ECONOMIC IMPACT OF JOINT FOREST PLANNING AND MANAGEMENT (JFPM) ON GROUNDWATER RECHARGE IN KARNATAKA, INDIA

PATIL VIKRAM*, MG CHANDRAKANTH**, NR GANGADHARAPPA***

*DAAD scholar, Division of Resource Economics, Humboldt University, Berlin
**Professor of Agricultural Economics, University of Agricultural Sciences, Bangalore, India
*** Professor of Agricultural Extension, University of Agricultural Sciences, Bangalore, India

Abstract — This study evaluates the economic impact of Joint Forest Planning and Management (JFPM) initiated by the Karnataka Forest Department especially on Groundwater Recharge considering productivity, wage income, income generating activities (IGAs) and equity in distribution in Karnataka, with the following specific objectives. 1) Estimation of economic impact of JFPM on groundwater recharge. 2) Assessment of equity in distribution of benefits of JFPM tree endowment at farm and village level and 3) Estimation of JFPM usufructs to farm women. Field data for the study were collected for 2008 from a population of all the farmers possessing irrigation wells in "JFPM + Watershed village" ; "JFPM village"; "Watershed village" and the "Control village"-(without JFPM / Watershed). In all the four situations of "only JFPM village", "JFPM + watershed village", "only watershed village" and "control village".

The major finding of the study is that due to JFPM all the dug wells became functional yielding net return per acre, net return per acre inch of groundwater and net return per unit cost of irrigation water. Net returns per acre from the rainfed crops, only JFPM village farmers realized the highest net returns per acre than that of the control area. The proportion of functioning borewells was higher in only JFPM village area, almost same in JFPM + watershed village area and control village area than that in only watershed area (66 per cent). JFPM impact is equally distributed over all categories of farmers and the purpose of the JFPM development program is served.

Key Words: Joint Forest Planning and Management(JFPM), Ground Water, Village Forest committee(VFC), Self Help Groups(SHGs) and Income Generating Activity(IGA).

ECONOMIC IMPACT OF JOINT FOREST PLANNING AND MANAGEMENT (JFPM) ON GROUNDWATER RECHARGE IN KARNATAKA, INDIA

VIKRAM, CHANDRAKANTH, GANGADHARAPPA

INTRODUCTION

Development of innovative forest developing institutions is a *sine quo non* for the development of forests and groundwater resources. The Forest Conservation Act of 1980 is an important step in this direction. Keeping this in view, Karnataka, Government desires that the people living in the villages adjoining the forests are involved in conservation, planning, protection, regeneration, development and management of degraded forests. In order to achieve these objectives, the JFPM program with the co-operation and involvement of the villagers was planned. NGOs (Non Government Organisations) and the CPRs (Common Property Rights) are emerging as stakeholders in the development process.

An important component of JFPM is the formation of Village Forest Committee (VFC), assigning duties and responsibilities, including the mechanism of sharing of produce.

The VFC formation is sequel to The National Forest Policy 1988 which envisaged involvement of people in the protection and development of forests. Accordingly, the Ministry of Environment and Forests issued guidelines (1/6/1990) to the State Government for adopting JFPM. JFPM is thus a comprehensive scheme of the forest department to partner with and involve local village communities in the conservation and sustainable management of forests.

JFPM in Karnataka

Karnataka Forest Department has constituted 3887 VFCs in the Karnataka state bringing nearly 3,40,000 ha of degraded forests under JFPM. There are special provisions for women in JFPM programme. JFPM schemes are known to provide many ecological, socio-cultural, and economic benefits to rural society.

Objectives:

There have been several research studies concerning the economic impact of developmental programs such as the Watershed development program, Tank rehabilitation program, Minor Irrigation Project. However, studies concerning economic impact of JFPM are rare and this study is a modest attempt towards exploring the economic Impact of JFPM on groundwater recharge in Chitradurga and Davanagere districts of Karnataka State, India with the following specific objectives: (1) Estimation of economic impact of JFPM on groundwater recharge. (2) Assessment of equity in distribution of benefits of JFPM tree endowment at farm and village level. (3) Estimation of JFPM usufructs to farm women.

METHODOLOGY

1.   Sampling framework

Bandekatte village in Molakalmur taluk was one of the four villages selected for this study. This village consists of 445 hectares of forest area which is under JFPM programme. This village also consists of watersheds. Hence, Bandekatte village having both JFPM and watershed programmes was selected. And *Adavimallapur* village in Harapanahalli taluk was selected for this study. This village consists of 550 hectares of forest area which was under JFPM programme. Hence, Adavimallapur village having JFPM was selected for the study. Hirehalli village in Molakalmur taluk in Chitradurga

district, located 8 kms outside the Bandekatte JFPM area, was selected as watershed for comparison. Eigalbasapur village in Harapanhalli taluk in Davanagere district located 6 kms outside the Adavimallapur JFPM area, was selected as control village for comparison. A sample of 23 farmers was drawn from JFPM + watershed village, 42 farmers from JFPM village and 24 farmers from watershed village. From the control village, 15 farmers were selected for comparison between JFPM +watershed, JFPM, watershed and control, totaling to a sample size of 104.

