Watershed intervention technology- A case study analysis

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Abstract

Land being the major non-renewable natural resource is inelastic in nature. As watershed supports the entire dry land agriculture/horticulture and also remain the catchments for tanks and reservoirs, the strength of the watershed development programmes will largely determine the growth in agriculture. Watershed management was a holistic approach aimed at optimizing the use of land, water, vegetation and all associated components in an area which could alleviate drought, moderate floods, prevent soil erosion, and improve water availability, increase fuel, fodder and agricultural production on a sustainable basis. Water harvesting is usually employed as an umbrella term describing a whole range of method of collecting and conserving various forms of runoff from different sources. Watershed Intervention Technology is a composite approach to an efficient use of land and water resources so as to get optimum production from them and also to preserve the soil from deterioration and future utility, (Ministry of Water Resources, 2008).

Introduction

Land being the major non-renewable natural resource is inelastic in nature. There is lot of pressure on land due to increasing population from the agricultural, industrial and housing sector. On the other hand, land is subjected to soil erosion and land degradation problem due to rain or wind action and faulty cultivation practices resulting in loss of topsoil, which is the place where all nutrients are available. This leads to poor yields, uneconomic returns, reservoir sedimentation, and reduction in storage capacity, reduction in ayacut area, and shutdown of hydel power stations, ecological imbalance, environmental pollution, droughts and floods. Hence the conservation, development and management of the land resources which ensures the physical, chemical and bio-logical health of soil profile is of prime importance and also a sine qua non for water resources management, right from soil moisture conservation to flood control.

Background of the study

In a predominantly agricultural system, the objective of improving the productivity, profitability and prosperity of the farmers and achieving agricultural development on an ecologically sustainable basis can be attained only when conservation, development and management of the land and water resources through construction of watersheds are assured Adhikari.et.al (2008). As watershed supports the entire dry land agriculture/horticulture and also

remain the catchments for tanks and reservoirs, the strength of the watershed development programmes will largely determine the growth in agriculture.

Water conservation and rainwater harvesting is most effective when taken up as part of watershed management. Watershed management involves soil and water conservation efforts integrated with appropriate cropping pattern, proper agricultural practices combined with animal husbandry as a community effort to reap maximum economical gain Chandrakanth.et.al. (1998). Watershed development and management, rather a multi-disciplinary activity represents a dynamic strategy, which was much more multifaceted than mere soil and water conservation Dineshkumar, et.al (2004) rightly endorsed that watershed management was a holistic approach aimed at optimizing the use of land, water, vegetation and all associated components in an area which could alleviate drought, moderate floods, prevent soil erosion, improve water availability, increase fuel, fodder and agricultural production on a sustainable basis.

Matters and Materials

Out of 5711 blocks available in India, over 470 blocks are classified either as over-exploited of groundwater or dark blocks at the all India level. Of the total over exploited blocks, over 76 per cent of the blocks are concentrated in five states, viz, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and Haryana. Narayanamoorthy.A. (1995). Out of 385 blocks in Tamil Nadu,180 blocks have almost exploited the potential and out of the 1.8 million wells in state about 12 per cent are dried up or abandoned due to ground water over-exploitation (Government of TamilNadu,2003). Out of the 31 districts in the state, 9 districts are (Coimbatore, Dharmapuri, Madurai, Ramanathapuram, Salem, Trichy, Tirupur, Tirunelveli and Kanyakumari) identified as ground water over exploited. Among the 9 districts, ground water exploitation is more pronounced in Coimbatore district. Hence Coimbatore district was chosen for the study. As the study was mainly based on primary data, the sampling respondents of the study were selected through multistage stratified sampling – techniques. In the first stage the 12 blocks in Coimbatore district viz, Anamalai, Annur, Karamadai, Kinathukadavu, Madukkarai, Periyanaickenpalayam, Pollachi North, Pollachi South, Sarkarasamakulam, Sulthanpet, Sulur and Thondamuthur were selected. These blocks are classified under “over exploited’, “critical”, and “semi-critical” blocks based on the average ground water exploitation. If the groundwater exploitation range is 100 per cent it is considered as “over-exploited”, between 85-100 per cent “critical” and 65-85 per cent “semi-critical”, the 6 blocks in which the net groundwater availability for future irrigation development was the lowest in Pollachi (South), Annur, Thondamuthur, Madukkarai, Pollachi (North) and Periyanaickenpalayam. Among the six blocks, Thondamuthur and Periyanaickenpalayam blocks were selected as these two blocks depend on groundwater irrigation. The study blocks receive rain heavily during south-west and north east monsoon period. The north east monsoon highly contributes to the rainfall in the Thondamuthur block 207.6 milli meter (mm) and Periyanaickenpalayam block 137mm.

