



A study on net returns from various sources and incremental net returns to the farmers of cauvery command areas: An economic analysis

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Abstract

In India farmers Welfare-oriented legislations since independence resulted in abolition of *inamdari* landholding pattern and hereditary village offices? Also, there were changes in the land use pattern resulting increase in net returns in farming economy. The gradual spread of alternate means of irrigation (bore well and use of electric pumps) contributed to increase in farm income. In this study, Net returns from various sources and incremental net returns of the Farmers due to canal water of Cauvery command areas is studied in Tumkur district, which is known as hard rock areas of Karnataka State. This study is a modest attempt of analyzing the Net returns from various sources and incremental net returns to the Farmers of Cauvery command areas under three situations of recharge in Tiptur taluk, Tumkur district of Karnataka. Here the irrigation wells located under canal command (GWCI) (Gadabanaalli), the irrigation wells located under tank command (GWTI) (Echanur), receiving the Hemavathy river water and another village Kibbanahalli where groundwater wells are located independently without canal or tank command (called groundwater under sole irrigation GWSI), which depend only on rainfall source have been considered. The net return per rupee of water, the net return per kg of output, is higher in both GWTI and GWCI compared to GWSI. Considering the income from Agriculture, non-agriculture and livestock, the net return per acre of net cropped area is the highest in GWTI and GWCI compared with GWSI. This shows that in addition to agriculture, the GWTI and GWCI farms have exhibited efficiency even in non-agriculture and livestock sources of income when compared with medium and large farmers. The incremental net return is computed between GWTI and GWSI, it turns to be positive for all sample farmers. The supply of water through channel system has contributed substantially for farmers who are totally dependent on agriculture.

Keywords: farmers, net returns, command area, crops, canal, well irrigation

Introduction

In India farmers Welfare-oriented legislations since independence resulted in abolition of *inamdari* landholding pattern and hereditary village Offices. Also, there were changes in the land use pattern resulting increase in net returns in farming economy. The gradual spread of alternate means of irrigation (bore well and use of electric pumps) contributed to increase in farm income. Groundwater development in the case of hard rock areas is threatened by uncertainties *inter alia* nature of rock type, type of aquifer, number and type of wells per unit of utilizable groundwater, while surface water bodies have pervasive influence on groundwater use in a specific region and overexploitation of groundwater is resulting in progressive decline in the productivity of wells, increasing the implicit cost of lifting of water due to declining water levels. However, groundwater is the major source of irrigation in Karnataka especially in rain fed south-eastern districts of Kolar, Bangalore, Tumkur and Chitradurga. It is the key component in agricultural income in these areas.

In this study, Net returns from various sources and incremental net returns of the Farmers due to canal water of Cauvery command areas is studied in Tumkur district, which

is known as hard rock areas of Karnataka State. The study area is covered by the Hemavathy river basin. In addition, in parts of the central Dry agro-climatic zone of Karnataka, in the Cauvery basin, the river Hemavathi is put to productive use. For example, in the process of getting the crucial and vital drinking water for the city of Tumkur, the riparian areas on either sides of the flow of the river are benefited from groundwater recharge. The Hemavathy masonry dam is constructed in Gorur in Hassan District which impounds 78 TMC of water assuming 50 percent dependability. The reservoir fills between June and September, during the south west monsoons. And the depletion period is October to May. The Tumkur branch canal from the Hemavathy left bank canal which brings drinking water to Tumkur city is 240 kilometers long carrying 1429 cusecs of water. In the year 1998, the water was let into the newly constructed Tumkur branch canal. While the water was being conveyed to Tumkur city, the riparian villages apparently did not get the benefit of groundwater recharge as the dimension of canal was not large enough to have appreciable percolation, which result on positive impact on Farmers income in these areas.

This study is a modest attempt of analyzing the Net returns

from various sources and incremental net returns to the Farmers of Cauvery command areas under three situations of recharge in Tiptur taluk, Tumkur district of Karnataka. Here the irrigation wells located under canal command (GWCI) (Gadabanaalli), the irrigation wells located under tank command (GWTI) (Echanur), receiving the Hemavathy river water, with a water spread of 363 acres and another vilallge Kibbanahalli where groundwater wells are located independently without canal or tank command (called groundwater under sole irrigation GWSI), which depend only on rainfall source have been considered.

