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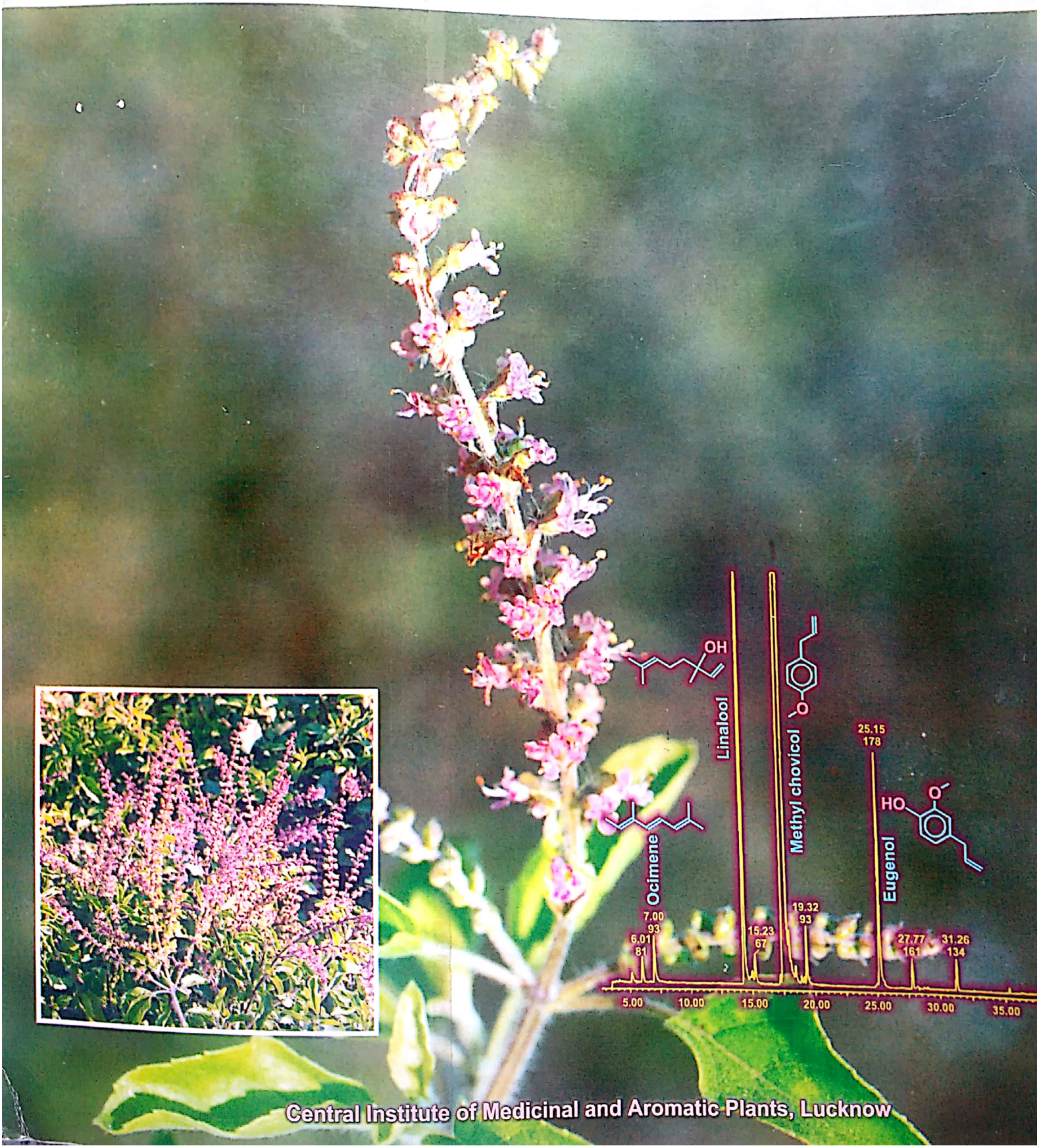

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A study for commercial cultivation of sweet flag (*Acorus calamus*) in Tumkur district of Karnataka