Land Use Pattern

Out of the total geographical area of 329 million hectare of the country, the land-use statistics are available for about 306 million hectare, constituting 93 per cent of the total area. According to the land-use data of 2000-01, the arable land (the net area sown plus the current and other fallow land) was estimated at 166.09 million hectare (54.2 per cent of the total reporting area). With the increasing demand for various agricultural, forestry and livestock products for consumption and export, it is very necessary that each piece of land is put for its best use. Further, intensification of various development progrmmes such as soil-water conservation, the extension of irrigation facilities, and the adoption of scientific agricultural practices have resulted in an element of dynamism in the land use and cropping patterns (Sohan Lal and Gajbhiye, K. S. 2007). The land use pattern of the study area is presented in the following table 1. The land was characterized as 'arable land', 'orchards' and 'non-arable land'.

In the Thondamuthur block, on an average small farmers own 2.0176 hectares of land, medium farmers 6.4036 hectares of land and large farmers 11.2575 hectares of land. On an average, the farmers in the Thondamuthur block own 4.3746 hectares of land. Among the land owned and used, orchards constitutes the major proportion across all the types of farmers (53.27 per cent) followed by arable land by 39.06 per cent of the farmers. Non-arable land constitutes a lesser percentage. On an average, a farmer in Thondamuthur block owns 0.3355 hectares of non-arable land.

Table 1: LAND USE PATTERN IN SELECTED STUDY BLOCKS

(in hectares)

Blocks	**Thondamuthur**				**Periyanaickenpalayam**			
Farmers / Land	**SF**	**MF**	**LF**	**ALL**	**SF**	**MF**	**LF**	**ALL**
Arable land	0.878 (43.52)	2.5338 (39.57)	3.6973 (32.84)	1.7089 (39.06)	0.981 (34.21)	1.2707 (19.69)	4.7628 (37.02)	1.8259 (34.11)
Orchards	1.0897 (54.01)	3.4605 (54.04)	5.7024 (50.65)	2.3302 (53.27)	1.300 (45.34)	4.6053 (71.35)	6.8252 (53.06)	3.1105 (58.12)
Non-arable Land	0.0499 (2.47)	0.4093 (6.39)	1.8578 (16.50)	0.3355 (7.67)	0.5865 (20.45)	0.5787 (8.96)	1.2763 (9.92)	0.4159 (7.77)
All	**2.0176 (100)**	**6.4036 (100)**	**11.2575 (99.99)**	**4.3746 (100)**	**2.8675 (100)**	**6.4547 (100)**	**12.8643 (100)**	**5.3523 (100)**

Source: Field survey, 2009. SF-small farmer, MF- medium farmer, LF- large farmer, Figures in brackets denote percentage to column total.

In the Periyanaickenpalayam block, on an average the farmers across all the groups own land in a larger measure compared to Thondamuthur block. The small, medium and large farmers on an average own 2.87, 6.45 and 12.86 hectares of land respectively. In Periyanaickenpalayam

block also, orchards constitutes a major proportion (58.12 per cent) followed by arable (34.11 per cent) and non-arable land (7.77 per cent).

