Decentralized Natural Resource Management: Equity Impacts on Groundwater Recharge Through JFPM in India

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Abstract

This study evaluates the economic impact of Joint Forest Planning and Management (JFPM) an institutional innovation with decentralized planning process. This has enabled to manage forests and water at local level through collective action of farmers with the help of the line Departments focusing on groundwater recharge. The economic impact on productivity, wage income, income generating activities and equity in the distribution of benefits are evaluated in Chitradurga and Davanagere identified as the most vulnerable districts by the National Planning Commission. Field data were collected (for 2008) from the population of all the participating farmers possessing irrigation wells in villages which have (1) only JFPM, (2) JFPM and Watershed program; (3) only Watershed program and (4) with neither JFPM nor Watershed programs as Control situation.

The net return per acre, net return per acre inch of groundwater and net return per rupee of irrigation water were respectively Rs.5709, Rs.413, Rs. 3.26 in JFPM + Watershed village, Rs.43978, Rs. 1716, Rs.8.42 in JFPM village, Rs. 8060, Rs.675, Rs.3.05 in Watershed village and Rs. 3369, Rs.247, Rs.1.04 in Control village. Conspicuously when open / dug wells are a failure all over the State, in this area, due to JFPM, all such wells became functional yielding water due to good recharge from the program. Accordingly from open wells net return per acre, net return per acre inch of groundwater and net return per rupee of irrigation water were Rs.76740, Rs.1738 and Rs.11.30 respectively. This was possible through collective action of the village community through JFPM which is proved to be cost effective, remunerative and equitable in improving the groundwater recharge in the open/dug wells which had become defunct due to the advent of modern deep borewells. The results also were significant using ANOVA.

There were also gender impacts as in JFPM + Watershed village, 46 women benefited from employment realizing return of Rs.2400 per capita per year and in JFPM village, 16 women benefited.

Key words: *JFPM, decentralization, groundwater, collective action*

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INTRODUCTION

Equity is crucial in the economics of the Joint Forest Planning and Management (JFPM) program of India, achieved through decentralization as it provides for inclusive growth and development. Equity implies fair share of benefits to different stakeholders of the JFPM program. Ensuring equity in natural resource conservation and management involves justice across caste, gender, and class. The economic aspect of equity is to find whether JFPM program has improved equality or reduced inequality in access to resources and in realization of the net returns.

The cause for inequity at regional level is uneven resource distribution and access by regional power structures and society hierarchies. The benefits of JFPM are reaching the rich who usually have higher gross irrigated area than the small and marginal farmers in the JFPM because of more access to groundwater. In order to ensure equity, priority has to be given to those areas where the land use practices have reduced the productivity to a level unable to sustain even subsistence farming. This inequity has made groundwater a vital and inevitable resource for irrigation. However, this is not specific to JFPM program, for any program, the distribution of benefits will be spread according to the area held.

Economic rationale for JFPM development program

Eeconomic impact assessment of the JFPM with the objective of assessing equity in the distribution of benefits, management and utilization of JFPM usufructs and through agriculture, horticulture, livestock and environment as reflected in incomes earned and access to resources.

JFPM program

This study pertains to the semi-arid tropics in Karnataka state, characterized by low rainfall with low groundwater recharge coupled with high groundwater extraction. In this scenario it is crucial to conserve the rainfall, moisture and the groundwater for the benefit of agriculture, livestock and sustainability of farming. Even though there are many programs such as watershed development, rehabilitation of minor irrigation tanks including desilting, soil and water conservation programs, predominantly by the Departments of Agriculture, Watershed Development and Minor Irrigation, these need to work in coordination with the forest programs for sustainable resource management, specially groundwater management. The JFPM commcned in 1990 throughout the country with the focus on development of natural and environmental resources through collective action. This principally involves people involvement to sustain natural resources and ultimately increase the groundwater table for sustenance of food, livestock, fodder production and other income generating activities. Development of innovative forest institutions is a *sine quo non* for the development of forests and groundwater resources. Thus far, Karnataka Forest Department has constituted 3887 Village Forest Committees (VFC) in Karnataka, bringing nearly 3, 40,000 ha of degraded forests under JFPM. There are special provisions for women in JFPM program. JFPM schemes are

known to provide many ecological, socio-cultural, and economic benefits to rural society.