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Abstract

The commercial cultivation of medicinal plants to enhance the supplies will reduce the pressure on the depletion of wild sources. Sweet flag (*Acorus calamus*), possesses the medicinal properties and is used in Ayurvedic formulations, veterinary medicine, besides being a safer insecticide. *A. calamus* is cultivated in Tumkur district using sewage water as well as groundwater for irrigation. It is an annual crop and comes up very well under waterlogged, marshy conditions. The net return per acre was Rs 23,410 and 12,465 per acre in sewage and ground water irrigated farms, respectively. The primary market for sweet flag in Tumkur district in Karnataka is oligopsonic. The cultivation of sweet flag in water logged and urban fringe using sewage water is economically viable.

Key words: *Acorus calamus*, endangered species, sewage water, irrigation.

Introduction

Sweet flag (*Acorus calamus*) is indigenous to India. It is found in the wild in different parts of the country including the marshy tracts of Kashmir and Sirmoor in Manipur and Naga Hills [6]. It is used as an ingredient in at least forty Ayurvedic pharmaceutical preparations. The dried sweet flag rhizomes are used in medicinal preparations and as a flavour in liquor. It is also an appetite stimulator and is useful in treatment of epilepsy, delirium, hysteria and loss of memory [10]. Alcoholic extract of the calamus rhizome is found to control the microbes *Staphylococus aureus*, *Eschericia coli* and *Aspergillus niger* [8,11]. The extract showed antibacterial and anti-inflammatory effect on experimental animals [12, 14]. There are also reports that the rhizome extract has anti-epileptic, anti-asthmatic and anti-carcinogenic properties. The rhizome was found to possess pesticidal action against four pathogens namely *Pencillium digitatum*, *P. italicum*, *Diplodia natalensis* and *Alternaria tenuis* [3]. The most promising insecticidal activity of the extract of *A. calamus* was found against *Pyrilla perpusilla* (housefly) and mosquito [3,4]. In the essential oil of *A. calamus*, there was pesticidal action against the storage pest *Tribolium castaneum* nematicidal activity, the root knot nematode larvae [6].

Sweet flag is considered as "regionally vulnerable" in south India and "critical" in northern India where it is collected from the wild [2]. To meet the domestic demand for sweet flag import of 2.5 tonnes during 1995, valued Rs 3.27 lakhs was undertake[1]. During 1997, collection of sweet flag for exports was banned in order to save its extinction from the wild [13].

This article examines the relative profitability of sweet flag cultivation with the following specific objectives.

1. Estimation of costs and returns of cultivated sweet flag using ground water and sewage water.
2. To study the externalities in the cultivation of sweet flag using sewage and ground water.
3. To study the marketing channels and price spread in sweet flag.

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Table-1. Economics of sweet flag cultivation per acre using sewage water for irrigation in Tumkur city, Karnataka, India-1998

S.no.	Items	Quantity	Value (Rs)	Percent
1.	Seed material (Number of bundles)	99	2964	10.3
2.	Farm yard manure (Tonnes)	1.1	220	0.8
3.	Fertilizers (NPL in kgs)	71:25:12	1202	4.2
4.	Men labour @ Rs 75 per day of 8 hours	132	9240	32.1
5.	Woman labour @ Rs 50 per day of 8 hours	112	5600	19.5
6.	Bullock labour (pair days)	10	1454	5.1
7.	Hire charges of machine for processing	-	136	-
8.	Transportation cost	-	330	1.1
9.	Interest on working capital @ 12.5%	-	2643	9.2
10.	Rental value of land (for one year)	-	5000	17.4
11.	Total cost of production (1 to 10)	-	28789	100.0
12.	Gross returns @ Rs. 2360/qtl.	23.04	54374	-
13.	Commission @4% payable to commission agent	-	2175	-
14.	Net returns (12-11+13)	-	23410	-
15.	Benefit-cost ratio	-	1.81	-
16.	Cost of production per qtl (Rs)	-	1239	-

Note: 1. Each bundle of *Acorus* rhizomes contains 400 to 450 planting material
2. Sewage water is used for irrigation which otherwise would have gone waste