Type of Soil

Cropping pattern depends on the type of the soil, climatic conditions, and irrigation facilities. The soil in India may be classified into four groups according to the availability of the rain water and evaporation. They are (1) alluvial soil, (2) black cotton soil, (3) red soil and (4) laterite soil. Soil which is the topmost layer of the earth's surface consists of four layers. The first topmost layer of soil is vital for the cultivation of crops. The Coimbatore district has mainly five types of soil viz; red loam, black soil, sandy coastal alluvium, red sandy soil and calcareous soil. Each type of soil benefits different types of crops through their unique physical, chemical and biological properties. The details of the soil in the study blocks are presented in the following Table 2.

Table 2: DISTRIBUTION OF FARMERS BASED ON TYPE OF SOIL

Blocks / Type of soil		Thondamuthur				Periyanaickenpalayam			
		SF	**MF**	**LF**	**All**	**SF**	**MF**	**LF**	**All**
RED	N	137	87	22	246	3	4	1	8
	C	97.85	98.86	100.00	98.40	2.03	8.00	1.92	3.20
BLACK	N	3	1	0	4	145	46	51	242
	C	2.14	1.14	0.00	1.60	97.97	92.00	98.08	96.80
ALL		**140**	**88**	**22**	**250**	**148**	**50**	**52**	**250**

Source :Field survey, 2009. SF-Small, Farmer, MF-Medium Farmer, LF-Large Farmer. N – Number stated, C – Percentage to column total.

Thondamuthur block is covered with red soil (98.4 per cent) and Periyanaickenpalayam is covered with black soil (96.80 per cent). Red soil has iron content and is fit for crops like red gram, bengal gram, green gram groundnut and caster seed. Black soil is rich in calcium, potassium and magnesium. Crops like cotton, tobacco, chilly, oilseeds, jowar, ragi and maize grow well in it.

Soil and Watershed intervention technology include summer ploughing, contour bunding, gully plugging, land levelling, diversion channels and drainage ditches. Of these all the sample farmers in the two selected study blocks use 'summer ploughing', 'contour bunding', and 'land levelling'. The application of these methods leads to conservation of soil, increase in water retention capacity of soil, recharging of ground water levels and increase in vegetative cover Muthamizh Vendhan, et.al (2010). The following table 3 gives the details of the total and average area per farmer under these measures and also the average investment made on these measures by the farmers.

Though all the farmers follow these three soil and moisture conservation measures, the per cent of gross cropped area under these measures were less than 80. About 50 per cent of the gross cropped area in the Thondamuthur block and 38 per cent in the Periyanaickenpalayam block were treated with summer ploughing. Large farmers in both these areas practice this measure comparatively in a larger measure. About 60 per cent of the total gross cropped area of the large farmers in the Thondamuthur block and 74 per cent in the Periyanaickenpalayam block were treated with summer ploughing. Per unit cost of summer ploughing varies from 1,266 in Periyanaickenpalayam block to 1,409 in the Thondamuthur block. Across the farmers it is the lowest among the small farmers with 1,275 and 1,234 in the Thondamuthur and Periyanaickenpalayam blocks respectively. The other two measures such as contour bunding and land leveling are carried out in less than 25 per cent of the gross cropped area in the study blocks. Contour bunding is carried out in about 13 per cent of the gross cropped area in the Thondamuthur block.

Table 3: SOIL AND MOISTURE CONSERVATION IN SELECTED BLOCKS

Blocks / Particulars	Thondamuthur				Periyanaickenpalayam			
	SF	MF	LF	All	SF	MF	LF	All
			SUMMER PLOUGHING					
Average area (ha)	1.25	4.03	7.15	2.74	1.24	2.92	5.38	2.44
Total area (ha)	175.02	354.90	157.42	687.35	183.92	145.88	279.83	609.65
Per cent to gross cropped area	44.13	51.06	59.58	50.69	19.82	51.46	73.81	38.34
Average investment	1275	1540	1261	1409	1234	1366	1236	1266
			CONTOUR BUNDING					
Average area (ha)	0.37	0.96	1.61	0.69	0.38	1.03	1.64	0.77
Total area (ha)	53.05	84.68	35.40	173.44	56.53	51.49	85.38	193.41
Per cent to gross cropped area	13.38	12.18	13.40	12.77	6.09	18.17	22.52	12.16
Average investment	1624	1772	1674	1707	1224	1255	1211	1226
			LAND LEVELLING					
Average area (ha)	0.22	0.76	1.06	0.48	0.87	1.15	1.68	1.09
Total area (ha)	30.31	67.27	23.26	120.85	128.71	57.26	87.20	273.18
Per cent to gross cropped area	7.64	9.68	8.8	8.91	13.88	20.20	23.00	17.18
Average investment	1806	1436	1507	1542	583	1296	1276	953
Total investment	**4705**	**4748**	**4442**	**4658**	**3041**	**3917**	**3723**	**3445**

