Journal of Rural Development, Vol. 37 No. (3) pp. 565-584
NIRD&PR, Hyderabad.

DETERMINANTS OF CONSUMPTION OF WATER IN RURAL AREAS: A CASE EXPERIENCE FROM COIMBATORE DISTRICT

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ABSTRACT

This paper analyses determinants of average consumption of domestic water by households in rural areas of Coimbatore district. For this study both primary and secondary data have been used. A multistage sampling method viz., systematic, stratified, proportionate random techniques was used to select sample villages. 342 sample households were selected across 4 taluks, 3 blocks, 4 village Panchayats and 31 habitations. Method of data analysis involved the use of descriptive statistics and linear regression for the sample households. The linear regression estimates revealed that the family size, dryland, total family income, total expenditure per month, total distance for water collection, sources of water for drinking and cooking, distribution time of water used for other purposes, age of water collector and per capita consumption of water (LPCD) are statistically significant at P > 0.05 level.

Keywords: Rural Water Supply, Per Capita Consumption, Consumption of Water.

Introduction

Access to clean drinking water is a fundamental right as pronounced in the right to life under Article 21 of the Constitution of India (Ramachandraiah C, 2001). Availability of potable drinking water in India has remained a challenge. There have been several programmes and policies of the government exclusively dealing with providing safe drinking water to the people. But over a period of time it has been seen that, the same problem persists even after implementation of different plans and programmes by the State. Even though the State's allocation on water sector has increased

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enormously, but simultaneously it is found that a large segment of population in the country is deprived of their basic right to drinking water.

With the dawn of Independence and ever since the introduction of Five Year Plans, the Indian State has taken many initiatives and has launched many programmes and schemes for providing safe drinking water to its people. Simultaneously, there has been an enormous increase in the plan outlay of the country[1] . There are also several policies drafted at the national level to facilitate the State provisioning of drinking water. Besides several Central programmes for drinking water, the Central government introduced the 'Technology Mission'[2] in 1986, drafted the National Water Policy in 1987, introduced Sector Reforms for water in 2002, and redrafted the National Water Policy 2002. All these major policy documents on water gave top priority to drinking water availability to all. It is estimated that 75 per cent of the world population mostly in developing countries does not have access to safe drinking water due to water pollution which acquires an even greater relevance in the context of an agrarian economy like India (Bhagirath Behera and V. Ratna Reddy, 2002).

The Department of Drinking Water Supply data show that out of a total of 1507349 rural habitations in the country, in which 1121366 habitations (74.39 per cent) are fully covered, 220165 habitations (14.64 per cent) are partially covered and remaining 165818 habitations (11.00 per cent) are not covered. Further, estimates show that out of the 2.17 lakh water quality habitations, about 70000 habitations have since been addressed for providing safe drinking water (Eleventh Five Year Plan 2007-2012, Planning Commission, GoI).

The rural water supply schemes are being executed by Tamil Nadu Water Supply and Drainage Board (TWAD) and handed over to the respective local body for further maintenance in accordance.The rural community is accessing of safe water through individual power pumps, combined water supply schemes (CWSS), hand pumps and open wells.

In Tamil Nadu, water supply assets are being maintained in a three-tier system viz., Gram Panchayat level, Panchayat Union level and District Panchayat level. Government orders were issued regarding providing House Service Connection (HSC) by fixing the deposit amount as ₹ 1000 and monthly tariff as ₹ 30. It was also ordered to utilise minimum 20 per cent of the house tax for water supply maintenance. The affordability of the house connection charge (₹ 30 per month) and the stand post charge (₹ 10 per month) can be determined by comparing these charges to the monthly income/ expenditure of rural households.

[1] The outlay in the First Five Year plan was ₹ 33.59 billion, which rose to ₹ 7800.00 billion in the Ninth Five Year Plan in the urban areas. The outlay In rural areas, 0.71 percentage (₹ 14 crore) in First Five Year Plan and 4.66 percentage (₹ 40,000 crore) in Ninth Five Year Plan.