Materials and methods

The crop is commercially cultivated in Karnataka State in Tumkur town and in Tharati village in the Tumkur district. This crop is traditionally being cultivated since the last century in Tharati village. The crop is cultivated in 60 acres by fifty farmers, utilizing the ground water drawn from irrigation wells sunk in the command area of three irrigation tanks in Tharati village. Paddy is an alternative crop here as the demand for the crop for medicinal and cosmetic purposes is on increasing trend, since the last ten years. Sweet flag in addition, is being cultivated in Tumkur city (Gubbi gate) using the urban sewage water on 140 acres. This area is increasing every year as there is no alternate crop that could be grown using sewage water.

The field data for this study were collected from a random sample of thirty farmers each in Tharati village where the crop is cultivated using ground water and from Gubbi gate where the crop is cultivated using urban sewage water. The average area planted to sweet flag per annum is 0.7 acre per farm.

Data were collected on costs and returns, labor employment, water requirement and marketing for the year 1997-98 [7]. The sweet flag wholesalers in Tumkur regulated market were interviewed. A sample of four retailers were interviewed in Bangalore city, one of the terminal market for sweet flag.

Agricultural practices adopted by the farmers

First the fields are puddled incorporating farm yard manure and green leaf manure (*Pongamia pinnata*) to facilitate for impounding water. The 'growing –tops' (shoot) of sweet flag are collected from the previous crop. These are planted in March – April in soft mud

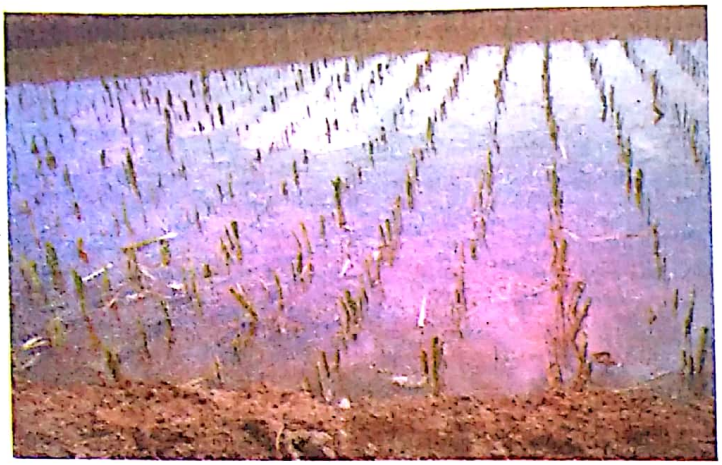

Figure 1. Sweet flag crop at transplanting

Figure 2. The length of sweet flag grown using groundwater

at 30 x 30 cm spacing (Figure-1]. The fields are flooded with 5 cm deep water. As the crop grows, the depth of water in the fields is raised to 10 cm till 20 days before harvest. The crop is weeded once every month for the first 4 to 5 months when the plants block the rows in a thick cover. Chemical fertilizers (usually urea / 17 All/ DAP) are used for top dressing in 2-3 split doses after 60 days of planting.

The leaf tips begin to turn yellow and this is the indication of crop maturity. Rhizomes are near the surface and grow 30-60 cm long [Figure-2]. They are harvested during February-March, when the crop attains 10-11 months. They are cut to 5 to 7.5 cm long pieces and sun dried for a day and later beaten and rubbed. This process of drying in sun and rubbing later is continued 2-3 times, till the leaf scales and fibrous roots are removed. For sewage water cultivated sweet flag, farmers use hand operated or power operated machines to remove the leafy scales and fibrous roots [Figure-3]. The dried rhizomes from ground water sweet flag contain 1.5 to 1.85 per cent calamus oil. The sewage water sweet flag contains 1 to 1.05 per cent calamus oil. Matured leaves (at the stage of harvesting) contain 0.10 to 0.12 per cent and 0.07 per cent to 0.082 per cent calamus oil in groundwater and sewage water irrigated conditions respectively. The average yield of sweet flag rhizome is 57.6 quintals /ha and 40 quintals/ ha in sewage and groundwater and sewage water irrigated conditions, respectively.

