Conservation of Endangered Medicinal plant: Management of Sewage water in urban fringes and water logged marshy lands in India

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Keywords: Sweet flag, medicinal plant, sewage water, groundwater, endangered species

Abstract

Farmers located in urban fringes discharging domestic sewage and farmers located in canal irrigation commands possessing water logged marshy soils can successfully learn from profitable cultivation of *Acorus calamus* (Sweet flag) medicinal plant, in addition experience positive externalities. Marginal land holders largely involved in its cultivation have in addition experienced positive external health benefits like virtual elimination of mosquito menace and foul smell, and enhancing scenic beauty. Sweet flag is identified as a critically endangered species. It is identified to possess medicinal properties and used in many Ayurvedic formulations, veterinary medicine and as bio pesticide. The net returns realized were Rs 23,410 and 12,465 per acre obtained using sewage water and groundwater for irrigation respectively. Thus, cultivation of Sweet flag in urban fringe using sewage water and on water logged and marshy soils using fresh water is economically and ecologically feasible.

Preamble

The shift to herbal and medicinal plant based medicines and cosmetics for human and veterinary health care is increasingly a recent phenomenon. This is increasing the effective demand for herbs and medicinal plants, thus facilitating ex-situ cultivation of medicinal plants as medicinal crops. *Acorus calamus* - the Sweet flag (English), Vacha (Sanskrit), Bach (Hindi), Baje (Kannada) is among such medicinal and aromatic plants being cultivated for its rhizome as the useful part. The plant is rich in medicinal properties and is accordingly used in at least forty (India's) 'ayurvedic' system of medicine. The rhizome is widely recognized by most farmers and rural households as it is frequently used in treating stomach related disorders especially among babies and children. The fact that already 27 patents have been registered on Sweet flag all over the world on different pharmaceutical uses and formulations, in itself is a testament for the potential and prospect of this medicinal plant. The rhizome exhibits pesticidal property against four pathogens viz., *Pencillium digitatum*, P. *italicum, Diplodia natalensis* and *Alternatira tenuis* (Arora and Pandey, 1984). The most promising insecticidal activity of A. *calamus* extract was found against *Pyrilla perpusilla* (housefly) and mosquito (Arora and Pandey, 1984, and Desmukh, Chavan and Renapurkar, 1982). The essential oil of A. *calamus*, was found to possess pesticidal action against the storage pest *Tribolium castaneum,* and nematicidal activity against the root knot nematode larvae (Kumar *et al*, 2000).

Demand, Red list and prospect for cultivation

Considering the uses, demand for Sweet flag is increasing at the rate of 10 per cent per annum. Currently, Sweet flag is gathered from the wild sources in addition to being cultivated. Due to increasing domestic demand, sweet flag was even imported[i]. During 1997, the collection of sweet flag for exports was banned in order to save the crop from

extinction in the wild. Accordingly, this plant was included in the Red list - described as "regionally vulnerable" in south India and "critical" in northern India[ii]. Thus, sweet flag is now declared an endangered medicinal plant, with economic importance. The National Biodiversity Act of India, 2002, promotes cultivation of medicinal plants, especially those endangered, to conserve the wild sources.

Innovative farmers in Tumkur town, Karnataka, India, have begun cultivating sweet flag using domestic sewage water, thus (i) reducing the nuisance of foul smell, (ii) increasing the scenic beauty of the land and (iii) realizing benefits of better health due to better ambient environment around sweet flag farms. This article examines the significance of cultivation of sweet flag using domestic sewage water and fresh (ground)water with the specific objectives as under:

1. Economics of Sweet flag cultivation using ground water and sewage water.
2. To study externalities in the cultivation of Sweet flag using sewage and fresh (ground)water.

Place and data

Karnataka is the lone State, where sweet flag is cultivated in India. The crop requires sumptuous water all round the year. In Tharati village of Koratagere taluk, Tumkur district, this crop is cultivated in 60 acres of marshy land by around fifty farmers, utilizing the ground water drawn from irrigation wells sunk in the command area of three irrigation tanks. As the demand for the crop for medicinal and cosmetic purposes is on the rise, Sweet flag in addition is cultivated in Tumkur town (with a population of 0.25 million), using domestic sewage water on 140 acres. This area is increasing every year as competing crop exists for this condition.

Field data for this study are collected from 30 farmers cultivating sweet flag using sewage water in Gubbi gate, Tumkur town. Field data are collected from a sample of another thirty farmers from Tharati village where the crop is cultivated using fresh

(ground)water. Data on costs and returns, labor employment, water used for irrigation, and externalities are estimated for 2005). Due to rise in demand for this crop for medicinal and cosmetic purposes, the area under the crop is increasing.

Economic performance of sweet flag

The productivity of Sweet flag per acre is 23.04 quintals and 16 quintals respectively on Sewage Water Sweet flag Farms (SWSF) and Groundwater Sweet flag Farms (GWSF). The higher yield on SWSF is due to use of organic nutrient rich sewage water for irrigation. GWSF realized gross return per acre of Rs. 54,374 ($ 1208) while it was Rs.45, 152 ($ 1003) on GWSF. The output price was Rs.2, 822 ($62.71) and Rs.2, 360 ($52.44) per quintal for the produce from GWSF and SWSF respectively. The higher price for GWSF is due to (i) better quality - thickness of rhizomes and (ii) high (calamus) oil content of 1.85 per cent as against 1.1 percent in SWSF. The difference in gross return is due to lower yield of Sweet flag on groundwater farms which is compensated by the higher price to some extent (Tables 1 and 2).