Methodology

Selection of the Sample Villages and Sampling

For identifying the sample villages, the resource persons from department of agriculture, irrigation, biodiversity, forestry (Vanavikasa) cooperative societies and Gram panchayats in the villages were approached. For comparison of the relative performance of the groundwater recharge in Tiptur taluk, Irrigation wells located under Hemavathy canal command (GWCI), the System tank command (Echanoor) (GWTI) and the groundwater wells under sole irrigation (GWSI), where the recharge is largely by rainfall (Kibbanahalli) have been chosen in consonance with study objectives in the Hemavathy river sub-basin of Cauvery river basin as under:

1. Groundwater wells for irrigation located under system tank irrigation command (GWTI): here such wells are recharged by system irrigation tank (sample of 35 farmers)
2. Groundwater wells for irrigation located under canal command (GWCI): here such wells are recharged by canal irrigation command (sample of 35 farmers)
3. Groundwater wells for irrigation located independently of tank or canal command (GWSI); here such wells are recharged largely by rainfall and acts as a control situation (sample of 35 farmers).

Sample Size

For this study, only farmers possessing irrigation wells in each of the three scenarios have been chosen. Hence a random sample of 35 farmers was drawn from each of the three scenarios, thus, totaling 105 for the purpose of this study.

Analytical Frame Work

Measures of Central Tendency and Ratios

Weighted average was computed in respect of socio-economic features, cropping pattern, cost of cultivation and returns from crop activities and access to groundwater. Ratios and percentages were employed to analyze the cropping pattern and cropping intensity. Simple averages, ratio measures, percentages and proportions are computed in order to draw meaningful inferences and to facilitate comparison of the average farm situation in Irrigation wells located under tank command (GWTI) i.e., System tank, Irrigation wells located under canal command (GWCI) and Irrigation wells located under sole irrigation, i.e. located neither under tank or canal command (GWSI).

Economics of Irrigation

The cost of cultivation is the summation of amortized cost of

irrigation, cost of human labour, bullock labour, machine hours, seeds and fertilizers, application of manure, plant protection measures, bagging, and transporting, cost of irrigation for each crop. The cost of production is the cost of cultivation + interest on variable cost. Gross return for each crop is the value of the output and the by product at the prices realized by farmers.

Net returns from well irrigation are the gross returns from gross irrigated area minus the cost of production of all crops. Notably the cost of cultivation of all crops includes the cost of irrigation.

Gross Returns for each crop is total value of the output at the prices realized by farmers. Net returns from well irrigated area = Gross Returns from gross irrigated area minus the cost of production of all crops (for the year 2008).

Net Returns per Rupee of Irrigation Cost

Net return per rupee of irrigation cost was derived to compare the net return per acre-inch of groundwater used with irrigation cost per acre-inch of groundwater. Analyzed by dividing net returns per acre-inch of groundwater used divided by irrigation cost per acre-inch of groundwater.

Synergistic role of Irrigation wells located under system tank command (GWTI) was calculated by incremental net returns per acre of gross cropped area over Irrigation wells not located under tank or canal command (GWSI) minus net returns from rain fed crops per acre of gross cropped area.

Net Return per Acre from Different Source

Farmers classified based on land holdings and net returns from the source like agriculture, livestock and Non-Agriculture activity was added to get sum of net returns for farmers across different categories. Overall net returns per acre from all sources.

Estimation of Contribution of Channel Water and Rainfall

An attempt is made to estimate the economic contribution of channel water. The underlying hypotheses for estimating the contribution of channel water are:

1. Net returns in Irrigation wells not located under tank or canal command (GWSI) minus net returns in Irrigation wells located under tank command (GWTI) i.e., System tank, reflect the contribution of channel water, because the GWSI received support only from rainfall.
2. Net returns in Irrigation wells located under canal command (GWCI) minus Net returns in Irrigation wells not located under tank or canal command (GWSI) i.e., reflect the contribution of channel water, because GWSI received only rainwater for recharge.