[2] The motive of Technology Mission was to provide scientific and cost-effective content to the Centrally sponsored Accelerated Rural Water Supply Programmes, Seventh Five Year Plan, 1985-90, p-55.

The total rural population of Tamil Nadu is 349.22 lakhs which is accounted for 85, 37,570 rural households. Of which 21, 18,954 house service connections have been provided at a rate of 25 per cent of households with individual household connections.

This paper focuses on the consumption of domestic water supply by the households in the rural areas of Coimbatore district of Tamil Nadu. Specifically the study examines the socio-economic factors that influence household's per capita consumption of water.

Methodology

The study used both primary and secondary data. The primary data were collected with the use of structured questionnaires. Coimbatore district in the State of Tamil Nadu has been chosen for the study. 342 sample households were selected across 4 taluks, 3 blocks, 4 village Panchayats and 31 habitations. Multi-stage sampling method has been used for this study viz., systematic, stratified proportionate random sampling methods to select the sample villages. To identify the study area lots of inputs have been used. The variables including water level, rainfall, Litre Per Capita per Day (LPCD), water quality, percentage of cultivated area, area less irrigated, area which is partially irrigated, and, partially less irrigated and percentage of water intensive crops cultivated were used in order to identify and fix the sample villages. These areas can be divided according to the nature of soil persistence, groundwater availability and the produce. Totally four villages were selected and grouped under four categories viz., wet, mixed (partially wet and partially dry), dry (arid) and hilly region. As per data the 'Anamalai' block was chosen under hill and wet area category, where the villages viz., 'Nedungundra' was selected under hill area category, where the scheduled tribes population is located, and, 'Subbegoundanpudur' was selected under wet area. The 'Ambothi' village in 'Annur' block has acute dry nature; hence the village was selected under dry area. In the mixed area (partially wet and partially dry) classification 'Thondamuthur' block was chosen in which 'Madampatti' village was selected as the study area. Of the total households, in the four selected villages, 10 per cent of the sample households were chosen proportionately.

The secondary data sources on the status of drinking water provision at Coimbatore district, the district chosen for study, across 1941 habitations were collected from the Tamil Nadu Water supply and Drainage Board (TWAD). These habitations are spread across 229 village panchayats, 12 blocks (Panchayat union), 6 taluks. A broad profile with the available information is attempted with the help of secondary information. Notwithstanding the reliability of the available secondary information, mainly the distributive aspects of rural water supply are analysed.

Descriptive statistics such as frequency distribution tables, mean and standard deviation were used to analyse the socio-economic characteristics of the respondents. The linear

regression model was used to determine the average consumption of water by households.

Hypothesis: The family size, landholding, family income, female education, area (wet, mixed, dry and hilly), expenditure, water distribution time for drinking and cooking water, distance and time spent for water collection are the key determinants of consumption of water.

Regression analysis was used for the hypothesis testing.

Results and Discussion

State and District Scenarios of Rural Water Supply: Water is a State subject and the schemes for providing water facilities are implemented by the States. The Central Government supplements the efforts of the States by providing financial and technical support. The Tenth Plan envisages provision of safe drinking water to all rural habitations. Two major programmes were implemented for rural water supply. These are Accelerated Rural Water Supply Programme and the Pradhan Mantri Gramodaya Yojana with an investment of over ₹ 45,000 crore. Accelerated Rural Water Supply Programme was launched during 1972-73 to assist the State/Union Territories for providing potable water to the rural population. The scheme aims at coverage of all rural habitations with population of 100 and above.

Table 1: Coverage of Habitations with Domestic Water Supply

District & State	Fully Covered habitation	Partially covered habitation	Not covered habitation	Total
India	916382	412646	270405	1599433
	(57.29)	(25.79)	(16.90)	(100.0)
Tamil Nadu	60357	22684	3969	87010
	(69.37)	(26.07)	(4.56)	(100.0)
Coimbatore	1503	260	178	1941
	(77.43)	(13.40)	(9.17)	(100.0)

Source: Tamil Nadu Water Supply and Drainage Board, Chennai, Resurvey (2012).