General observations

I. *Output and returns per acre*

The yield per acre of sweet flag was 23.04 quintals and 16 quintals in Sewage Water Sweet flag Farms (SWSF) and Ground Water Sweet flag Farms (GWSF), respectively. The higher yield on SWSF is due to the use of organic nutrient rich sewage water. SWSF realized gross return per acre of Rs. 54, 374 while it was Rs. 45,152 on GWSF. The output price was Rs. 2,822 and Rs. 2,360 per quintal for GWSF and SWSF respectively. The higher price for ground water sweet flag is due to the (i) thickness of the rhizome and (ii) high oil content of 1.85 per cent (called *Calamus* oil) as against 1.1 per cent in SWSF (This was tested with the laboratory assistance of Dr M Vasundhara, Associate Professor of medicinal and aromatic crops, University of Agricultural Science, Bangalore). The difference in gross return is due to lower yield of sweet flag on ground water farms and this is compensated by the higher price of sweet flag to some extent.

The increase in net returns on SWSF over GWSF to the tune of 88 per cent is due to higher yield of 23 quintals per acre of rhizomes on SWSF when compared with the yield of 16 quintals per acre on GWSF. This is due to (i) use of organically rich sewage water and (ii) savings in imputed irrigation cost to the tune of Rs. 2619 per acre which is responsible for the cost advantage of Rs 12.39 per kg, being the cost of production per kg of sweet flag on SWSF. The cost per kg of sweet flag on GWSF is Rs. 18.48. Thus, there is an overall saving in the cost to the tune of 50 per cent on SWSF on per kg basis, when compared with GWSF.

II. *Externalities in the cultivation of sweet flag*

The positive externalities due to the cultivation of sweet flag in Tumkur city are (i) the virtual elimination

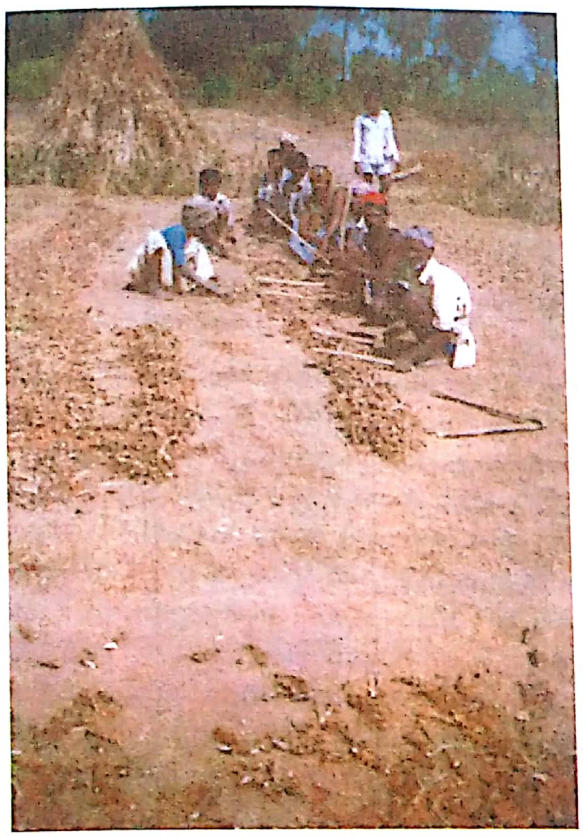

Figure 3. Sweet flag grown using groundwater being processed by manual labour

Figure 4. Harvesting stage of sweet flag grown using domestic sewage water

of the erstwhile mosquito menace in sewage water area. (ii) Improvement in the general health and appetite of farmers involved in cultivation of sweet flag (in both SWSF and GWSF) (iii) Scenic view for onlookers due to lush growth of sweet flag in Tumkur tank command. It is also reported that *A. calamus* crop used in waste water treatment in the aeration tank, secondary setting and subsequent post treatment for increased natural resources and P compound removal and disinfection [9,15]. Due to enhanced productivity of sweet flag from sewage water, the pressure on gathering sweet flag from the wild sources is accordingly reduced. In addition, due to extraction of Calamus oil and its use in cosmetics industry in the recent years, the sweet flag area is expanding and is likely to enhance further [Figure-4]. This will further widen the benefits of cultivating sweet flag in Tumkur city.