Source: Field survey, 2009, SF- Small Farmers, MF – Medium Farmers, LF – Large Farmers, ha - hectares

The application of this method varies widely among the farmers in the Periyanaickenpalayam block.

The percentage of gross cropped area under contour bunding was about 22.5 for the large farmers`. and the lowest 6.09 among the small farmers. The unit cost of contour bunding varies from 1,211 for the large farmers in the Periyanaickenpalayam block to 1,674 in the Thondamuthur block. The percentage of gross cropped area under land levelling was less in the Thondamuthur block. Less than 10 per cent of the gross cropped area in the Thondamuthur block is treated with the land levelling measure. In the Periyanaickenpalayam block about 14 to 24 per cent of the gross cropped area is treated with land levelling measure. The unit cost of land levelling is 1,542 in the Thondamuthur block and 953 in the Periyanaickenpalayam block.

On an average the total investment made on soil and moisture conservation measures were worked out to 4,658 in Thondamuthur block and 3,445 in Periyanaickenpalayam block.

The analysis reveals that

- ★ The investment on soil and water conservation measures is high in Thondamuthur Block compared to Periyanaickenpalayam block.
- ★ Across the farmers, the investment incurred is high among the medium farmers.

Satyendra,et.al (2008) reported that the watershed treatment activities improve conservation of soil and moisture; improve and maintain the fertility status of soil. Satyendra, P.G, (2006) and Palanisami et al., (2009) also supported the same through their works.

Watershed Technology

Water harvesting is usually employed as an umbrella term describing a whole range of method of collecting and conserving various forms of runoff from different sources. In particular, for dry land agriculture, it is collection of excess runoff water in storage tank and using it for the betterment of crop production in the collected and other areas. There are three types of collected tanks, namely, farm ponds, percolation ponds and silt detention tanks. The water collected in the farm pond is directly used for protective irrigation. The water stored in other structures will recharge the ground water and is used for protective or supplementary irrigation by providing open/tube wells (Sivanappan, R.K. 2004).

Different types of watershed conservation measures are carried out in the study area. They include ‘farm pond ’, ’percolation pond’, ‘renovation of tank’ and ‘rejuvenation of wells’. The details of the various measures are given in the following table 4. As the data reveals ‘farm ponds’ and ‘percolation ponds’ are the two main watershed technologies followed in both the study blocks. In the Thondamuthur block, about 76 per cent of the farmers have farm ponds. Farm ponds were used as a water conservation measure by about 69 per cent of the small farmers, 82 per cent of the medium farmers and 95 per cent of the large farmers. The farmers have more than one farm pond also. This percentage was about 13. One large farmer has 3 farm

ponds in his cultivable land area. Percolation ponds were used extensively by the large farmers (95.4 per cent), closely followed by the medium farmers (72.7 per cent). About 36 per cent of the small farmers have percolation ponds.

Renovation of tank was carried out by 7 per cent of the farmers in the Thondamuthur block. Among the 88 medium farmers, 17 (19.23 per cent) have renovated their tanks. Rejuvenation of wells was carried out by only 2 per cent of the farmers. Rejuvenation of wells was carried out by only 2 per cent of the farmers.