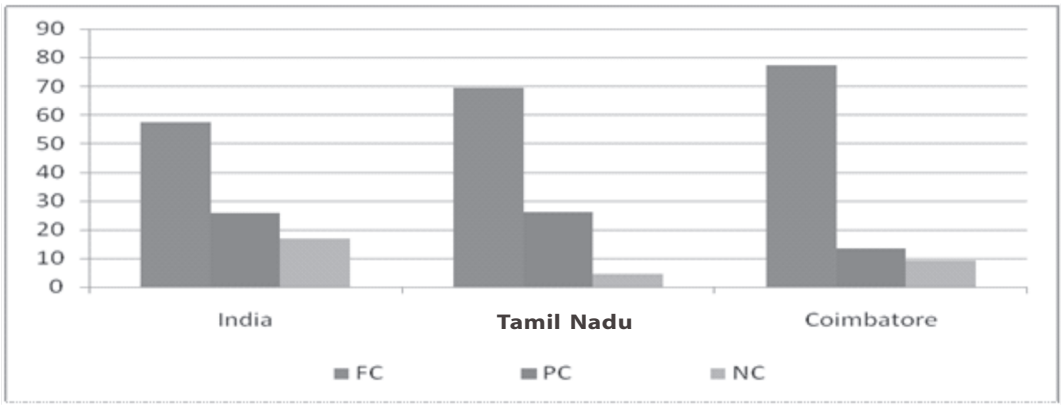

Figure 1: Coverage of Habitations with Domestic Water Supply

The above Table 1 designate the status and coverage of rural habitations in national, State and district level. The total number of rural habitations in the State is 87010 according to 2003 resurvey by the TWAD Board, of which 74.06 per cent of the rural habitations are fully covered and 25.40 percentages of rural habitations are partially covered with respect to rural water supply. The State comprises 385 Panchayat unions (blocks) and 12620 village panchayats. The total number of rural habitations in Coimbatore are 1941 of which 77.43 percentage are fully covered and 13.40 per cent of rural habitations are partially covered with respect to rural water supply. During the introdution of Five Year Plans in India it was realised that providing safe drinking water to the people was vital for the development of the country but, the plan outlay was not significant. Total plan outlays are increasing, but per cent of allocation for rural water supply sector is gradually decreasing. Government must concentrate on not covered habitations.

Table 2: Execution of Schemes in Coimbatore District

Type of Sources	Before 1990	1991-2000	2001-2010	Total
Hand pump	1134	1061	151	2346
	(48.34)	(45.23)	(6.44)	(100.0)
	[58.09]	[39.69]	[6.34]	[33.49]
Power pump & mini power pump	612	699	1246	2557
	(23.93)	(27.34)	(48.73)	(100.0)
	[31.35]	[26.15]	[52.35]	[36.5]
CWSS	73	662	472	1207
	(6.05)	(54.85)	(39.11)	(100.0)
	[3.74]	[24.77]	[19.83]	[17.23]

(Contd.....)

Table 2 (*Contd.....*)

Open well & ring well	119 (95.20) [6.10]	5 (4.00) [0.19]	1 (0.80) [0.04]	125 (100.0) [1.78]
Others (Pipeline extension, gravity scheme, etc.)	14 (1.82) [0.72]	246 (31.95) [9.20]	510 (66.23) [21.43]	770 (100.0) [10.99]
Total	1952 (35.10) [100.0]	2673 (32.65) [100.0]	2380 (32.26) [100.0]	7005 (100.0) [100.0]

Data computed from habitation wise resurvey 2012.
Source: TWAD, Resurvey 2010.
() Parenthesis indicates column wise percentage
[] Parenthesis indicates row-wise percentage

Over the decades different water schemes have been initiated in the district. It may be relevant to discern the impact of major national and international missions with respect to rural water supply. Although the water supply schemes got started from the First Five Year Plan onwards, they gained momentum after the declaration of the International Drinking Water Supply and Sanitation decade (1981 – 1990). More than 50 per cent of the existing schemes were initiated during this period. Subsequently, at the national level, Rajiv Gandhi Drinking Water Mission was started during 1986. These missions have made a remarkable change in the implementation of rural water supply schemes in India. Before 1990 the percentage of hand pumps was high, that is 58.09, while compared to power pumps and mini pumps, CWSS, open well, ring well and others.