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 JFPM with the co-operation and involvement of the villagers can provide fillip to forest conservation with the help of NGOs. In the JFPM the villagers have only usufruct rights to the forests and no timber rights.

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 through collective action.

There have been studies concerning the economic impact of developmental programs such as the Watershed development program (Chandrakanth, Bisrat and Bhat, 2004), Tank rehabilitation program (Girish, Nagaraj and Chandrakanth, 1997). However, studies concerning economic impact of JFPM focusing on groundwater recharge are absent. This study is a modest attempt towards exploring the economic Impact of JFPM on groundwater recharge, agricultural productivity, income from wage employment, other income generating activities, equity in distribution of JFPM benefits among different classes of farmers in Chitradurga and Davanagere districts.

REVIEW OF LITERATURE

Nagaraj and Chandrakanth (1997) studied the inequity in access to groundwater resources and indicated the skewedness in asset and income distribution for farmers in the eastern dry zone of Karnataka. They indicated that the shift to water intensive crops and favorable policy instruments like soft loans to sink wells and zero marginal costs for electrical power disturbed the equity in well irrigation and paved the way for use of expensive technologies for the rapid harnessing of groundwater.

Girish *et al (1997)* studied the rehabilitation of irrigation tanks in Eastern Zone of Karnataka and indicated that Rs. 240 per acre was saved by application of silt to ragi crop and Rs. 6,250 per acre of grape Rs. 740 for maize. Dugwells showed recharge of 308 GPH and dug cum bore wells is 483 GPH and for bore wells 350 GPH, after rehabilitation.

Nagaraj *et al* (2003) highlighted that medium and large farmers together (69 per cent) owned 80 per cent of the irrigation wells. Similarly, 88 per cent of the wells in the gross irrigated area were operated by medium and large farmers. This reflects the inequity persisting in ground water irrigation, in addition to persisting inequity in land holding distribution. The study also revealed that the cost per acre-inch of water extracted considering all wells, was highest increase of small farmers Rs.422 per acre inch compared to large farmers incurred Rs. 346 per acre much of water. Considering only the functioning well, the cost per acre-inch of water is

marginally higher in case of small farmers (Rs. 276) as against large farmers (Rs. 270). The study draws the attention of policy makers to support for small and marginal farmers though different programs. The gini co-efficient values indicate that there is an inequality in both net income and value of water extracted across size groups. The magnitude of the co-efficient is similar for net income and volume of water extracted (0.71 and 0.72, respectively).

Rucha (2003) reported that the 'equity issue' in JFM is discussed in two contexts: equity in participation and equity in benefit sharing. Benefit sharing can further be envisaged in two ways: sharing of benefits between Forest Department and communities, and benefit sharing between the community members. Equity in participation by all members including women, poor and the landless has been well defined in the Forest policy, 1988.

METHODOLOGY

Bandekatte (village with watershed program + JFPM) and Hirehalli (with only watershed program) in Molkalmur taluk and Adavimallapur (village with only JFPM) and Eigalbasapur (control) village are chosen in Chitradurga and Davanagere districts respectively for detailed study (Figure1 and figure 2). Population study of farmers with borewells/ dugwells has been done in all the four treatments. In the JFPM + watershed village and in only watershed village, there were 23 and 24 farmers respectively and in only JFPM village and control village there were 42 and 15 farmers respectively.

Marginal farmers are those holding below 2.5 acres, small farmers hold between 2.5 and 5 acres, Medium farmers are those holding between 5 and 10 acres and large farmers are those holding more than 10 acres. There was no instance of land leasing activity. Primary data for the study were collected from personal interviews during December 2008 with 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 of respective taluks were collected regarding expenditure on different activities of JFPM program.