2.   Data base

Primary data for the study were collected from personal interviews during December 2008 with a structured pre-tested schedule. The information included economic features of the sample respondents, cropping pattern, land holdings, source of irrigation and investment on irrigation wells, costs and returns from crops and livestock. Secondary data from Forest departments were collected regarding expenditure on different activities of JFPM program.

3.   Analytical tools used

Weighted averages, ratio measures, percentages and proportions are computed. Annual externality cost was worked out in JFPM and non-JFPM areas to obtain a measure of the negative externality. In order to estimate the impact of JFPM program, farmers were classified based on land holding and area (farmers in JFPM + watershed, only JFPM, only watershed and control). ANOVA is used to test the statistical validation of the results. Based on the secondary data given by the forest department, the JFPM usufructs to women were assessed by employment created to women.

RESULTS AND DISCUSSION

1   Age, depth and yield of irrigation wells

The proportion of functioning borewells was higher in only JFPM (100 per cent) as well as in JFPM + watershed (94 per cent) and than that in only watershed area (66 per cent). The proportion of well failure was the highest in only watershed area (34 per cent) followed by JFPM + watershed (6.5 per cent) and control area (6 per cent).The groundwater yield of borewells was the highest in JFPM + watershed and only JFPM than only watershed and control area. The average age and average depth of borewells was comparable in both only JFPM as well as in non-JFPM areas. However, the life of irrigation wells was higher in only watershed area (7.38 years) and control area (17 years) compared to JFPM + watershed (5.5 years) and life of irrigation wells in only JFPM was zero which is because of no well failure till now. (Table 1)

ECONOMIC IMPACT OF JOINT FOREST PLANNING AND MANAGEMENT (JFPM) ON GROUNDWATER RECHARGE IN KARNATAKA, INDIA

VIKRAM, CHANDRAKANTH, GANGADHARAPPA

Table 1: Details of irrigation borewells in JFPM + watershed, only JFPM, only watershed and control areas, 2007-08

Sl. No.	Particulars	JFPM + watershed (1)	Only JFPM (2)	Only watershed (3)	Control (4)	Percentage change (1 over 4)	Percentage change (2 over 4)	Percentage change (3 over 4)
1	No. of sample farmers	24	42	23	15	60.00	180.00	53.33
2	Number of functioning wells	29	24	27	15	93.33	60.00	80.00
3	Number of failed wells	2	0	14	1	100.00	-100.00	1300.00
4	Total number of wells	31	24	41	16	93.75	50.00	156.25
5	Proportion of well failure	6.45	0.00	34.15	6.25	3.20	-100.00	446.40
6	Yield of groundwater (GPH)	1914	2125	1176	1650	16.00	28.79	-28.73
7	Age of wells(years)	6.71	5.88	6.36	9.72	-30.97	-39.51	-34.57
8	Life of wells (years)	5.5	5.88	7.38	17	-67.65	-65.41	-56.59
9	Depth of bore wells(ft)	239	230	262	249	-4.02	-7.63	5.22
10	Range of year of construction (earliest well- latest well)	1988-2007	1995-2007	1990-2007	1988-2006	-	-	-
11	Investment per well (US$)	1,638	1,190	1,374	1,534	0	(1)	(0)
12	Investment per functioning well (US$)	1,751	1,190	4,023	1,637	0	(1)	4
13	Amortized cost per well (US$)	240	242	213	242	(0)	(0)	(0)
14	Amortized cost per functioning well (US$)	253	242	308	258	(0)	(0)	0
15	Annual externality cost (US$)	13	-	151	30	(1)	(3)	10

Note: *GPH- Gallons per hour, percentage change= only JFPM over Non-JFPM area*

In the only JFPM area, there were 21 farmers possessing dug wells constructed during 1990-2007. It is heartening to note that 100 percent of the dug wells are functioning in the only JFPM area, with appreciable age of 7 years and the lowest amortized cost with zero externality, as there are no well failures, groundwater yield and average depth as compared to control area. This is because of high water availability due increased recharge. And investment per well and investment per functioning well was also same because no dug wells were failed in only JFPM area. But there were no dug wells found in JFPM + watershed and only watershed areas. Height of water column per day in kharif was about 24 feet, about 21 feet in rabi and about 19 feet in summer. This shows that due to JFPM there is improvement in drinking water availability reducing drudgery and saving time for farm women *(Table 2)*.