During 1991 – 2000, among all the sources the hand pump implementation was greater rather than hand pumps, CWSS, open well, ring well and others (pipeline extension, gravity scheme). Before 1990, hand pump execution followed by 1991 – 2000 was 39.69 and during 2001 – 2010 it was 6.34 per cent. Power pump and mini power pumps execution was about 31.35 per cent before 1990 and in 1991 – 2000 it was 26.15 per cent. But after 2001 there was a three – fold increase in power pumps which is shown in the Table 2. The (CWSS) combined water supply scheme has the greater execution in 1991 -2000 when compared to the periods before 1990 and after 2001. Regarding the availability of open wells, ring wells, the greater percentage prevailing before 1990 and after 2001 and continuous downward sloping is visible thereafter, but in the same year that is before 1990 the execution of open well, ring well was 6.10 per cent and during 1991 – 2000 the percentage was 0.19 and after 2001- 2010 it was 0.04 which is completely opposite to the execution of CWSS. On the other hand, pipeline extension, gravity schemes have an increasing trend and that is clearly shown in the above Table 2.

Table 3: Number of Schemes Executed by Different Agencies

Types of Sources	Agency Executed				Total
	TWAD	Local Body	DRD	Others	
Hand pump	1042	1286	2	16	2346
	(44.42)	(54.82)	(0.09)	(0.68)	(100.00)
	[25.54]	[47.44]	[33.33]	[7.69]	[33.49]
Power pump & mini power pump	1639	771	2	145	2557
	(64.10)	(30.15)	(0.08)	(5.67)	(100.00)
	[40.17]	[28.44]	[33.33]	[69.71]	[36.50]
CWSS	1125	65	1	16	1207
	(93.21)	(5.39)	(0.08)	(1.33)	(100.00)
	[27.57]	[2.40]	[16.67]	[7.69]	[17.23]
Open well & ring well	7	117	1	0	125
	(5.60)	(93.60)	(0.80)	(0.00)	(100.00)
	[0.17]	[4.32]	[16.67]	[0.00]	[1.78]
Others (Pipeline extension, gravity scheme, etc.)	267	472	0	31	770
	(34.68)	(61.30)	(0.00)	(4.03)	(100.00)
	[6.54]	[17.41]	[0.00]	[14.90]	[10.99]
Total	4080	2711	6	208	7005
	(58.24)	(38.70)	(0.09)	(2.97)	(100.00)
	[100.00]	[100.00]	[100.00]	[100.00]	[100.00]

Data computed from habitation-wise resurvey 2012.
Source: TWAD, Resurvey 2010.
() Parenthesis indicates column wise percentage.
[] Parenthesis indicates row-wise percentage.

Various schemes have been implemented in the last two and a half decades (1972 – 1998) to augment the water supply. TWAD (Tamil Nadu Water Supply and Drainage) board, local bodies, DRDA (District Rural Development Agency) are the major agencies and organisations involved in executing the water supply schemes. Among these, installation of hand pumps and power pumps were the two dominant schemes. The local bodies in the respective village panchayats have also provided hand pumps. While then TWAD board created more of hand pumps followed by the local bodies, Combined Water Supply Schemes (CWSS), pipeline extension and gravity schemes were initiated by the TWAD. The DRDA concentrated more on installing hand pumps and a very few power pumps.

Table 3 explains that TWAD board executes 44.42 per cent of hand pumps and local bodies execute 54.82 per cent. Likewise, DRDA and others execute 0.09 and 0.68 percentage, respectively. Similarly, the percentage of power pumps which is executed by the TWAD board was 64.10 and those executed by the local bodies, DRDA and others are of percentages

30.15, 0.08 and 5.67, respectively. It is observed that the TWAD board has implanted CWSS to an extent of 93.21 per cent of CWSS and local bodies have executed to 5.39 per cent whereas DRDA and others to the percentage of 0.08 and 1.33 correspondingly. Despite the fact that, 5.60 per cent of TWAD board executes on open well, ring well and 93.60 of local body, respectively. About 34.68 per cent of the pipeline extension schemes belong to TWAD Board and local bodies executed 61.30 per cent. The percentage of execution was zero for DRDA whereas, 4.03 per cent for other agencies and that is clearly observed in Table 3.