Table 4: CLASSIFICATION OF THE SAMPLE FARMERS BASED ON THE TYPE OF WATERSHED TECHNOLOGY IN THE STUDY AREA

Watershed Technologies	Block	Thondamuthur				Periyanaickenpalayam			
	Farmer Number	SF	MF	LF	All	SF	MF	LF	All
Farm pond	1	95	58	11	164	105	10	6	121
	2	1	14	9	24	43	37	28	108
	3	0	0	1	1	0	1	18	19
	N	96	72	21	189	148	48	52	248
	C	68.57	81.80	95.45	75.60	100	96	100	99.20
Percolation pond	1	50	54	16	120	0	7	20	27
	2	0	10	4	14	0	1	2	3
	3	0	0	1	1	0	0	0	0
	N	50	64	21	135	0	8	22	30
	C	35.7	72.7	95.4	54	0	16	42.3	12
Renovation of Tank	1	0	16	2	18	5	24	30	55
	N	0	17	1	18	5	24	30	55
	C	0	19.32	4.55	7.2	3.38	48	57.69	20
Rejuvenation of Well	1	4	1	0	5	0	0	0	0
	N	4	1	0	5	0	0	0	0
	C	2.86	1.14	0	2	0	0	0	0
Sample Size	**All**	**140**	**88**	**22**	**250**	**148**	**50**	**52**	**250**

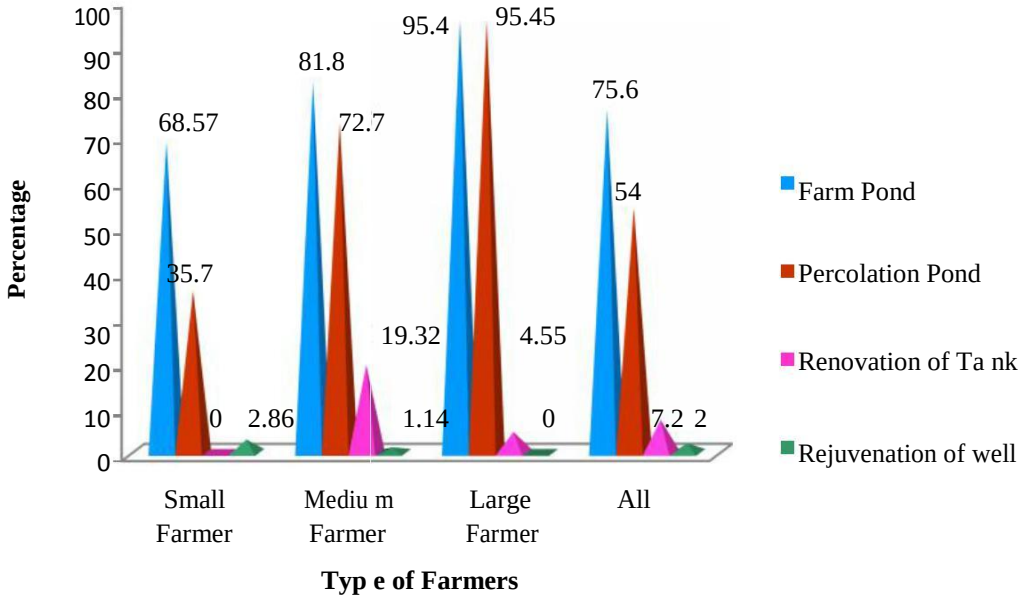
Source: Field survey, 2009. SF-Small, Farmer, MF-Medium Farmer, LF-Large Farmer.

