



## SUSTAINABLE USE OF GROUNDWATER RESOURCE IN DRY AGROCLIMATIC CONDITION: ECONOMICS OF GROUNDWATER IRRIGATION IN FIG CROP IN KARNATAKA

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### ABSTRACT

Sustainable use of groundwater resource in the cultivation of fig crop is examined in a dry agro-climatic zone of Karnataka. Data were collected from 35 farmers cultivating fig during 2002. Use of drip irrigation, about 40 per cent of irrigation water could be saved as compared with traditional methods of irrigation. This has enhanced the value of the precious groundwater. Net returns low groundwater user group in fig were Rs.21781, Rs. 33037 and 48079. for medium water user group the corresponding net increases were Rs.26480, Rs.45104 and Rs.43184 that the returns increases of were third fourth and fifth year respectively Rs.11150, Rs.47058 and 52000 In another comparison in terms of net returns per rupee of cost of groundwater, the IRR was low water user, group medium water user group as compared with high water user group 39.39 % 49.19 % and 50.95 % the Benefited cost ratio was 2.17, 2.77 and 2.66 for the said groups.

**KEY WORDS:** Low water user (LWU), Medium water user (MWU), High water user (HWU).

### INTRODUCTION

Fig, *Ficus carica*, is one of the ancient fruits known to mankind which also finds its mention in the Bible. It is reported to be under cultivation from 3000-2000 BC in the eastern Mediterranean region. Karnataka is the eighth largest state of India and 36,22,921ha fig is becoming popular in dry zones of Karnataka where horticultural crops are grown extensively. Well suited to drip irrigation technology, low labour requirement, high profits, export earnings and government policies. In Karnataka, in this context, the present study is carried out with the following specific objectives, to estimate the groundwater use per acre in fig crop and analyze the investment capacity of farmers in coping mechanism in the wake of groundwater scarcity.

### METHODOLOGY

The study was conducted in Hagaribommanahalli taluk in Bellary district Karnataka the list of fig growers was collected from the Department of Horticulture the field data were collected from the sample of 35 farmers, the data were collected during February 2002. Farmers adopted drip irrigation on their farm due to acute scarcity of groundwater. The farmers were interviewed personally using a structured pre tested schedule. The data pertaining to socio-economic aspects, land holding, cropping pattern,

groundwater use for different crops, coping mechanisms used to overcome the groundwater scarcity and details pertaining to fig cultivation were obtained. To estimate the groundwater use by crops, details of the number of micro tubes per plants, discharge of each micro tube per hour, number of hours to irrigate the plant and number of plants in the farm were collected from the sample farmers

### FARMERS CLASSIFICATION

Post stratified based on the volume of groundwater used per acre of gross irrigated area. Sample size small, large and medium farmers, classified according to groundwater used per acre in such a way that the frequency of farmers in each class is almost comparable. For fig farmers groundwater use up to 22 acre inches per acre formed low groundwater user group, farmers using between 22 and 26 acre inches per acre constituted medium groundwater user group, and farmers using more than 26 acre inches per acre belong to High groundwater user group.

### Well age and well life

To reemphasize, the irrigation well refers to well that is 'functioning' at the time of collection of field data the age of the well was estimated as the year 2002 minus the year of well construction or sinking or drilling). To be explicit, the average 'age' of the well-included 'age' of those wells, those are still functioning. The general formula used is:

$$\text{Average age of well is estimated as } = \frac{\sum_{i=0}^n (f_i X_i)}{\sum_{i=0}^n (f_i)}$$

Where, f = number (frequency) of wells yielding irrigation groundwater in each age group,  $X_i$  = Age group of wells (0, 1, 2, 3,.....n in years), i= ranges from Zero to n, where n refers to the longest age of the well in the group.

## Economics of groundwater irrigation in fig crop in Karnataka

Wells constructed during the year 2002 and still functioning at the time of field data were assumed to have zero age, as the effect of interference is to increase both the initial and current failures. However, very few wells were drilled during the year 2002.

In a nutshell, the formula for amortized cost is:  
**Amortized cost of irrigation bore well (BW)** = (Amortized cost of BW + Amortized cost of pump set + Amortized cost of conveyance + Amortized cost of overground structure + Repairs and maintenance cost of pump set and accessories).