Table 2: Details of irrigation dug wells in JFPM and control area, 2007-08

Sl. No.	Particulars	Only JFPM (1)	Control (2)	Percentage change (2 over 4)
1	Number of farmers	21	2	
2	Number of functioning wells	21	0	-
3	Number of non-functioning wells	0	2	
4	Total number of wells	21	2	
5	Proportion of well failure	0	100	-
6	Yield of groundwater (GPH)	1938	0	-
7	Age of wells(years)	6.71	0	-
8	Life of wells (years)	NA	16	-100.00
	Depth of dug well (ft)	26	42.5	-39.90
9	Diameter of the dug well(ft)	20	25	
10	Height of water column per day in a. Kharif (feet)	24	0	-
	b. In rabi (feet)	21	0	-
	c. summer(feet)	19	0	-
11	Range of year of construction (earliest well- latest well)	1990-2007	1980-1988	-
12	Investment per well (US$)	808	250	-
13	Investment per functioning well (US$)	808	No functioning well	-
14	Amortized cost per well (US$)	140	68	3
15	Amortized cost per functioning well (US$)	140	-	-
16	Annual externality cost (US$)	0	NA	NA

Note: *GPH- Gallons per hour, percentage change= only JFPM over control area*

NA- Not Available

2   Irrigation well details

In only JFPM area investment per bore well was lower as compared to control area by 23 per cent, but in JFPM + watershed it was higher as compared to only watershed by 19 per cent. However, investment per functioning well is lower in JFPM + watershed and only JFPM as compared to only watershed and control area by 56 and 27 per cent respectively. This is due to more well failures in the only watershed and control area.

Amortized cost per functioning well in JFPM + watershed is lower by 2.24 per cent, 6.32 per cent lower in only JFPM and 19.31 per cent higher in watershed as compared to control area.(Table 1)

There were no dug wells found in JFPM + watershed and only watershed area. All the dug wells were functioning in only JFPM area while no functioning well in control area. The amortized cost per dug well and per functioning dug well was same (Rs. 5,608). This is because no well failure in only JFPM area. (Table 2)

3   Particulars of groundwater resources

The net irrigated area per functioning well of sample farmers was higher in JFPM + watershed (4.47 acres) by 24.17 per cent, 43.33 per cent lower in only JFPM with borewells (2.04 acres), 72.78 per cent lower in only JFPM with dug wells (0.98 acres) and 8.06 per cent lower in only watershed (3.31 acres) as compared to control area (3.6 acres). Gross irrigated area per farm was also higher in JFPM + watershed (10.74 acres) by 79 per cent, 22.17 per cent lower in only JFPM with borewells (4.67 acres), 67.50 per cent lower in only JFPM with dug wells (1.95 acres) and 24.33 per cent higher in only watershed (7.46 acres) as compared to control area (6 acres).

Environmental economic impact of only JFPM programme is reflected through cost of irrigation, cost and net return to groundwater used. Irrigation cost per acre-inch of groundwater used was lower in JFPM + watershed as well as in only JFPM as compared to only watershed area and control area. This shows that there is positive impact of only JFPM and JFPM +watershed development programs.

Table 3: Particulars of groundwater resources in JFPM + watershed, only JFPM, only watershed and control areas, 2007-08

Sl. No.	Particulars	JFPM + watershed (1)	Only JFPM (2)		only watershed (3)	Control (4)	Percentage change (1 over 4)	Percentage change (2a over 4)	Percentage change (2b over 4)	Percentage change (3 over 4)
			Bore well (a)	Dug well (b)						
1	Groundwater extracted per farm (Acre inches)	77.83	59.81	43.11	48.56	48.98	58.90	22.11	-11.98	-0.86
2	Groundwater extracted per well (Acre inches)	61.73	53.79	43.11	39.57	48.98	26.03	9.82	-11.98	-19.21
3	Number of sample farmers owning functioning wells	23	21	21	22	15	-	-	-	-
4	Per cent of farmers owning wells	100	100.00	100.00	91.67	100	-	-	-	-
5	Number of functioning wells	29	24	21	27	15	93.33	60.00	40.00	80.00
6	Net irrigated area (acre)	129.5	49.00	20.50	89.5	54	139.81	-9.26	-62.04	65.74
7	Net irrigated area per functioning well (acre)	4.47	2.04	0.98	3.31	3.6	24.17	-43.33	-72.78	-8.06
8	Gross irrigated area (acre)	247	98.00	41.00	179	90	174.44	8.89	-54.44	98.89
9	Gross irrigated area per functioning well (acre)	8.52	4.08	1.95	6.63	6	42.00	-32.00	-67.50	10.50
10	Gross irrigated area per farm (acre)	10.74	4.67	1.95	7.46	6	79.00	-22.17	-67.50	24.33
11	Irrigation intensity (per cent)	190.73	200.00	200.00	200	166.67	14.44	20.00	20.00	20.00