N – Number stated, C – Percentage to column total

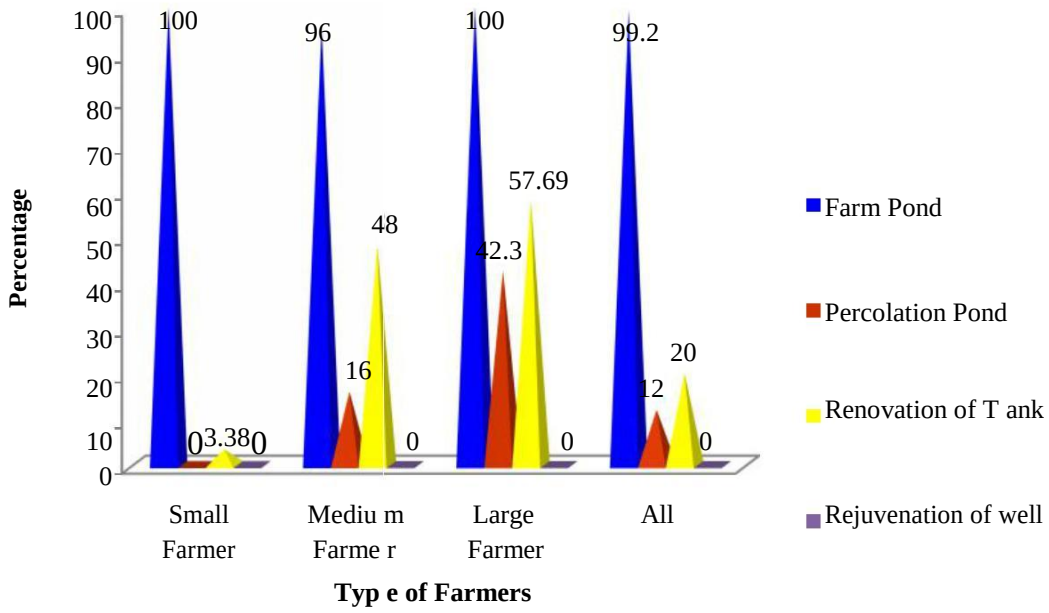
In the Periyanaickenpalayam block almost all the farmers, small and large have farm ponds. Only 4 per cent of the medium farmers do not have farm ponds. Altogether about 99.2 per cent of the farmers in the Periyanaickenpalayam block have farm ponds. Among the 50 medium farmers 37 farmers have two farm ponds. In the case of large farmers 53.85 per cent have two farm ponds. Altogether about 46 per cent of the farmers in the Periyanaickenpalayam block have

two farm ponds and 7.6 per cent three farm ponds. Percolation ponds are constr ucted by 42.3 per cent of the large farmers. Three farmers in the Periyanaickenpalayam block hav e two percolation ponds. Altogether in the Periyan aickenpalayam block only 12 per cent have perc olation ponds.

Figure 1: WATERS HED TECHNOLOGIES IN SELECTED BL OCKS THONDAMUTHUR



PERIYA NAICKENPALAYAM



Renovation of tanks was carried out by 20 per cent of the farmers in the Periyanaickenpalayam block. In this large farmers constituted 57.69 per cent and medium farmers 48 p er cent. None of the farmers in the Periyanaicken palayam block have rejuvenated their wells. Th e analysis reveals that

- ★ In the Thondamuthur block medium and large farmers conserve water through farm and percolation ponds.
- ★ In the Periyanaickenpala yam block the farmers mostly depend on farm ponds as water conservation measure

Conclusion

Watershed Intervention Technology is a composite approach to an ef ficient use of land and water resources so as to get o ptimum production from them and also to preserve the soil from deterioration and future utility, (Ministry of Water Resources, 2008). Land and water are the natural resources that are essential for t he existence of life. They are under tremendous stress due to the ever-increasing biotic pressure. Lan d degradation is mainly due to soil erosion caused by natural and manmade causes such as deforestation, overgrazing, reckless mining and ge neral mismanagement. Physical and biological deterioration of land with associated fertility depletion also occurs due to water logging, salination, alkalinatio n, acidification etc. To help reduce the pace of degradation and accelerate the process of develo pment and conservation of land, water and vegetation in an integrated

manner- the watershed approach has been considered the most appropriate in recent times. It is often assumed that investing in water conservation is automatically beneficial, without looking in detail at the costs and benefits, and particularly the on-farm versus off-farm costs of soil degradation (Charlotte Bgyd et.al, 2000). The watershed intervention technology has made a significant shift in land use pattern. Further it has made a positive impact on ground water level and its recharge level leading to increased irrigation and cropping intensities.

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