Table 4: Rural Water Supply Scheme-wise Installation Cost

Scheme	Statistics	Installation Cost (₹ In Lakh)
Hand pump	Sum	1002.77
	Mean	0.43
	N	2346
Power pump & mini power pump	Sum	8371.13
	Mean	3.27
	N	2557
CWSS	Sum	116545.53
	Mean	96.56
	N	1207
Open well & ring well	Sum	75.17
	Mean	0.60
	N	1125
Others (Pipeline extension, gravity scheme, etc.)	Sum	1140.91
	Mean	1.48
	N	770
Total	Sum	127135.51
	Mean	18.15
	N	7005

Data computed from habitation wise resurvey 2012.
Source: TWAD, Resurvey 2010.

A crucial component of economics of drinking water supply is the cost of provision of sources, provision of water sources entails investment on various schemes, which involves installation of mechanical devices, digging of wells, construction of over head tanks, laying of pipelines, quality testing and labour cost and so on. Table (4) depicts the installation cost of various schemes with regards to the number of hand pumps in which 2346 have been taken into

account, of this the installation cost incurred was ₹ 1002.77 lakh. On an average ₹ 0.43 lakh that is ₹ 43,000 was the cost incurred per hand pump. Whereas, the number of power pumps and mini power pumps were totalled to 2557 and the installation cost was ₹ 8371.13 lakh which implies that, the cost per pump was ₹ 3.27. With respect to CWSS, 1207 CWSS are implemented and the installation cost incurred for the scheme was ₹ 116545.53, and the cost of per CWSS connection was ₹ 96.56. Next to CWSS, the other schemes like open wells, ring wells were 1125 in number and the installation cost is ₹75.17 lakh, which means that ₹ 60,000 was the cost incurred for single open well, ring well. Similarly, the other sources like pipe line extension, gravity schemes, etc., have incurred an installation cost of ₹1140.91 lakh, which shows that the cost incurred for each installation was ₹1.48 lakh. Obviously, installation cost for CWSS is huge amount.

Table 5: Demand, Supply and Shortage of Domestic Water in Coimbatore District

S. No	Name of the Block	No. of Habitations	Tot pop (2001)	Per capita (LPCD)	Demand	Supply	Shortage
1	Karamadai	366	123478	30.63	4939120	3781935.46	1157184.54
2	Annur	270	81459	29.41	3258360	2395799.70	862560.30
3	P.N.Palayam	185	79719	36.86	3188760	2938830.16	249929.84
4	S.S. Kulam	90	35426	41.72	1417040	1478051.44	-61011.44
5	Thondamuthur	140	56965	35.75	2278600	2036498.75	242101.25
6	Madukkarai	85	36582	27.76	1463280	1015688.47	447591.53
7	Sulur	136	91169	31.36	3646760	2859086.65	787673.35
8	Sultanpet	119	68794	30.08	2751760	2069601.01	682158.99
9	Kinathukadavu	121	89930	31.98	3597200	2876273.55	720926.45
10	Pollachi North	159	94067	37.11	3762680	3491128.09	271551.91
11	Pollachi South	166	71086	35.61	2843440	2531689.35	311750.65
12	Anamalai	104	68609	35.21	2744360	2415828.44	328531.56
	Total	1941	897284	33.12	35891360	29715771.67	6175588.33

Data computed from habitation-wise resurvey 2012.
Source: TWAD, Resurvey 2010.