Sl. No	Particulars	JFPM + watershed (1)	Only JFPM (2)		Only watershed (3)	Control (4)	Percentage change (1 over 4)	Percentage change (2a over 4)	Percentage change (2b over 4)	Percentage change (3 over 4)
			Bore well (a)	Dug well (b)						
12	Irrigation cost per acre inch of groundwater used(Rs.)	127	204	154	221	239	-47.06	-14.38	-35.39	-7.14

Note: *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 (net return per acre-inch of groundwater used/ irrigation cost per acre-inch of groundwater).*

4. Net return per farm from different sources

The overall net returns between the sample farmers in JFPM + watershed, those who are in only Watershed, the gap in overall net return, of around Rs. 18,470. While the overall net returns between the sample farmers in only JFPM and control area, the gap in overall net return, of around Rs. 38,806. The overall net return per acre of net cropped area for sample farmers in JFPM + watershed (Rs. 13,068) was lower than sample farmers in only JFPM (Rs. 20,044). This is mainly due to increased water availability and chilli seed production taken in only JFPM area which realized higher net return as compared to other crops grown in JFPM + watershed area. But the constraint is if the chilli seed production is taken up in the areas other than JFPM, the farmers would have realized same returns as that of in only JFPM area. However increased availability of water and reduced cost of irrigation in only JFPM area also contributed for increased net returns which is the supremacy of only JFPM over the non- JFPM areas.

One of the reasons for the better performance of JFPM is the cultivation of chilli seed crop which fetches net return per acre of Rs. 125000 akin to seed production is only observed in JFPM not in other sample areas even though these areas are close to Ranebennur, the hub of seed production. Hence while these are compelling reasons to accept that the JFPM has yielded higher net return per acre, there are no compelling reasons to accept that other three areas also equally potential. Analysis was conducted by substituting the chilli seed production crop with next best alternative crop that is onion. However the results from this analysis totally discount the contribution of JFPM (table 1 and table 2 given in appendix). Hence this study upholds the economic supremacy of only JFPM over all the other three treatments in its entirety.

Nevertheless the farmers in control area realized the net return from wage employment (11 per cent) but in case of JFPM + watershed, only JFPM and only watershed it was negligible. While 6.56 per cent of the overall net return was from the livestock in JFPM + watershed which is higher as compared to only watershed area (3.47 per cent) but only 3.97 per cent of the overall net return was from the livestock in only JFPM which is comparatively lower than control area (7.43 per cent).

Considering, sample farmers in JFPM + watershed area, their net return is largely influenced by Agriculture which contribute to 93 per cent of net return which is lower as compared to only watershed area. This is mainly because contribution of livestock to net return is high in JFPM + watershed area than in only watershed area. But in only JFPM area, contribution of agriculture to net return is 95 per cent which is higher as compared to control area (82 per cent). This is mainly due to higher water availability and chilli seed production in only JFPM area realized higher net return and also contribution of livestock to net return in lower than that in control area.

The gap between net return per acre of net cropped area of small and marginal farmers, medium farmers and large farmers is very high in JFPM + watershed and only JFPM area as compared to only watershed and control area. Thus, it is apparent 1. JFPM + watershed and only JFPM benefits are higher for small and marginal farmers and medium farmers over watershed as well as control area.

2. The effect that as the farmers in JFPM + watershed and only JFPM area are due to engaged in agriculture in this farm, their time is unavailable for earning through wage employment, income generating activity and livestock.

3. That maize, groundnut and onion are the major crops in JFPM + watershed and only watershed area which occupy at least 80 per cent of gross irrigated area for sample farmers. While maize, chilli seeds and jowar are the crops in only JFPM area which occupies around 93 per cent of gross irrigated area. But in control area maize and Sunflower are the major crops grown in control area which occupies around 78 per cent of gross irrigated area.

Table 4: Net returns per farm from different sources in JFPM + watershed and only JFPM areas, 2007-08

(Rupees)