Results

Net returns of different rain fed crops in GWTI, GWCI and GWSI

The Net return per acre from Ragi+avare was higher in GWTI farms (Rs. 2234) than that in GWCI farms (Rs.2180) and GWSI farms (Rs.1797). The net return per acre from Sorghum realized by GWTI farms was Rs. 3025, it was Rs. 2945 for GWCI farms and Rs. 3085 for GWSI farms.

Considering the output per acre in Ragi + Avare and

Sorghum, GWTI farms produced higher (724 kg and 863 kg respectively) followed by GWSI farms (680 kg and 867 kg respectively) and GWCI farms (711 kg and 834 kg respectively) (Table 1). The net returns in GWTI and GWCI are above that in GWSI. Net return per kg of output is also higher in GWCI and in GWTI. The productivity however shows mixed results across the three situations.

Table 1: Net returns of rain fed crops for sample farmers in GWTI, GWCI and GWSI

Per crop of		Ragi+Avare	Sorghum	Over all
Average cropped area per farm	GWTI	2.17	0.76	2.93
	GWCI	1.90	0.85	2.75
	GWSI	2.83	0.75	3.58
NR per acre (Rs.)	GWTI	2234	3025	2765
	GWCI	2180	2945	2705
	GWSI	1797	3085	2538
NR per kg of output (Rs.)	GWTI	3.09	3.51	3.41
	GWCI	3.07	3.53	5.05
	GWSI	2.64	3.56	3.21
Output per acre (kg)	GWTI	724	863	808
	GWCI	711	834	667
	GWSI	680	867	787

GWTI: Groundwater use under System percolation tank, GWCI: Groundwater use under Canal irrigation, GWSI: Groundwater use under sole irrigation, dependent only on rainfall for recharge

Net returns from different well irrigated crops in GWTI, GWCI and GWSI.

In GWTI farms, the net return per acre was higher from Paddy, Coconut, Banana, Tomato, and Okra (Rs. 11028, Rs. 10385, Rs. 72090, Rs. 24502 and Rs. 12290 respectively) than that for GWSI farms (Rs. 7822, Rs. 7546, Rs. 65607, Rs.

11015 and Rs. 11962 respectively). The net return per rupee of water from Paddy, Coconut, Arecanut, Banana and Tomato was higher in GWTI farms (Rs. 8.03, Rs. 8.14, Rs. 39.06, Rs. 69.37 and Rs. 54.98) than that in GWSI farms (Rs. 3.18, Rs. 2.03, Rs. 12.96, Rs. 28.00 and Rs. 8.24) and the Net Return per rupee of water from Arecanut and Banana realized by GWCI farms was higher (Rs. 61.89 and Rs. 82.07 respectively) than that by GWTI farms (Rs. 39.06 and Rs. 69.37 respectively).

Considering the output per acre inch of groundwater from Paddy, Coconut, and Banana, GWSI farms produced higher (41kg, 112kg, and 1059kg, respectively) than that in GWTI farms (20 kg, 98.53 kg and 767 kg respectively) (Table 2). The net return per rupee of water, The net return per kg of output, is higher in both GWTI and GWCI compared to GWSI. Even though the net return per acre inch of groundwater shows mixed results, the crucial parameter is the net return per rupee of groundwater, which is the maximum in the case of GWCI and GWTI compared to GWSI. The cost of cultivation per kg of output is also the lowest in the GWCI and GWTI compared to GWSI. These are the other indicators reiterating the supremacy of system tank over the GWSI.

From irrigated crops, the net return per rupee of water, the net return per kg of output, is higher in both GWTI and GWCI compared to GWSI. Even though the net return per acre inch of groundwater showed mixed results, the crucial parameter is the net return per rupee of groundwater, which is the maximum in the case of GWCI and GWTI compared to GWSI. The cost of cultivation per kg of output is also the lowest in the GWCI and GWTI compared to GWSI. These are the other indicators reiterating the supremacy of System tank over the Non-System tank.