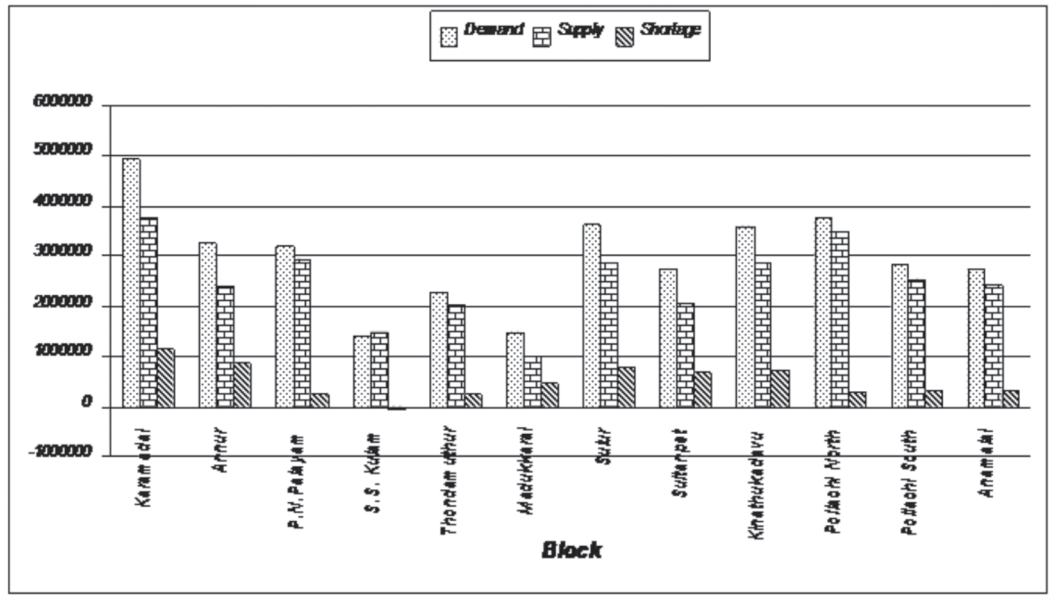

Figure 2: Demand, Supply and Shortage of Domestic Water in Coimbatore District

In Table 5, the secondary data compiled from Tamilnadu Water Supply and Drainage Board (TWAD) and analysed indicate the block-wise demand and supply of water, with the given 2001 census population. It reveals the demand, supply and shortage of water in various blocks of Coimbatore district. Among the twelve blocks excluding Sarkarsamukulam which has the privilege of enjoying average consumption of water to about 40 litres, as prescribed by the government norms, all other blocks has inadequate Litre Per Capita per Day. The Table also infers the mean Over Head Tank per habitation against block population. Among the total 1941 habitations, 1851 habitations are in need of adequate water supply. Only Sarkarsamukulam block has the LPCD as 41.72 and the rest of the habitations have inadequate LPCD ranges from 27.76 in Madukkarai to 36.86 at P.N. Palayam. Incidentally, the average LPCD per individual to the district is only 33.12 which is proportionately lower as provided by the local bodies. Obviously the given or allotted LPCD per individual is that of 40 litres in the Coimbatore district. Concerning the fixed norms in relation with the blocks of the district there has not been adequate water of LPCD allocated. Taking the population demand as concern, every individual needs 40 litres of LPCD whereas, the given LPCD is insufficient. Hence, demand of the population is not satisfied by the supply, also inadequacy exists. The equilibrium level of water supply is not attained, resulted in shortage of LPCD. This Table helps to understand the existing reality which does not break even level i.e. the demand does not fulfil the supply even at the prescribed level of LPCD by government.

Inferences derived from the secondary data were validated and looked up to understand the reality. Naturally, the demand of the population lies somewhere higher than the supply. It is clearly visible at the supply side that there is a huge difference which is revealed in LPCD ranges according to the blocks. There is an identical gap and disequilibrium existing at 40 litres of LPCD but the primary data envisage that the demand of the population does not correlate with even the given prescribed norms. Hence, there is a drastic requirment of water as compared to the given secondary data. It reflects in the study area and the provision of water by local panchayat bodies made the people to retrench their LPCD as water is their basic amenity. Hence, provision of LPCD is currently in a slump being considering the necessity of LPCD for the population in Coimbatore district. Vast changes can be drawn in the policy level to augment the LPCD across the district. Because the stringent water availability causes the economically deprived population required more on water for their routine usage, by changing or making available of adequate water availability to the population, can make changes in the way of living as it is the basic convenience that must be rendered by the government.