In this study, the SWSF farmers expressed no negative externalities since they did not incur any health expenditure even with a constant exposure to sewage water. Farmers realized that sweet flag was the only crop which could withstand the inherent quality of sewage water and reap substantial net returns. The virtual absence of foul smell of sewage water and mosquitoes and other human pests due to the cultivation of sweet flag were the other major benefits. As there is no cattle menace, there was no need for watch and ward against vertebrate pests. In addition, there was an excellent control of rodents in the sweet flag fields.

III. *Marketing of sweet flag*

The trading season is from March to May which is also the harvesting season of the crop. Even though sweet flag could be stored for at least one year without any deterioration, most of the farmers preferred to sell their crop immediately after the harvest due to their immediate cash needs and due to lack of storage space. Among the different market channels, 80 per cent of the produce was sold through the channel: Cultivator→ Trader → Commission agent → Pharmacy / End user. The dried rhizomes are sold to traders. This is an oligopsonic market since (about 45) farmers growing sweet flag using ground water from Tharati village

Table-2. Economics of sweet flag cultivation per acre using ground water for irrigation in Tharati Village, Tumkur District, Karnataka, India-1998

S. no.	Items	Quantity	Value (Rs)	Percent
1.	Seed material (Numbers of bundles)*	99	2475	8.0
2.	Green Leaf manure (Tonnes)	2	1523	4.9
3.	Farm yard manure (Tonnes)	6	1298	4.2
4.	Fertilizers (NPK in kgs)	18:5:5	361	1.2
5.	Men labour @ Rs 45 per day of 8 hours	220	9900	32.1
6.	Woman labour@ Rs 25 per day of 8 hours	182	4550	14.7
7.	Bullock labour (pair days)	14	1664	5.4
8.	Extraction of ground water (acre inches valued at Rs. 19.69/ acre inch)**	133***	2619	8.5
9.	Transportation cost (15 kms)	-	393	1.3
10.	Interest on working capital @ 12.5%	-	3098	10.0
11.	Rental value of land (one year)	-	3000	9.7
12.	Total cost of production (1 to 12)	-	30880	100.0
13.	Gross returns (Rs.2822/q)	16	45152	-
14.	Commission @4% payable to commission agents	-	1806	-
15.	Net returns (13-12-14) (Rs)	-	12465	-
16.	Benefit-cost ratio	-	1.40	-
17.	Cost of production per qtl (Rs)	-	1848	-

Note: * Each bundle contains 400 to 450 plants.
** Groundwater cost includes electricity cost used in pumping by considering, 5 (as HP of pumpset) X 0.75 Kilo Watt Hour (per HP as powder used) X price per Kilo Watt Hour (as Re 0.50) X Number of Hours of pump run for entire crop period (as 396.8 hours for the entire year, considering rainy season and stage of the crop) = Rs. 2619
*** Per hour of pump run (7575 gallons =) 0.335 acre inch of groundwater is applied through irrigation.

(selling 1100 quintals of produce) and (about 70) farmers cultivating sweet flag using sewage water from Tumkur city (selling 3300 quintals of produce) sell to just four traders in Tumkur regulated market. In the Tumkur market, 25 per cent of the sweet flag is from ground water and 75 per cent of sweet flag is from sewage water farms.

IV. *Sweet flag is not a notified commodity in the Tumkur regulated market*

It was noticed that sweet flag was not a notified commodity in the Tumkur regulated market. As the GWSF farmers received a price of Rs. 2781 per quintal, while SWSF farmers received Rs. 2375 per quintal, the traders maximized their net return by mixing sweet flag received from both the sources and sold at the rate of Rs. 3000 per quintal to the next trader in the chain realizing an effective margin of 17 per cent.