Table 2: Net returns of well irrigated crops for sample farmers in GWTI, GWCI and GWSI

Per crop of		Paddy	Coconut	Arecanut	Area + Cococnut	Banana	Tomata
Output per acre (kg)	GWTI	1826	4759	833	-	22897	11238
	GWCI	1887	4969	863	-	22309	10204
	GWSI	2213	4590	798	-	22592	9111
NR per acre (Rs.)	GWTI	11028	10385	41897	16923	72090	24502
	GWCI	10059	10961	43225	18638	63164	15878
	GWSI	7822	7546	36064	13121	65607	11015
NR per acre-inch of water (Rs.)	GWTI	121	215	1416	543	2420	1507
	GWCI	206	253	1629	576	1803	781
	GWSI	145	185	1531	513	3077	725
NR per rupee of water	GWTI	8.03	8.14	39.06	12.47	69.37	54.98
	GWCI	6.87	9.81	61.89	23.27	82.07	25.17
	GWSI	3.18	2.03	12.96	3.04	28.00	8.24
Output (kg) per acre-inch of water	GWTI	20	98.53	28	-	767	691
	GWCI	39	112	33	-	637	520
	GWSI	41	112	34	-	1059	600
Cost per kg of output (Rs.)	GWTI	0.75	0.268	1.29	-	0.045	0.040
	GWCI	0.776	0.231	0.810	-	0.034	0.060
	GWSI	1.11	0.81	3.49	-	0.10	0.15

GWTI: Groundwater use under System percolation tank, GWCI: Groundwater use under Canal irrigation, GWSI: Groundwater use under sole irrigation, dependent only on rainfall for recharge

Net return per acre from different sources in GWTI, GWCI and GWSI.

Considering net returns per acre of net cropped area realized from all the sources, in GWTI, small farmers realized higher

return of Rs. 34204 compared to medium farmers and large farmers (Rs. 26360 and Rs. 22161 respectively). The overall net return per acre of net cropped for sample farmers in GWTI and GWCI was higher (Rs. 26692 and Rs. 22075) than GWSI

(Rs. 16720), since canal water program amply supported these farmers through increase in irrigated area and livestock production and through income generating activity to some extent (Table 3). In the GWCI the overall net returns per acre for sample farmers being Rs. 22075 per acre. It is higher to that obtained by GWSI farmers Rs. 16720 per acre. The contribution of agricultural income is substantial being 84.73 per cent, livestock (8.47 per cent) and Non-Agriculture (6.80 per cent) for sample farmers. Large farmers realized lower net return per acre of Rs. 21194 to that of small farmers (Rs. 22209) (Table 3).

For the farmers in GWSI, large farmers are realizing higher net return per acre of Rs. 19867, contribution of agriculture livestock and Non-Agriculture were 74.56, 10.26 and 16.89

per cent respectively. The Net returns per acre for small and medium farmers were Rs. 16854 and Rs. 14910 respectively. The contribution of Non-Agriculture was relatively higher for small (27.50 per cent) and medium farmers (17.07 per cent), as compared to live stock (9.17 and 9.22 per cent respectively). However they realized 63.33 and 73.71 per cent respectively from agriculture (Table 3).

Considering the income from agriculture, non-agriculture and livestock, the net return per acre of net cropped area is the highest in GWTI and GWCI compared with GWSI. This shows that in addition to agriculture, the GWTI and GWCI farms have exhibited efficiency even in non-agriculture and livestock sources of income when compared with medium and large farmers.

Table 3: Net incomes per farm from different sources in GWTI, GWCI and GWSI

Sources of income	Sample total			Net return per farm	Net cropped (NCA)	Net return per acre of NCA
	Non-agriculture	Live stock	Agriculture			
For sample farmers in GWTI						
Small farmers	27423 (23.41)	10924 (9.32)	78814 (67.27)	117161 (100)	3.43	34204
Medium farmers	7444 (4.21)	27605 (15.61)	141811 (80.18)	176861 (100)	6.71	26360
Large farmers	26750 (7.43)	17400 (4.83)	315808 (87.73)	359958 (100)	16.24	22161
overall	17071 (9.72)	20243 (11.53)	138297 (78.75)	175612 (100)	6.58	26692
For sample farmers in GWCI						
Small farmers	2250 (2.93)	9692 (12.61)	64900 (84.46)	76842 (100)	3.46	22209
Medium farmers	11789 (7.60)	15049 (9.70)	128261 (82.70)	155100 (100)	6.82	22720
Large farmers	17875 (6.81)	14503 (5.53)	230051 (87.66)	262429 (100)	12.38	21194
overall	11000 (6.80)	13700 (8.47)	137045 (84.73)	161745 (100)	7.33	22075
For sample farmers in GWSI						
Small farmers	17467 (27.50)	5824 (9.17)	40225 (63.33)	63516 (100)	3.77	16854
Medium farmers	15357 (17.07)	8299 (9.22)	66323 (73.71)	89980 (100)	6.04	14910
Large farmers	44583 (16.89)	27097 (10.26)	196831 (74.56)	263995 (100)	13.29	19867
overall	21271 (20.17)	9972 (9.46)	77511 (73.50)	105456 (100)	6.31	16720