Amortized cost of BW = {[Compounded cost of bore well \* (1+i)<sup>AL</sup>]/ [(1+i)<sup>AL</sup>-1]}

Where,

AL = Average life of bore well = 9 years, as indicated by the study.

Compounded cost of bore well = Historical cost of Bore well\*(1+i)<sup>(2002-year of construction)</sup>

The amortized cost of irrigation for each crop is worked out by multiplying the cost per acre-inch of groundwater with the number of acre-inches of groundwater applied for each crop. The Total cost of irrigation is thus apportioned over individual crops according to the groundwater used in each crop. Thus,

**Cost per acre inch of ground groundwater** = [Total amortized cost of irrigation from all wells] divided by (Total acre inches of groundwater used for irrigation in a year]

## RESULTS

**TABLE 1:** Costs and returns on LWU in Fig cultivation (Rs per acre)

Particulars	I year	II year	III year	IV year	V year
<b>Establishment cost</b>					
Planting material	1250				
Land preparation	1026				
Transport of inputs	307				
Fencing	2070				
Digging pits and planting	873				
Sub total	5526				
Annual establishment cost	993	993	993	993	993
<b>Production cost</b>					
Staking	2778	1656	1811	1918	1900
Fertilizers application	3735	3620	3752	3850	3985
Manures application	2178	2171	2600	2510	2650
Plant protection chemicals	3142	3000	2850	2971	3500
Weeding	1200	1285	1320	1400	2000
Irrigation cost@ (Rs 162.9 per acre inch for 17.47 acre inch)	2846	2846	2846	2846	2846
Labour charges for pruning	2487	2571	2428	2785	2428
Labour charges for weeding	508	447	500	500	500
Labour charges for harvesting	166	236	263	289	263
Transport of produce			192	200	192
Grading			139	170	139
Packing cost			154	160	154
Consultancy fee per year	370	370	370	370	370
Sub total	19410	18202	19225	19969	20927
Total cost	20404	19196	20219	20963	21921
<b>Income</b>					
Yield (kg/acre)			1500	2000	2500
Price per / kg	28	27	28	27	28
Gross returns	0	0	42000	54000	70000
Net returns per acre (Rs)	-20404	-19196	21781	33037	48079

Note: LWU (Low water user group)

### Fig crop- LWU

(Table1).The cost per acre calculated to Rs. 5526 in the first year. The annual establishment cost was Rs. 993 per acre fencing with Rs.1026 was the important activity in establishing fig farm. Fertilizers (Rs.3735) and plant protection chemicals Rs.314 covered a major share in production cost in the first year and the same where Rs.3985 and Rs.3500 in second year. Irrigation costs at the rate Rs.162 per acre-inch of water used, Rs.2846 per acre.

Fig crop begins to bear fruits in the third year and gross return in the third year where Rs.42000 increases the gross return increases and reached Rs.70000 in fifth year. From third year onwards the profit to flow and it was Rs. 21,781 Rs. 33,037 and Rs. 48,079 in successive years respectively. Similar results have observed by Chal, J.S., (1989).

**Fig crop- MWU**

Establishment cost was Rs. 6919 per acre, fencing Rs.2590 followed by land preparation Rs.1850 to Rs. 18184 per acre in the first year and fertilizer cost and irrigation cost were the items of high expenditure (Rs. 4156 and Rs. 2806 respectively in the first year and Rs. 4025 and 2806 in fifth year). The amount spent on different items does not vary much over years. The total production cost per acre varies

from in Rs. 18848 (second year) to Rs. 22356 (fifth year). From the third year onwards fig starts yielding. MWU group. Net returns were Rs. 26480 on first year and fifth year Rs. 43184 in second years. It turns positive, in third year and the gross income was Rs. 45630 that year. In fourth and fifth year, the gross return was Rs. 64380 and net return Rs. 65540 respectively (Table.2).