Sources of net returns	Sample total				Net cropped Area (NCA)	Net return per acre of NCA	Net return per farm
	Agriculture	*Livestock*	*Wage employment*	*Sum of net returns*			
For sample farmers in JFPM + watershed (Chitradurga)							
Small and marginal farmers (9)	*477460* *(94.43)*	*28146* *(5.57)*	*0* *(0.00)*	*505606* *(100.00)*	*25.00*	*20224*	*56178*
Medium farmers (9)	*862333* *(91.40)*	*81190* *(8.60)*	*0* *(0.00)*	*943523* *(100.00)*	*56.00*	*16848*	*104835*
Large farmers (5)	*1328557* *(93.17)*	*79360* *(5.57)*	*18000* *(1.26)*	*1425917* *(100.00)*	*139.00*	*10258*	*285183*
Overall (23)	*2668350* *(92.81)*	*188696* *(6.56)*	*18000* *(0.63)*	*2875046* *(100.00)*	*220.00*	*13068*	***125002***
For sample farmers in Only JFPM (Davanagere)							
Small and marginal farmers(29)	*2394037(96. 10)*	*76115* *(3.06)*	*210000* *(0.84)*	*2491152* *(100.00)*	*73.00*	*34125*	*85901*
Medium farmers (9)	*915957* *(97.49)*	*23625* *(2.51)*	*0* *(0.00)*	*939582* *(100.00)*	*61.00*	*15402*	*104398*
Large farmers (4)	*418090* *(83.96)*	*56345* *(11.32)*	*235000* *(4.72)*	*497935* *(100.00)*	*62.00*	*8031*	*124483*
Overall (42)	*3728085* *(94.89)*	*156085* *(3.97)*	*44500* *(1.13)*	*3928670* *(100.00)*	*196.00*	*20044*	***93539***
Overall Net returns per acre from all sources considering Irrigated and Rainfed condition from agriculture, livestock, and other income generating activities in JFPM= (2875046.90+3928670.87)/(220+196)= Rs. 16355.09							

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

Table 5: Net returns per farm from different sources in only watershed and control areas, 2007-08

(Rupees)

Sources of net returns	Sample total				Net cropped Area (NCA)	Net return per acre of NCA	Net return per farm
	Agriculture	Livestock	Wage employment	Sum of net returns			
For sample farmers in Only watershed (Chitradurga)							
Small and marginal farmers (8)	432406 (94.89)	23290 (5.11)	0 (0.00)	455696 (100.00)	25.00	18228	56962
Medium farmers (9)	916653 (96.48)	33470 (3.52)	0 (0.00)	950123 (100.00)	64.50	14731	105569
Large farmers (7)	1119124 (97.23)	31835 (2.77)	0 (0.00)	1150959 (100.00)	106.50	10807	164423
Overall (24)	2468183 (96.53)	88595 (3.47)	0 (0.00)	2556778(100.00)	196.00	13045	**106532**
For sample farmers in control (Davanagere)							
Small and marginal farmers (6)	106183 (58.03)	16800 (9.18)	60000 (32.79)	182983 (100.00)	18.00	10166	30497
Medium farmers (7)	266747 (83.44)	22935 (7.17)	30000 (9.38)	319682 (100.00)	49.50	6458	45669
Large farmers (2)	297017 (93.31)	21310 (6.69)	0 (0.00)	318327 (100.00)	55.00	5788	159163
Overall (15)	669947 (81.60)	61045 (7.43)	90000 (10.96)	820992 (100.00)	122.50	6702	**54733**
Overall Net returns per acre from all sources considering Irrigated and Rainfed condition from agriculture, livestock and income generating activities in non-JFPM= (2556778.21+820992.35)/(196+122.5)= Rs. 10605.25							

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

Table 6: Incremental net returns, 2007-08

Type of farm	*JFPM over Non-JFPM area = Rs. 16355.09 – Rs. 10605.25 = Rs. 5749.84*	
	For sample farmers in JFPM + watershed over watershed (Chitradurga)	*For sample farmers in JFPM over control area (Davanagere)*
Small and marginal farmers	*1996*	*23959*
Medium farmers	*2118*	*8944*
Large farmers	*-548*	*2243*
Overall	*23*	*13342*

Table 7: Estimated contribution due to JFPM development program, 2007-08

Sl. No.	*Particulars*	*Rs. Per acre*
1	***Contribution of JFPM program :*** *A. net returns in only JFPM minus net returns in control area*	*= 20044 – 6702* *=13342*
	B. Net returns in JFPM + watershed minus net returns in watershed	*=13068 -13045* *= 23*
2	***Contribution of JFPM + Watershed:*** *Net returns in (JFPM + watershed) minus Net returns in control area*	*=13068- 6702* *=6366*
3	***Contribution of Watershed:*** *A. Net returns in watershed minus Net returns in control area*	*= 13045- 6702* *= 6343*
	B. Net returns in JFPM + watershed minus net returns in only JFPM	*=13068 – 20044* *= -6976*

Testing of Hypothesis

It was hypothesized that the net return per acre from all the sources is significantly different across four types of farmers viz. those in JFPM + watershed, those in only JFPM, those in only watershed and in control area.