Table 6: Distribution of Schemes per 1000 Populations in Coimbatore District

Types of Schemes	Total No.	Source / 1000 population
Hand Pump	2346	2.00
Power Pump & Mini PP	2557	2.18
CWSS	1207	1.03
Open well & Ring well	125	0.11
Others (Pipeline extn., Gravity scheme)	770	0.66
Total	7005	5.98

Data computed from habitation-wise resurvey 2012.
Source: TWAD, Resurvey 2010.

The above Table 6 gives the details of the distributional source of water supply per 1000 population in Coimbatore district as a whole. Besides hand pump and overhead tanks, there exist other schemes also like CWSS, open well, ring well and pipeline extension. The total number of hand pumps in the district was 2346, the average number, of power pumps and mini power pumps were recorded greater in number that is 2557 and the average number of the same was 2.18 per 1000 population. Other sources like CWSS, open well, ring well and pipeline extension are in use, the total number of availability of CWSS was 1207, the average number of CWSS is worked out to be 1.03 per 1000 population followed by the total number of open well, ring well was 125 and 770 other sources were there of which the average number per 1000 population was 0.11 and 0.66, respectively. Hence, the above data evidently show that the number of power pumps and mini power pumps were recorded the highest in number compared to all the other sources.

Table 7: Area-wise Distribution of Litre Per Capita Consumption of Water for Different Purposes

Consumption of Water Per Day (in Litres)

Area	Statistics	Drinking	Bathing	Cooking	Washing utensils	Washing clothes	Cleaning House	Sprinkling at entrance	Livestock purpose	Gardening	Vehicles	Total Consumption	LPCD	Total consumption (According to Norms)	LPCD (According to Norms)
Wet	Sum	1005	2616	10782	3699	3407	431.36	2664	504	338.1429	15.42	29502.92	7295.786	22574.36	5521.21
	Mean	11.04	28.75	118.48	40.65	37.44	4.74	29.27	5.54	3.72	0.17	324.21	80.17	248.07	60.67
	S.D.	3.97	7.86	46.25	10.42	29.24	3.43	8.72	24.69	10.77	1.14	95.90	17.89	74.50	10.24
Mixed	Sum	1199	3133	13545	4356	4884.75	347.03	2272	1278	102.84	159.37	35911.99	8525.002	27215.03	6434.45
	Mean	10.52	27.48	118.82	38.21	42.85	3.04	19.93	11.21	0.90	1.40	315.02	74.78	238.73	56.44
	S.D.	3.62	7.39	55.05	13.09	25.01	3.51	7.02	35.31	3.92	3.26	117.65	18.18	85.42	11.63
Dry	Sum	940	1868	7179.75	2243	3129.75	69.83	852	1512	0	23.13	20481.46	4516.209	14964.58	3291.09
	Mean	9.22	18.31	70.39	21.99	30.68	0.68	8.35	14.82	0.00	0.23	200.80	44.28	146.71	32.27
	S.D.	3.59	7.97	64.37	12.48	20.22	1.57	7.22	42.79	0.00	1.15	147.06	24.97	101.67	16.82
Hilly	Sum	367	1098	4662	2070	2268	0	0	144	0	0	12553	3322.667	10141	2680.52
	Mean	10.49	31.37	133.20	59.14	64.80	0.00	0.00	4.11	0.00	0.00	358.66	94.93	289.74	76.59
	S.D.	3.01	6.44	38.36	11.19	21.28	0.00	0.00	16.96	0.00	0.00	78.89	15.24	63.45	11.27
Total	Sum	3511	8715	36168.75	12368	13689.5	848.22	5788	3438	440.9829	197.92	98449.37	23659.66	74894.97	17927.27
	Mean	10.27	25.48	105.76	36.16	40.03	2.48	16.92	10.05	1.29	0.58	287.86	69.18	218.99	52.42
	S.D.	3.71	8.97	59.11	16.28	26.32	3.31	12.12	34.08	6.16	2.14	131.99	26.42	98.88	19.34

Source: Primary data (2012).