DISCUSSION

Net returns per farm from different sources in JFPM areas, 2007-08

Considering net returns per acre of net cropped area realized from all the sources, in JFPM + watershed, small and marginal farmers and medium farmers realized higher net return of Rs. 20,224 and Rs.16, 848 respectively as compared to large farmers (Rs. 10,258). Small and marginal farmers in only JFPM area realized a net return (Rs. 34,125) higher than medium farmers (Rs. 15,402) and large farmers (Rs.8, 031).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) while 6.56 per cent of the overall net return was from the livestock
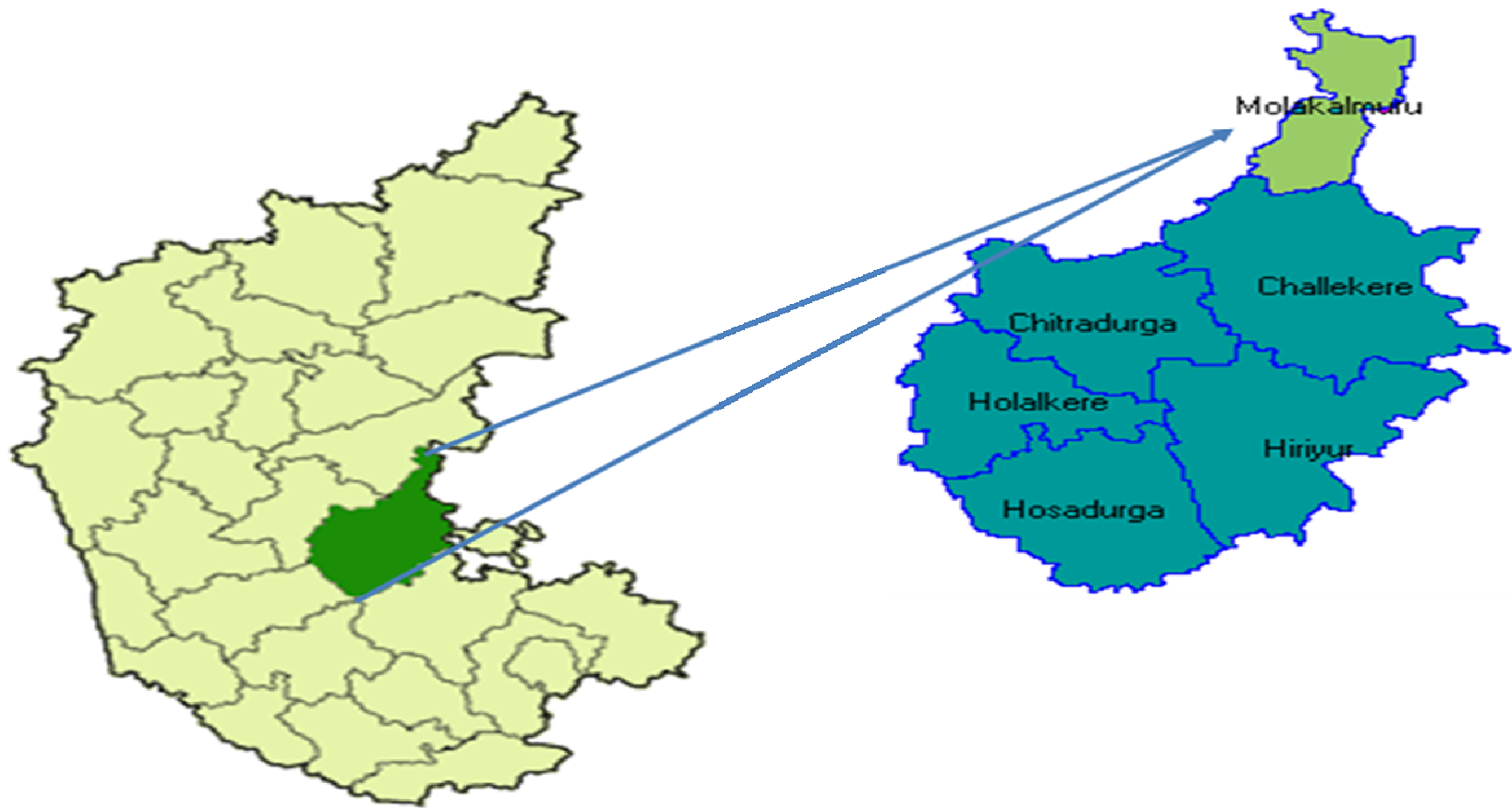
Fig 1: Map of the study area in Chitradurga district of Karnataka
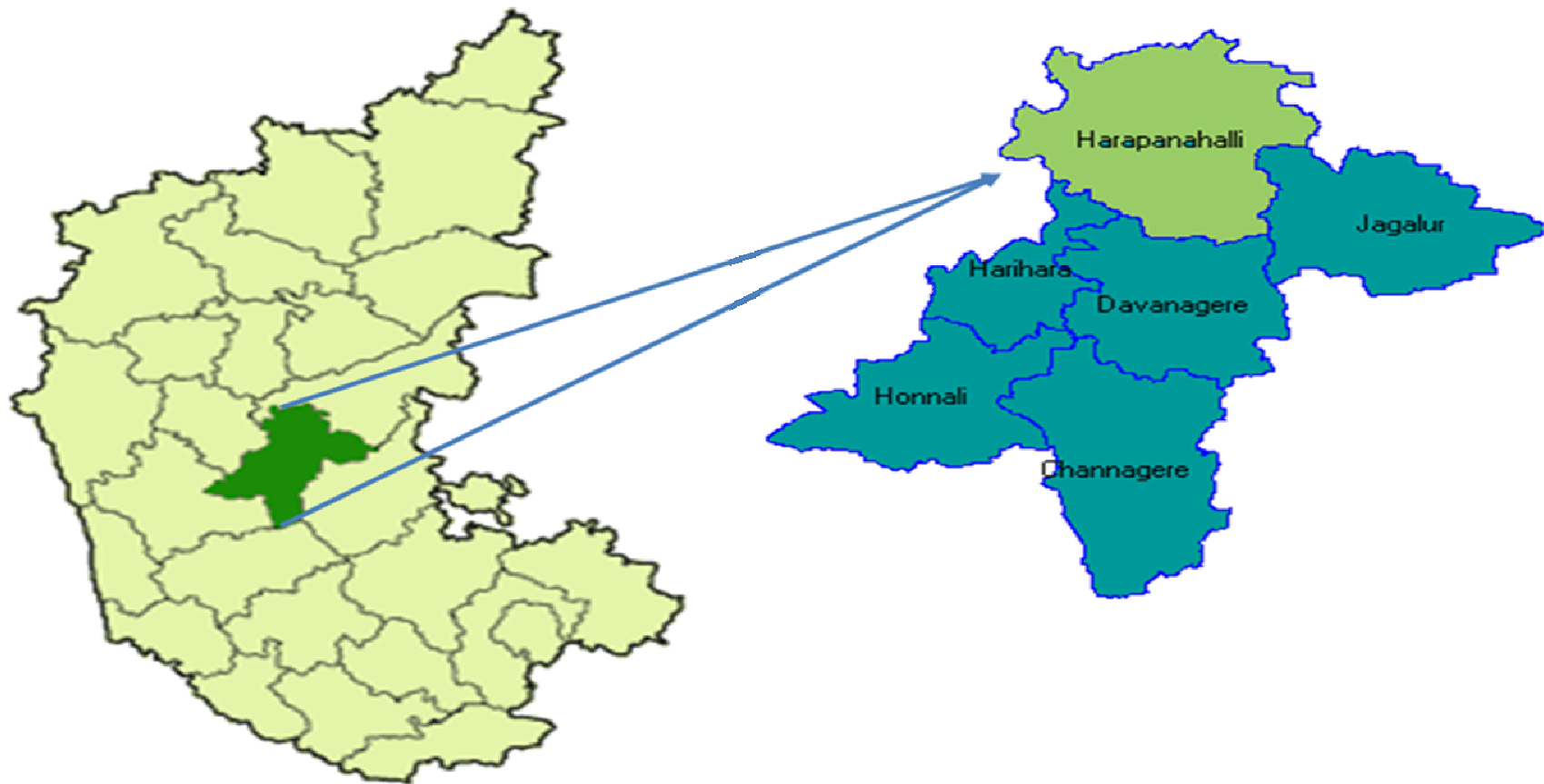
Fig 2: Map of the study area in Davanagere district of Karnataka