**TABLE 2:** Costs and returns on MWU in Fig cultivation (Rs per acre)

Particulars,	I year	II year	III year	IV year	V year
Establishment cost					
Purchase of Plant materials	1421				
Land preparation	1850				
Transport cost of inputs	327				
Fencing cost	2590				
Opening of pits Planting	731				
SUB TOTAL	6919				
Annual establishment cost	1244	1244	1244	1244	1244
Production cost					
Staking cost	2778	1656	1811	1918	2000
Fertilizer cost	4156	3529	3418	3587	4025
Manure cost	2433	2211	2050	2033	3650
PPC cost	2433	2611	2800	2689	3185
Irrigation cost@ (Rs 159.8per acre-inch for 23 acre inch	3675	3675	3675	3675	3675
Labour Weeding cost	1500	2000	2500	2800	3000
Labour Pruning cost	258	245	321	289	350
Labour Harvesting cost		129	160	185	281
Transport cost of output		192	200	192	165
Grading cost		139	170	139	160
Packaging cost		154	160	154	250
Consultancy fee	370	370	370	370	370
Sub Total	17603	16911	17635	18031	21111
Total cost	18848	18156	18880	19276	22356
Income					
Yield (Kg/acre)			1620	2220	2620
Price / kg(Rs)	28	27	28	29	28
Gross Returns	0	0	45630	64380	65540
Net Returns per acre (Rs)	-18847	-18155	26480	45104	43184

Note: MWU (Medium water user group)

**Fig crop- HWU**

The establishment cost amounted to Rs.5292/acre and the fencing and plant materials Rs. 2070 and Rs. 1140 where the major items of the annual establishment cost of Rs. 1058 per acre. The production cost was Rs.19035, Rs.17946, Rs.17849 and Rs.19022 and Rs.20499 year

respectively in second, third years and fourth and fifth year). The gross returns obtained were Rs.29000 profit generated in the from third, fourth and fifth are year Rs. 66080 and Rs.72500 per acre respectively. Net returns were Rs.11150 on first year and fifth year Rs.52000. similar results have observed by Janakarajan, S. (1993.) (Table 3).

**TABLE 3:** Costs and returns on HWU in Fig cultivation (Rs per acre)

Particulars	I year	II year	III year	IV year	V year
Establishment cost					
Purchase of Plant materials	1140				
Land preparation	909				
Transport cost of inputs	327				
Fencing cost	2070				
Opening of pits Planting	846				
Sub total	5292				
Annual establishment cost	952	952	952	952	952
Production cost					
Staking cost	2778	1656	1600	1750	1800
Fertilizer cost acre	3525	4250	4395	4250	4585
Manure cost	3344	2211	2050	2083	3650
PPC cost	3536	3056	3300	3185	3185
Irrigation cost@ Rs106.8 per acre inch for 26 acre inch	2777	2777	2777	2777	2777
Labour Weeding cost	1250	1598	1300	2500	2000
Labour Pruning cost	350	375	385	300	325
Labour Harvesting cost	154	204	218	281	281
Transport cost of output		169	145	165	165
Grading cost		140	160	160	160
Packaging cost		189	198	250	250
Consultancy fee	370	370	370	370	370
SUB TOTAL	18084	16995	16898	18071	19548
Total cost	19035	17946	17849	19022	20499
Income					
Yield (Kg/acre)			1000	2360	2500
Price per/ kg (Rs)	28	27	29	28	29
Gross Returns	0	0	29000	66080	72500
Net Returns	-19035	-17946	11150	47058	52000

Note: HWU (High water user group)

The investment on fig garden was economically viable in all the three groups of farmers. The net return per acre of in fig range from Rs.49778 to Rs.55110, the BC ratio is

2.17, 2.77 and 2.66 respectively the crop is economically viable to invest on Fig crop (Table.4).

**TABLE 4:** Evaluation of investment in Fig garden different water use groups

Particulars	LW U	MWU	HWU
Discounted cost	25428	19383	18719
Discounted return	55110	53778	49778
Benefited cost Ratio	2.17	2.77	2.66
Net Present Value (Rs)	29681	31557	31058
Internal rate of return (%)	39.39	49.19	50.95

Note: LWU (Low water user group) MWU (Medium water user group) HWU (High water user group)

## CONCLUSION

The net returns were higher among HWU Group of farmers Rs.52000 per acre followed by MWU group of farmers Rs.43184 and lastly LWU group (Rs.48079) per acre. But the benefit cost ratio was highest for MWU farmers 2.77 followed by HWU group 2.66 and LWU group 2.17. The MWU groups of farmers were achieving a NPV of Rs.31558 per acre. This amounted Rs.31059 and Rs.29682 per acre for HWU group and LWU group respectively. The IRR was 39.39, 49.19 and 50.95 % respectively in low, medium and high water use groups. Similar finding have observed by Anand, P. (1994).

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