour for 1992-93 and 1993-94 put together was Rs 66,274.57/ha. The percentage of expenditure made towards land preparation (jungle clearing, preparation of peg and peg marking; opening and filling of pits with fertile soil), transportation of cardamom seedlings to the site of planting and planting of seedlings and staking constituted the highest component (23.04%), amounting to Rs 15,281.07/ha. This was followed by aggregate costs incurred on labour on different operations like application of manure (15.42%), *katte* tracing (7.40%), irrigation (6.17%), opening of drainage channels (6.13%), light digging (3.09), weeding (2.47%), plant-protection measures (2.47%), application of fertilizers (2.23%), application of kaolin, castrol and neem cake (1.85%), mulching (0.74%), planting of fast-growing trees (0.3%) and opening and filling of pits for gap filling (0.12%) accounting for 48.39% (Rs 32,058/ha). Of the total labour costs during this period, benefits accrued to the labourers @40%, which constituted a considerable share of 28.57%, amounting to Rs 18,935.67/ha (Table 1). This finding is in conformity with the earlier study by Korikanthimath (10).

For the establishment of cardamom, a total cost of Rs 36,961.72/ha was invested on various inputs, of which fertilizers and organic manure (coffee husk-compost) put together formed a major share of 48.55% (Rs 17,947.19/ha) followed by seeddlings (27.95%), plant-protection chemicals (14.85%), and other remaining inputs constituted 8.65% (Table 2). This is in agreement with the studies of Korikanthimath (10).

A commercially worth moderate maiden crop yield of 135 kg/ha was obtained in the second year (19 months) after planting compared with 30 months required under the normal practice. A peak yield of 1,510 kg/ha was realised with an outstanding net return of Rs 4,32,737.95/ha in the third year (1994-95). A subsequent sharp decline in the yield was noticed (49.47%) in 1995-96, recording 747 kg/ha. Subsequently, the lowest yield of 500 kg/ha was noticed during 1998-99 crop season, which confirms the findings of Korikanthimath *et al.* (13) and Korikanthimath (6). This decline in the yield level is because cardamom is a rhizomatous crop and most of the vegetative buds would have expressed their full potential due to conversion of most of the suckers into bearing ones in that particular year during which the highest yield was obtained. Since the suckers that would have already undergone production, die (decay) during the following season by giving rise to sister/

daughter suckers, the yield decreases greatly subsequently (Korikanthimath, 10). This is a common phenomenon in the Malabar type commonly grown in Karnataka. The yield of cardamom depends on the formation of adequate number of tillers and storage of source (photosynthates) in the rhizomes. Hence adequate care during the first 10 months is very important and it is imperative to follow the appropriate cultural operations methodically (Korikanthimath, 7) (Table 3).

Farm operations carried out during the bearing period (1993-94 to 1998-99) crop seasons by taking up various cultural operations, and average labour employed are given in Table 4. Out of the various operations, harvesting accounted for 32.66% of the total labour costs (Rs 61,770.41/ha). It involves picking of ripened and physiologically matured fruits from panicles. Normally 6-7 rounds of picking is done in a crop season. Delay in harvesting results in splitting up of capsules and damage by rodents and birds. Studies carried out on the influence of the stage of harvesting on recovery indicated that the recovery was 29% when harvested at ripened stage and 24% at physiologically mature stage compared with 14% at immature stage (Korikanthimath *et al.*, 13; Korikanthimath, 10). Hence for obtaining a higher recovery and to minimise splitting up of capsules by rodents etc., 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 for obtaining high crop recovery and returns.

The average cost incurred on labour was the highest to an extent of 65.47% (Rs 61,770.41/ha), of which the actual total charges on labour were only Rs 44,121.72/ha whereas 40% of the benefits accrued to the labourers alone accounted Rs 17,648.72/ha. The requirement of labour was highest during 1996-97, i.e. 76.19% of the total costs of cultivation (Rs 88,536.10/ha). On the whole an average of Rs 94,343.19/ha/year was incurred including the cost of inputs as an average of 6 crop seasons (1993-94 to 1998-99). This cost also included interest on working capital, depreciation costs and apportioned establishment costs (Table 5).

The total investment towards establishment was Rs 68,677.26/ha during the first year (1992-93). Though the encouraging yield commenced in the second year itself, the returns were quite short of the establishment and variable costs, with a negative balance of Rs 3,157.30 in the second year, which was met out in 1994-95. A moderate yield of 135 kg/ha in the second year (19 months), planting was an encouraging factor to meet a major part of the establishment cost. On an average for the 6 crop seasons and 1 year of establishment period without any yield (beginning year, 1992-93), Rs 95,194.47 were obtained as net returns per year per ha with 691.67 kg/ha average yield, accounting for Rs 1,72,716.78/ha as gross returns with Rs 77,522.17/ha as total cost of cultivation. Higher yields are known to bring down the cost of cultivation in cardamom (Korikanthimath *et al.* 13; Korikanthimath,8; Korikanthimath, 10).

The discounting cash-flow measures viz., Net Present Value (NPV) Rs 6,27,995.71/ha, Benefit:Cost Ratio (BCR) of 3.12 and Internal Rate of Return (IRR) 84.14% indicate that investment on introducing cardamom in marshy areas is a viable and feasible proposition. The payback period of 2.14 years indicates that the investment will be recovered almost in 2 to 3 years.

SUMMARY

A model field investigation was conducted for converting the low-lying marshy area for cultivation of cardamom by adopting high production technology. The study area was completely marshy and was unsuitable for cultivation of any plantation crop. As cardamom is a moisture and shade-loving plantation crop, an attempt was made to bring the marshy area under cardamom cultivation by providing adequate drainage and raising fast-growing shade tree species. A detailed economic evaluation showed that by following intensive cultivation a moderate yield of 135 kg/ha could be obtained in the very second year after planting (19 months) comapred with 30 months required under the normal practice. A peak yield of 1,510 kg/ha was realised with an outstanding net return of Rs 4,32,737.95/ha in the third year (1994-95). On the whole an average yield of 691.67 kg/ha for 6 crop seasons (1993-94 to 1998-99) was obtained. Of the total costs, labour component accounted for a major share of 65.47% (Rs 61,770.41/ha), which highlights the generation of gainful employment opportunities for small and marginal farmers. The study revealed that the cultivation of cardamom in marshy areas would be an economically remunerative and ecologically feasible proposition, as the discounted cash flow measures viz., NPV (net profit value), BCR (benefit: cost ratio) and IRR (internal rate of return), justified the viability of cardamom cultivation. The payback period of 2.14 years indicated that the investment on cardamom can be met in 3 years by successful conversion of marshy areas.

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