The net return per acre from all the sources in only JFPM (Rs. 88,764) was significantly higher over only watershed (Rs. 30059), control area (Rs. 11798) and JFPM + watershed area (Rs. 32149). This apparently shows the significant economic performance compare to other three situations. The net return from JFPM + watershed was significantly higher over control area, however the net return from JFPM + watershed over only watershed is insignificant. This shows that the only JFPM alone has performed better than JFPM + watershed activity. The reason for economic out performance of only JFPM over any other control is attributable to:

1. As the farmers realized Rs. 9.65 net return per rupee of irrigation cost, the highest compare to other 3 situations.

2. The realization of Rs. 78, 738 net return per acre is higher compare to other 3 situations.

3. Only JFPM farmers have also used higher water per acre of gross cropped area (15 acre inches)

4. In only JFPM, there was zero well failure though the proportion of well failure was comparable in JFPM + watershed and control area and associated features.

5. The JFPM + watershed farmers did not perform to the level as that of only JFPM area.

6. Another important reason for economic outperformance of only JFPM farmers is their choice of crops which included maize, jowar, ragi and chilli seed production. The chilli seed production was taken in 35 per cent of gross cropped area.

The unique feature in only JFPM is presence of 21 functioning dugwells and 24 functioning borewells both with zero failures among the population of 42 farmers.

In addition the groundwater resource endowment as reflected in:

1. The zero well failure

2. The highest yield of dugwell (1938 GPH) and yield of borewell (2125 GPH) are comparable

3. The age of borewells as well as dugwells is comparable.

4. The depth of dugwells are hardly 26 feet and earliest dugwell was constructed in 1990 and latest dugwell was in 2007 with investment per well of Rs. 32,333.

5. In recent years dugwells are rare phenomenon; perhaps this only JFPM (Adavimallapur) has the only area in the country which has demonstrated that dugwell could be successful. It is heartening to that even in the newly claimed to be found Saraswathi (Guptagamini) river in northern India water was not extracted from dugwell but from borewells.

6. The cost of dugwell Rs. 32,333 which is much lower compare to borewell (Rs. 47,592) and with a lowest amortized cost (Rs. 5608)

5.   Contribution of JFPM Program

The overall contribution of only JFPM was found to be Rs. 13,342 per acre, higher than the contribution of JFPM + watershed (Rs. 6366) and control area (Rs. 6343). Upon performing ANOVA, it is found that the net returns per acre from all sources in JFPM + watershed and JFPM is significantly different from that in watershed area and control area. Thus, the overall contribution of JFPM program to farmers not possessing watershed (only JFPM) as well as farmers possessing watershed (JFPM + watershed) is statistically significant.

Table 8: ANOVA for net returns per acre from all the sources across different categories of sample farmers in Chitradurga and Davanagere districts, 2007-08

Sl. No.	Particulars	Mean	F statistic
1	a. only JFPM	88764	40.608**
	b. JFPM + watershed	32149	
2	a. only JFPM	88764	46.904**
	b. only watershed area	30059	
3	a. only JFPM	88764	52.766**
	b. Control area	11798	
4	a. JFPM + watershed	32149	0.232
	b. only watershed area	30059	
5	a. JFPM + watershed	32149	21.248**
	b. Control area	11798	
6	a. only watershed area	30059	26.576**
	b. Control area	11798	

Note: ***, ** and * indicate significance at 1, 5 and 10% respectively

6   Economics of groundwater recharge

6.1   Economic impact on sample farmers in JFPM area

The net return per acre is hypothesized to reflect the quintessence of farm efficiency in using the resources and opportunities optimally. Considering small and marginal, medium and large farmers together, the net return in JFPM is Rs. 20,044 per acre. For small and marginal farmers, net return is Rs. 34,125 and for medium farmers, net return is Rs. 15,402. For Large farmers, net return is Rs 8,031 per acre. These are the direct impacts of JFPM. For these farmers, 95 percent of the net return is obtained from the cultivation of crops (Agriculture), 4 percent from livestock, and 1 percent from wage employment.

Table 9: Gini coefficient for income distribution for different classes of farmers in JFPM + watershed over only watershed area in Chitradurga District, 2007-08

Type of farm	JFPM +watershed	only Watershed
Small and marginal farmers	0.72	0.65
Medium farmers	0.66	0.67
Large farmers	0.73	0.88
Overall	0.72	0.69

Table 10: Gini coefficient for income distribution for different classes of farmers in only JFPM over control area in Davanagere District, 2007-08

Type of farm	only JFPM	Control area
Small and marginal farmers	0.64	0.66
Medium farmers	0.63	0.66
Large farmers	0.73	0.77
Overall	0.63	0.76

6.2   Economic impact on irrigated farmers in Non-JFPM area

Considering small and marginal, medium and large farmers together the net return per acre is Rs.6702 per acre, for small and marginal farmers net return is Rs. 10166 and medium farmers Rs.6458 and for large farmers Rs 5788. Here farmers realized 82 percent of net returns from agriculture, 7 percent from livestock and 11 percent from wage employment.