GWTI: Groundwater use under System percolation tank, GWCI: Groundwater use under Canal irrigation, GWSI: Groundwater use under sole irrigation, dependent only on rainfall for recharge

Note: GCA: Gross cropped area, NR: Net returns Figures in the parentheses indicate percentage to the respective total

Incremental net return per acre due to Channel water linkage in GWTI, GWCI over GWSI

The incremental net return per acre in GWTI has been positive for the sample farmers over GWCI. It was higher for small farmers (Rs. 11995) compared to medium (Rs. 3640) and large farmers (Rs. 968). The overall incremental net return per acre in GWTI over GWCI was Rs. 4617. When the incremental net return is computed between GWTI and GWSI, it was positive for all sample farmers. Here too, the incremental returns are relatively higher for small and medium farmers (Rs. 17350 and Rs. 11450 respectively) than for large

farmers (Rs. 2295). The overall incremental net return per acre in GWTI over GWSI was Rs. 9972. The incremental net return is computed between GWCI and GWSI here too, the incremental returns are relatively higher for small and medium farmers (Rs. 5355 and Rs. 7810 respectively) than for large farmers (Rs. 1327). The overall incremental net return in GWCI over GWSI was Rs. 5355. This reiterates that canal water supply to GWTI and GWCI has contributed substantially to net returns per acre compared with those farmers who are not connected with canal water (GWSI) (Table 4).

Table 4: Incremental net returns per acre to GWTI over GWCI and GWSI

Type of farm	GWTI over GWCI = (Rs. 26692 – Rs. 22075 = Rs. 4617)	GWTI over GWSI = (Rs. 26692 – Rs. 16720 = Rs. 9972)	GWCI over GWSI = (Rs. 22075 – Rs. 16720 = Rs. 5355)
Small farmers	11995	17350	5355
Medium farmers	3640	11450	7810
Large farmers	968	2295	1327
Overall	4617	9972	5355

Note: Incremental net return in GWTI over GWSI = net return per acre from all sources in GWTI minus that in GWSI.

GWTI: Groundwater use under System percolation tank, GWCI: Groundwater use under Canal irrigation, GWSI: Groundwater use under sole irrigation, dependent only on rainfall for recharge

Conclusions

- The net return per farm was higher in GWTI farmers and GWCI as compared to GWSI farmers, because in GWTI and GWCI the average size of gross irrigated area per farm was higher as compared to GWSI farmers.
- The overall net return per rupee of investment was higher for GWTI farmers followed by GWCI farmers and GWSI farmer. These show the importance of channel water supply to these areas through Hemavathy linkage.
- The Net return per rupee of amortized groundwater irrigation cost (Rs) is the highest in GWCI and GWTI over GWSI on small farms and is a pointer to the relative economic efficiency of small farmers compared to medium and large farmers. Thus, small farmers need to be encouraged with policy support due to their better economic performance over medium and large farmers.
- The contribution from irrigated crops through higher ground water availability and Lowering the dependence on Non-agriculture activity, increasing the income from livestock due to the role of irrigation which contributed much to the net returns in GWTI farmers with irrigation wells.
- The incremental net return is computed between GWTI and GWSI, it turns to be positive for all sample farmers. The supply of water through channel system has contributed substantially for farmers who are totally dependent on agriculture.
- Considering income from agriculture, non-agriculture and livestock, the net return per acre of net cropped area is the highest in GWTI and GWCI compared with GWSI. This shows that in addition to agriculture, the GWTI and GWCI farms have exhibited efficiency even in non-agriculture and livestock sources of income when compared with medium and large farmers.
- Coconut and Arecanut crops occupy at least 70 per cent of gross irrigated area in GWTI, GWCI and GWSI. The other major commercial crops cultivated in the study area were Banana, Paddy, Tomato and Brinjal. If farmers had adopted drip irrigation, other seasonal crops also, the productivity would have improved.