Discussion

In sewage water sweet flag farms (SWSF), 51.6 per cent of the total cost of production is contributed by human labor, followed by planting material cost which forms 10 per cent of the total cost (Table-1). In ground water sweet flag farms (GWSF) too, 46.8 per cent of the total cost of production is contributed by

human labor (Table-2). SWSF employs about 112 woman days per acre forming 46 percent of the total labor, while GWSF employs about 182 woman days per acre forming 45 per cent of the labor. In SWSF, the major portion (35 per cent) of labor cost is towards harvesting, followed by labor for irrigation (29 per cent). In GWSF, major portion (35 per cent) of cost is towards labor for irrigation followed by labor for harvesting (26 per cent).

Cultivation of sweet flag using sewage water is twice profitable than its cultivation using groundwater. The city municipalities / corporations can also encourage cultivation of this crop near the semi urban areas by utilizing the urban domestic sewage water, which results in better economic utilization of sewage water. This improves the quality of ambient environment. Commercial cultivation of sweet flag reduces pressure on gathering from the forests and conserves biodiversity. This also reduces burden on foreign exchange for meeting the domestic requirements.

References

1. Anonymous. 1998. Market –Trends in Production, Price, Export and Import, etc. *J Med Arom Pl Sci* **20**: 117-118.
2. Anonymous. 1997. Medicinal Plants of India, Guidelines for National Policy and Conservation Programmes, Foundation for Revitalisation of Local Health Traditions, Bangalore 10-11.
3. Arora R, Pandey GN. 1984. Effect of essential oils on citrus decay pathogens. *Biol Mem* **9**: 69-72.
4. Desmukh PB, Chavan SR, Renapurkar DM. 1982. A study of insecticidal activity of 20 indigenous plants. *Pesticides* **16**: 7-10.
5. Kulkarni VM, Rao PS. 1999. *In-vitro* propagation of sweet flag (*Acorus calamus*, Araceae). *J Med Arom Pl Sci* **21**: 325-330.
6. Kumar VS, Srivastava RK, Krishna Alok, Tomar VKS, Singh AK, Sushil Kumar. 2000. Cultivation, chemistry, biology and utilization of bach (*Acorus calamus*): a review. *J Med Arom Pl Sci* **22**: 338-348.
7. Lokesh GB. 1999. A resource economics study of sweet flag (*Acorus calamus*) in Tumkur district, Karnataka). Unpublished M.Sc (Agricultural Economics) thesis submitted to University of Agricultural Sciences, Bangalore-65.
8. Syed Meena, Riaz M, Chaudhari FM. 1991. The antibacterial activity of the essential oils of the Pakistani *Acorus calamus*, *Callistemon lanceolatus* and *Laurus nobilis*. *Pakistani J Sci Ind Res* **34**: 456-458.
9. Toni G. 1994. Advance microorganism removal from clarified sewage via plant covered soil filters. *Lenz Anton Korresp Abwasser* **41**: 2250-2.
10. Varier's Vaidyaratnam PS. 1994. Indian Medicinal Plants- Compendium of 500 species **1**: 51-52.
11. Vashi IG, Patel HC. 1987. Chemical constituents and antimicrobial activity of *Acorus calamus* Linn. *Comp Physiol Econ* **12**: 49-51.
12. Varde AB, Ainapure SS, Naik SR, Amladi SR. 1988. Anti-inflammatory activity of coconut oil extract of *Acorus calamus*, *Ocimum sanctum* and *Ocimum basilicum* in rats. *Indian Drugs* **25**: 226-228.
13. Ved DK, Anjana Mudappa, Dharashan Shankar. Regulating export of endangered medicinal plant species – Need for scientific rigour: Downloaded from the website: .www: iisc.ernet.in/~currsci/august/articles8.htm.
14. Vohora SB, Shah SA, Sharma K, Naqvi SAH, Dandiya PC. 1989. Anti-bacterial, anti-pyretic, analgesic and anti- inflammatory studies on *Acorus calamus* Linn. Annals of the National Academy of Medical Sciences **25** : 13-20.
15. Yus'kiv MR. 1987. Method of waste water treatment *Otkrytiya Izobret* **1**: 77.