6.3   Economics of groundwater recharge

Economics of groundwater recharge for small and marginal farmers is measured as the difference in the net returns between farmers with irrigation wells in JFPM and farmers with wells outside JFPM. Accordingly, farmers with irrigation wells in JFPM realized a net return of Rs. 20, 044 while those outside the JFPM realized Rs. 6,702 per acre as net return. Thus, the overall contribution of groundwater recharge due to JFPM is Rs. 13,342 per acre which is 199 percent higher than net returns outside the JFPM. Thus, due to JFPM the incremental net return due to contribution from groundwater recharge is Rs. 13,342 per acre of which agriculture and livestock contribute to substantially.

6.4   Assessment of Equity in benefits

There is equity in distribution of benefits in JFPM for farmers possessing irrigation wells. Here large farmers realized net returns of Rs. 8,031 per acre while small and marginal farmers and medium farmers realized net return of Rs. 34,125 and Rs. 15,402 well above that realized by large farmers. Small and marginal farmers constitute around 70 percent in the JFPM and as they realized 329 percent higher net return than large farmers which is a pointer towards equity in the distribution of benefits.

6.5   Equity in income distribution across different categories of farmers

The equity in distribution is also found out by Gini co-efficient which is calculated to know the equity of income distribution across different categories of farmers both in JFPM and Non-JFPM areas. In JFPM + Watershed area, the co-efficient was ranges from 0.73 (large farmers) to 0.72 (small farmers), while in JFPM area the co-efficient ranges from 0.73 (large farmers) to 0.64 (small farmers). This indicates that there is equity in income distribution among farmers in JFPM.

The Lorenz curve also indicates that there is more equity in income distribution of farmers in JFPM area than in JFPM + watershed area *(Figure 5.3 and Figure 5.4)*.

6.6:   JFPM usufructs to farm women

JFPM program in collaboration with NGO in Bandekatte village (JFPM + watershed) formed three Self Help Groups in 2006 namely Bharathambe Swasahay Sangh (BSS), Marikambe Swasahay Sangh (MSS) and Bhumika Swasahay Sangh (BhSS) and created the employment for 46 women by engaging them in different activities like vegetable sales, poultry, dairy, sheep rearing and small businesses, etc. and each of them realized return of about Rs.2400 per year.

In Adavimallapur village (JFPM), about 16 women got employment by engaging in collecting Bidi leaves for 60 days and extraction of gum for 30 days in a year. And each realized return of about Rs. 1250 and Rs. 600 respectively.

Table 11: Loan taken and savings by different SHGs in JFPM program in Bandekatte

Sl. No	SHG	Members (women)	loan by JFPM (Rs.)	savings (Rs. /wk /person)	Savings / year/ person
1	Bharathambe Swasahay Sangh	16	40000	50	2400
2	Marikambe Swasahay Sangh	15	30000	50	2400
3	Bhumika Swasahay Sangh	15	30000	50	2400

Table 12: Number of Women employed and Returns realized from non- timber products in JFPM village, 2008

Particulars	Women employed	No. of days collected / year / person	Quantity / person	Price / unit	Total returns/ person
Bidi leaves (bundles)	6	60	49	25	1225
Gum extraction (Kg)	10	30	5	120	600

6.7:   Logarithm of Net return functions for water use per farm in acre inch, area under chilli seed production and study area

The results of the production function analysis reveal that for 1 percent increase in water used, the average net return from all crops per acre increases by 0.51 percent. However for 1 acre increase in the area under chilli seed production, the average net return per acre increases by 61 percent. Due to only JFPM the average net return will be far higher than due to JFPM + Watershed and only watershed programme. One of the reasons for higher average returns from JFPM is due to the year of initiation of the program. The JFPM was initiated in 2002 while the JFPM + Watershed were initiated in 2005.

Table 13: Summary Output of regression for Logarithm of Net return functions

Regression results	Coefficients	Standard Error	t Stat
Intercept = Log a	7.928	0.583	13.6
logx1= Water used per acre (acre inches)	0.506	0.214	2.368
x2 = area under chilli seed production (acres)	0.611	0.277	2.21
d1 = 1 for JFPM, O otherwise	1.576	0.307	5.134
d2 = 1 for JFPM + Watershed, O other wise	0.9	0.186	4.841
d3=1 for Watershed, O otherwise	1.131	0.191	5.909
F Statistic			**53.76****
R Square			0.737
Adjusted R Square			0.723
Standard Error			0.559
Observations			102

Note: **, ** and *** indicates significance at 1%, 5% and 10% level respectively*

CONCLUSION

This study was taken to examine the impact of only JFPM and JFPM + watershed program in Harapanahalli and Molakalmur taluks. It was hypothesized that JFPM being unique community driven Integrated Forest Development Project with strong institutional collaboration and co-ordination among various agencies which aimed at sustained alleviation of poverty, will improve skills and employment opportunities under non-farm sectors.