References

1. Anonymous, Potential linked plan of Tumkur District, published by NABARD, Bangalore, 1996-2001.
2. Anonymous, Central Ground Water Board, Ground Water Information Booklet, Tumkur District, Karnataka, South Westren Region, Bangalore, 2008.
3. Arun Prasad, Sam MJ. Multiple cropping in Tungabhadra region of Karnataka. *Annals of Agricultural Research*. 1990; 11(2):149.
4. Biradar AA. Techno-economic issues of watershed development approach-a case study of district watershed, Gulbarga (Karnataka). *Indian Journal of Agricultural Economics*. 1991; 46(3):313.
5. Chahal TS, and Chahal JS. Management of irrigation through crop diversification in Punjab. *Indian journal of Agricultural Economics*. 1989; 44(3):299-300.
6. Chandrakanth MG, Arun V. Externalities in groundwater Irrigation in hard rock areas. *Indian Journal of Agricultural Economics*. 1997; 52(4):761-770.
7. Deshpande RS, Ratna Reddy V. Differential impact of watershed based technology: Some analytical issues, *Indian Journal of Agricultural Economics*. 1991; 46(2):261-269.
8. Dhawan BD, Satyasai KJS. Economic Linkages among Irrigation Sources: A study of beneficial role of canal seepage. *Indian Journal of Agricultural Economics*. 1988; 44(2):669-674.
9. Diwakara H. Synergistic effects of watershed treatments on farm economy through groundwater recharge- A resource economic analysis. M.Sc (Agri.) thesis, (Unpublished), University of Agricultural Sciences, Bangalore, 2000.
10. Gauraha AK. Crop diversification over decade: A village case study. *Indian journal of Agricultural Economics*. 1996; 51(4):696.
11. GIREESH, M., 1996, Rehabilitation of irrigation tanks in eastern dry zone of Karnataka - An economic analysis. M.Sc (Agri.) Thesis (Unpublished), University of Agricultural Sciences, Bangalore.
12. Janakarajan Social and Economic implications of groundwater in south India. *Indian Journal of Agricultural Economics*. 1993; 48(1): 87-96.
13. Karunakaran KK, Palanisami K. An analysis of Impact of Irrigation on cropping intensity in Tamil Nadu. *The Indian Economic Review*. 1998; 33(2):207-217.
14. Kulkarni SP. Comparative Economic Analysis of Openwell and Borewell Irrigation in Northern Region of Karnataka. M.Sc (Agri.) Thesis (Unpublished), University of Agricultural Sciences, Bangalore, 1976.
15. Lokesh GB. Economic impact assessment of watershed development programmes: A study of Kallambella watershed, Karnataka. Ph.D. Thesis (unpublished), University of Agricultural Sciences, Bangalore, 2004.
16. Nagaraj N, Chandrashekar H, Yatheesh HS. Sustainability and Equity Implications of Groundwater Depletion in Hard Rock Areas of Karnataka: An Economic Analysis. *Indian Journal of Agricultural Economics*. 2003; 58(3):438-447.
17. PATIL BL. Cropping pattern, Yields and income under different sources of irrigation in Mudhol taluk-An Economic Analysis, M. Sc. (Agri.) Thesis (unpublished), University of Agricultural Sciences, Dharwad, 1987.
18. Prahaldachar M. Small Farmers Access to Irrigation Wells-Insights from a field study in Karnataka. Paper presented in the Workshop on Efficiency and Equity in Groundwater use and Management, Organized at IRMA, Gujarat, India, 1989.
19. Savadamuthu S. Percolation Ponds in Tamil Nadu. *Indian Journal of Soil Conservation*. 1988; 15(3):23-31.
20. Zene Abraha, Economic Impact of irrigation on crop production in Malaprabha command area-A Temporal analysis. M.Sc. (Agri.) Thesis (unpublished), University of Agricultural Sciences, Dharwad, 2000.