(Rs. 1,88,696) in JFPM + watershed and it was 3.97 per cent in only JFPM area (Rs. 1,56,085) *(Table 1)*.

The overall net return was Rs. 13,068 per acre of net cropped area for sample farmers in JFPM + watershed and 94.43 per cent of this was from agriculture crops. And the overall net return for sample farmers in only JFPM was Rs. 20,044 of which the contribution of agriculture was 96 per cent *(Table 1)*.

Table 1: Net returns per farm from different sources in JFPM + watershed and only JFPM areas, 2007-08

(Rupees)

Sources of net returns	Sample total					Net return per acre of NCA	Net return per farm
	Agriculture	Livestock	Wage employ-ment	Sum of net returns	Net cropped Area (NCA)		
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. Exchange rate 1 euro = Rs. 60 during Oct 2010.

Table 2: Net returns per farm from different sources in only watershed and control areas, 2007-08

(Rupees)

Sources of net returns	Sample total			Sum of net returns	Net cropped Area (NCA)	Net return per acre of NCA	Net return per farm
	Agriculture	Livestock	Wage employment				
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

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In the village with watershed, the overall net return per acre for sample farmers was Rs. 13,045 per acre which is 95 per cent higher than that of control area (Rs. 6,702). This difference is more than that in the case of JFPM + watershed and only JFPM areas (Rs. 13,068 and Rs. 20,044) *(Table 2)*.

Contribution of agriculture (Rs. 24, 68,183) to the overall net return was 96.53 per cent for sample farmers in only watershed, while contribution of agriculture (Rs. 6, 69,947) to overall net return was 81.60 per cent for sample farmers in control area. And the contribution of livestock to overall net return was 3.47 per cent and 7.43 per cent for sample farmers in only watershed (Rs. 88595) and control area (Rs. 61045) respectively. And the contribution of wage employment to overall net returns for sample farmers was 10.96 per cent in control area, while it was zero in case of only watershed area *(Table 2)*.

By considering only JFPM and control area, the contribution of only JFPM per acre was Rs. 13,342. The contribution of JFPM + watershed per acre was Rs.6366. The contribution of watershed per acre by considering only watershed and control area was Rs. 6343 *(Table 3)*.

Table 3: 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

Incremental net return due to JFPM

The incremental net return due to JFPM has been positive The incremental returns are relatively higher for farmers in only JFPM (Rs. 13342) than for farmers in JFPM + watershed area (Rs. 23). The incremental net return per acre due to JFPM + watershed for small and marginal farmers and medium farmers was Rs. 1996 and Rs. 2118 respectively. The incremental net return per acre due to only JFPM for small and marginal (Rs. 23959) and medium farmers (Rs. 8944) was higher than the large Farmers (Rs. 2243) (*Table 4).*

Table 4: Incremental net returns per acre

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

Note: Incremental net return in JFPM over Non- JFPM = net return per acre from all sources in JFPM minus that in non-JFPM area

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 find the equity in income distribution across different categories of farmers. In JFPM + Watershed area, the Gini ranged from 0.73 (large farmers) to 0.72 (small farmers), while in JFPM area the Gini ranged from 0.73 (large farmers) to 0.64 (small farmers). This indicates that there is equity in income distribution among farmers in JFPM (*Table 5 & Table 6*).