There are different types of farmer beneficiaries in a JFPM program. It was hypothesized that if the JFPM impact is equally distributed over all categories of farmers in the area, the purpose of the JFPM development program is served. In this study, the impact of JFPM program on all categories of farmers and in addition on the overall group was estimated (i.e. all the classes taken together).

The cropping pattern of was almost similar in all the four regions with major rainfed crops like jowar, ragi, maize and groundnut, maize, onion and Sunflower being major crops under irrigated farming. Chilli seed production is grown only by only JFPM farmers. Women in Only JFPM and JFPM + watershed received additional employment through self help groups and other usufruct benefits of JFPM program. Thus hypothesis that JFPM development programme generates additional employment is proved.

The net return per farm and net return per rupee of irrigation cost is very much higher in only JFPM compared to other three situations. And also increased availability of water in only JFPM area showed that there is positive impact of JFPM on groundwater recharge. Only JFPM farmers performed better than farmers in other three situations. Also within the group small and medium farmers realized higher returns than large farmers which prove the hypothesis that JFPM development programme has brought fair distribution of income across different classes of farmers.

POLICY IMPLICATION

This study apparently is a pointer towards the role of JFPM in augmenting soil and water conservation efforts. The JFPM efforts have registered the highest net returns to farmers when compared with watershed activities and JFPM + watershed activities. This indicates the clear supremacy of the performance of JFPM in heralding agricultural output in consonance with groundwater conservation.

The heartening lesson is the existence of successful dug wells / open wells in the JFPM area which are par excellence in relation to the net returns and other economic yardsticks. The study is a clear pointer towards the positive economic performance of JFPM when compared with other three types of treatment (JFPM + watershed), JFPM, watershed and control. The amortized cost of water from dug wells is far lower than that from borewells. Similarly the net returns per acre inch of groundwater are the highest on JFPM farms compared with other farms. The ongoing JFPM activities in different parts of Karnataka villages need to be promoted with commitment and support by the government.

REFERENCES

*BARBIER AND EDWARD, B., 1990, Farm level economics of soil conservation in the uplands of Java. Land Economics, **66**(2):199- 213.*

*BHATTACHARYA, A.K. AND BASNYAT, B., 2005, Empowering people through Joint Forest Management: a study from Madhya Pradesh (India). The International Forestry Review (IFR), **5**(4):370-378.*

BISWAS, KALLOL, DHARUDU MURALI, REDDAPPA REDDY AND GOVINDAPPA, K., 1997, People and forest; mutual survival - a case study on the VSS of Nainayana Cheruvu, Anantapur District, for the Department of Social Work, April, Sri Krishna Devaraya University, Ananatapur, Andhra Pradesh.

CHANDRAKANTH, M.G., BISRAT, A. & BHAT, M.G. (2004), Combating negative externalities of drought: a study of groundwater recharge through watershed. Economic and Political Weekly, 39 (11), 1164-1170.

D'SILVA, EMMANUEL AND B. NAGNATH., 2002, Behroonguda: A Rare Success story in joint forest management. Economic and Political Weekly February 9.

DEEPAK, S.C., CHANDRAKANTH, M.G. & NAGRAJ, N. (2005), Groundwater Markets and Water Use Efficiency: The Case of Karnataka. IWMI-TATA Water Policy Research Highlights, No. 12, 2005.

ENVID., 2000, Impact assessment of JFM in Vishakapatnam forest division for AP forest department. Department of Environmental Science, Andhra University, Vishakhapatnam.

GUJRATI, D. N., AND SANGEETA., 2007, Basic Econometrics, (4th Ed.), Tata McGraw- Hill Publishing Company Limited, New Delhi. p:285-287.

*LIGON, E. AND NARAIN, U., 1999, Government management of village commons: comparing two forest policies. Journal of Environmental Economics and Management, **37**(3): 272-89.*
LOKESH, G. B., 2004, Economic impact assessment of watershed development programme: a study of Kallambella watershed, Karnataka. Ph.D. thesis, (Unpublished), University of Agricultural Sciences, Bangalore.

*NAGARAJ, N., CHANDRASHEKAR, H. AND YATHEESH, H. S., 2003, Sustainability and equity implications of groundwater depletion in hard rock areas of Karnataka: an economic analysis. Indian Journal of Agricultural Economics, **58**(3): 438- 447.*

SUNDER, N., ROGER JEFFERY AND NEIL THIN., 2001, Branching out – joint forest management. Oxford University Press, New Delhi.

VIKRAM PATIL, 2009, Economic Impact of JFPM on Groundwater Recharge in Chitradurga and Davanagere Districts, MSc thesis, (unpublished), University of Agricultural Sciences, Bangalore.