Table 1: Economics of Sweet flag cultivation per acre using sewage water in Tumkur urban fringe, India

Sl.No.	Items	Sewage water irrigated farms		
		Qty	Value (Rs)	Percent
1.	Seed material (Number of rhizomes)	29700	3112	10.3
2.	Farm yard Manure (Tonnes)	1.1	231	0.8
3.	Chemical fertilizers (NPK)		1262	4.2
4.	Man days	132	9702	32.1
5.	Woman days	112	5880	19.5
6.	Bullock pair days	10	1527	5.1
7.	Hire Charges of Machine for Processing (hours)	23.04	143	0.5
8.	Transportation Cost (Rs)		346	1.1
9.	Interest on working capital @ 12.5%		2775	9.2
10.	Rental Value of Land (one year)		5250	17.4
11.	Total cost of production (1 to 12)		30228	100.0
12.	Gross returns (Rs.2963/qntl)	23.04	57093	

13.	Commission @ 4 percent payable to commission agents.		2284	
14.	Net return (12 - 11 - 13) (Rs.)		24581	
15.	Net Return Per Rupee of total Cost		0.81	
16.	Cost of Production per quintal (Rs.)		1468	

The increase in net returns on SWSF over GWSF by 88 per cent is due to higher productivity of 23 quintals on SWSF when compared with 16 quintals per acre on GWSF. This is due to (i) cultivation of sweet flag using organically rich sewage water and (ii) savings in imputed irrigation cost by Rs.2619 per acre. Both these are 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 a overall saving in the cost by 50 per cent on SWSF, when compared with GWSF.

Table - 2: Economics of Sweet flag cultivation Per Acre in degraded land using Ground Water for irrigation in Tharati village, Tumkur District, Karnataka, India

Sl. No.	Items	Quantity	Value (Rs)	Percent
1	Seed material (Number 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/qntl)	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 power 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

Externalities in cultivation of sweet flag

Positive externalities due to cultivation of Sweet flag in Tumkur town are (i) virtual elimination of mosquito menace in SWSF area (ii) general health benefits and improvement in appetite of farmers and farm laborers cultivating Sweet flag, (iii) scenic beauty of sweet flag crop in outskirts of Tumkur town, erstwhile a nuisance spot, and (iv) reduction of pressure on gathering Sweet flag from the natural forests and (v) control of rodents in Sweet flag fields. It is also reported that *A. calamus* crop used in sewage water treatment in the aeration tank, secondary setting and subsequent post treatment for increased natural resources, P compound removal and disinfection (Toni, 1994 and Yus'kiv1987). In addition**, t**here is no cattle menace and thus no need for watch and ward against vertebrate pests. SWSF expressed no negative externalities as they did not incur any health expenditure, despite their constant exposure to sewage water.

Quality concerns

The dried rhizomes from GWSF contain 1.5 to 1.85 per cent calamus oil, while the SWSF contain 1 to 1.05 percent. Matured leaves (at harvest stage) have 0.10 to 0.12 percent and 0.07 percent to 0.082 percent calamus oil respectively from SWSF and GWSF respectively. The higher oil content for ground water Sweet flag is due to the (i) thickness of the rhizome and (ii) better management practice, iii) high productivity in SWSF due to higher organic matter. Medical practitioners were also happy to learn that heavy metals and hazardous contents were absent in SWSF, since sewage water is was free from iindustrial effluents.

Implications and Prospects

Cultivation of sweet flag using sewage and fresh water is profitable and ecologically sound as it exerts positive externalities. In addition to providing employment and income opportunities to marginal farmers and women labour, farmers indicated that their overall health improved due to their regular exposure to the crop during cultivation. Thus, sweet flag can be encouraged in urban fringes and marshy/ waterlogged conditions in developing countries like India for better economic utilization of sewage water with least cost and productive use of degraded land, as the crop is capable of withstanding domestic sewage and water logged conditions. In addition, such a commercial cultivation of sweet flag conserves biodiversity (in the wild) and reduces burden on forest sources. Sweet flag is thus crucial on the count that it offers as the lone alternative crop which could be cultivated using sewage water in urban / semi urban areas, where disposal of sewage is a predicament and in water logged areas of canal irrigation commands, where drainage is a predicament.

Reference

1. Arora R, Pandey GN. 1984.Effect of essential oils on citrus decay pathogens. *Biol Mem* **9**: 69-72
2. Desmukh PB, Chavan SR, Renapurkar DM. 1982. A study of insecticidal

activity of 20 indigenous plants. *Pesticides* **16:** 7-10

3. Kumar.V.S., Srivastava.R.K., Alok Krishna., Tomar.V.K.S., Singh.A.K., and Sushil kumar., 2000 Cultivation, chemistry, biology and utilization of batch (*Acorus calamus*) : a review, **22 :** 338-348

4. Toni G.1994. Advance microorganism removal from clarified sewage via plant covered soil filters. *Lenz Anton Korresp Abwasser* **41:** 2250-2

5. Yus'kiv MR. 1987. Method of wastewater treatment. *Otkrytiya Izobret* **1:** 77.