Table 5: 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 6: 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

The dug wells or open wells were rejuvenated in JFPM village exclusively due to the JFPM program. While in most other areas of Karnataka state, dug wells are a total failure due to the advent of deep irrigation borewells, the JFPM village presented an unique situation, where the dug wells are still functioning despite the cumulative interference affecting the cone of depression of dug wells. The chief advantage of such a rejuvenation of dug wells is that small and marginal farmers who had lost their investment due to failure of dug wells earlier, are saved of the huge investment burden required to drill a borewell, since dug wells were rejuvenated due to the JFPM program. If JFPM can be extended to other areas of the State and if farmers through collective action achieve similar results, then it brings a great relief for the groundwater farmers of Karnataka, currently suffering from large scale failure of irrigation wells (Figs 3 and 4).

Fig 3: Dugwell Yield Rejuvenated in JFPM Area

Fig 4: Dugwell-Totally Failed in Non-JFPM Area

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 and Figure 6)*.
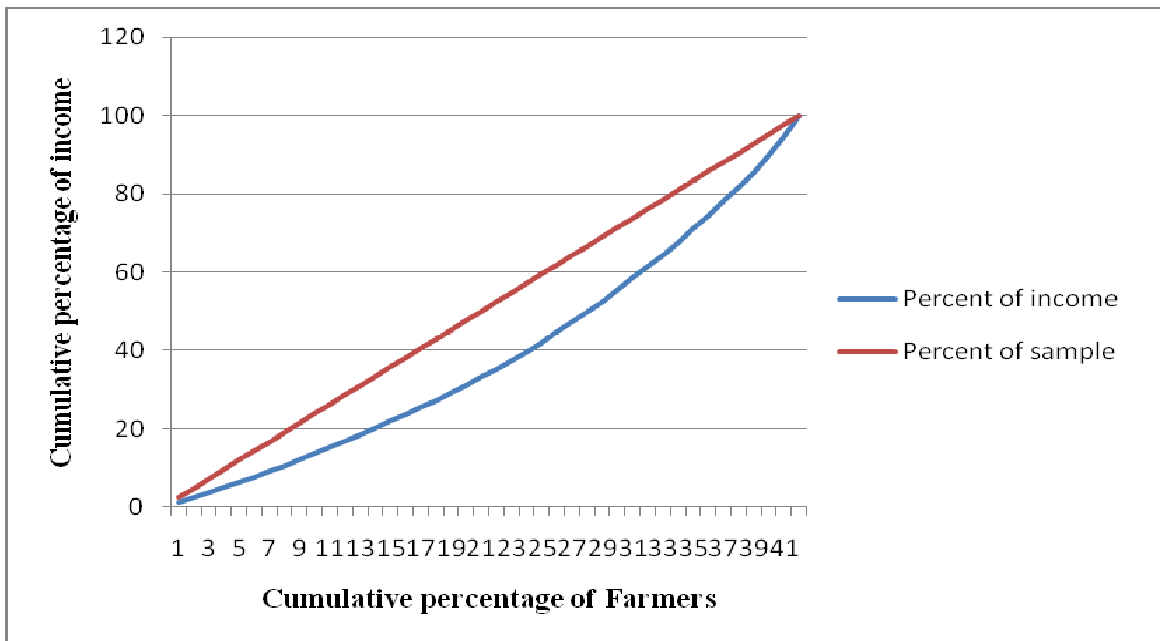

Figure 5: Lorenz curve showing the income distribution of the farmers in JFPM area
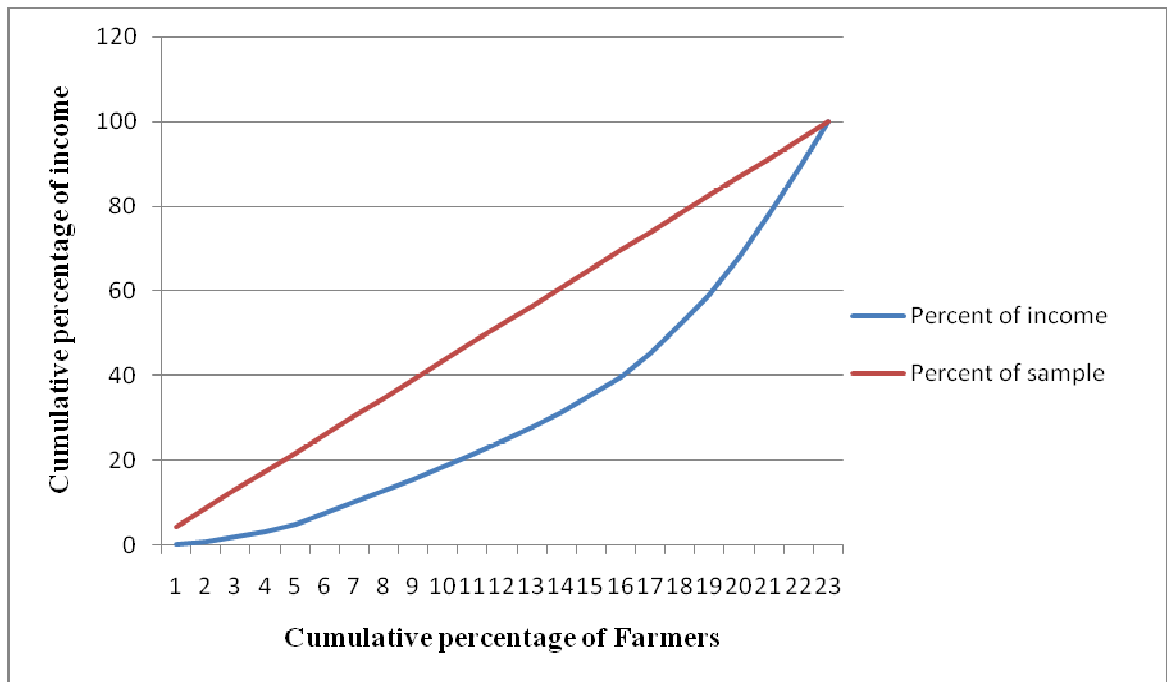
Figure6: Lorenz curve showing the income distribution of the farmers in JFPM + watershed area

Statistical validation of the results

ANOVA is analysis of variance tool which used to test the difference, if any among the different groups, indicated a significant difference between the net returns per acre from all the sources among four situations namely, JFPM + watershed, only watershed, only JFPM and control area except JFPM + watershed and only watershed *(Table 7).*

Multiple comparisons is done through the pair-wise comparisons of the group means for all selected post hoc procedures. Considering the net return per acre from all the sources, there is a significant difference between the JFPM + watershed and control area but not between JFPM + watershed and only watershed farmers. Considering the net return per acre from all the sources. there is significant difference between only JFPM and control area and only JFPM and only watershed area. Considering net return per acre for sample farmers there is significant differences between JFPM + watershed and only JFPM *(Table 7).*

Table 7: 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

CONCLUSIONS AND IMPLICATIONS

The net returns from all sources to the farmer per acre can be taken as an indicator of efficiency in the implementation of developmental program. This study indicated that the net returns for small and marginal farmers were higher by 235% in JFPM village, 79% in Watershed village, 99% in JFPM+Watershed village over the control situation. This is a *prima facie* indicator of efficiency, equity and collective action of developmental programs in natural resources. The results of this study clearly indicate that the collective action of farmers in the JFPM and watershed programs is largely responsible for statistically and economically significant net returns as well as in their equitable distribution of benefits. The collective action not only enhanced the access to water and forest resources, but also indicated equity in distribution of benefits. The small and marginal farmers realized higher net returns through greater access to groundwater than large farmers, a desirable impact of developmental programs on equity. Thus, collective action paves the way for improved, equitable and efficient access to groundwater and natural resources for small and marginal farmers in Karnataka through JFPM and watershed

developmental programs. It is desirable for the State to promote such developmental programs for the benefit of small and marginal farmers.

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