The Department of Drinking Water Supply (DDWS), Ministry of Rural Development, has set itself the goal of providing safe and adequate water for drinking, cooking and other domestic needs on a sustainable basis to every rural person. This Table reveals the average consumption of water per household in the study area. Actually, the government norms allotted per individual per day utility of water is 40 litres. It incorporates drinking, cooking, bathing, washing utensils, house cleaning and ablution per day for every individual. The Table expresses the consumption of water collectively at household level and corresponding LPCD. In wet area average litres of water consumed for drinking is only 11.04 litres. Among all the domestic consumption bathing needs more quantity of water which is 118.48 litres followed by washing utensils which is nearly 41 litres.

It is clearly seen in Table 7 that there is an inflated water usage in bathing than to the other domestic usages, even washing of clothes has less consumption of water in wet areas which have the circumference of river water and this source point is utilised for washing. Therefore, the utilisation of water in source point cannot be calculated for it is floating water and is not used in domestic supply. Hence, the usage of domestic water for bathing is diminished. Owing to the awareness obtained among the people, they are not using river water for drinking. Consequently utilisation of domestic water towards washing the clothes has been cutback by the villagers. Normally the actual LPCD is around 80 litres per individual. Which shows the government norms of 40 litres LPCD has been surpassed due to the reason that availability of water since is wet area. The supply of actual water according to government norms is nearly 61 litres.

The average domestic consumption of water in mixed area is 315 litres per household. LPCD is comparatively higher than dry area and lower than wet and hilly areas. Irrigation well has the great consequence on water usage pattern since washing of clothes is done in this source and hence bathing average percentage reflects higher than other domestic usage which is 118.82 litres. The given supply according to norms in wet area of LPCD is 75 litres. Another usage that draws importance is maintenance or cleaning of vehicles need 1.4 litres of water which is hardly reflected as a major usage in other areas as reflected in mixed area. The average family size in dry area is 4.49 persons but the supply according to norms of LPCD is only 32 litres. That supply is an amalgamation of government source and private sources of distribution. There is a vast difference in the consumption pattern naturally in this area due to acute dryness compared to other areas. Relatively, bathing (70.39 litres) takes less quantity of consumption of water than other areas since school children even take bath once in two days and others take bath once in four days which shows the pathetic condition of the area. Working population retrenched their usage of water towards bathing; even with the sweat they are saving water for their children who are going to schools. Considerably, the supply of LPCD through government sources is insufficient and not satisfactory. Hence, people have to immensely depend on private sources which are also limited. It is clearly visible form the Table

that meagre quantity of water has been used for cleaning houses and sprinkling. Augmenting the supply of water towards government distribution system resembles stochastic hence dependence on available next best possible opportunistic private sources which is also rarely available.

In hilly area which has surplus quantity of water, but neither government source nor private source are available. This special feature of traditional source in hilly region which enjoys extravagant availability of water. The springs are the available source to them. There is hardly any possibility to supply water by constructing OHT or any other distribution system. Local panchayat has constructed a water tank which stores water and pipe line has been laid for the supply for the source point, springs through gravity. It would be hard to as there are no stand posts or any other distribution system but the pipeline as such has huge opening with closet, where in necessarily requirements have been availed from it. Though the average consumption of water for cleaning house, sprinkling, gardening and vehicle maintenance is zero litres. total household utilisation rise up to around 359 litres. The LPCD is in actual need of nearly 95 litres. Naturally, consumption of water is directly proportionate to the availability of water and vice versa, hence it is incidentally visible in hilly and wet areas. One of the major components in hilly area is that springs as water source completely fulfils the need of the tribal population. Overall, the Table reveals the consumption of water against various area classifications, its relevance with various domestic usage patterns, LPCD according to norms and its actual need by the population. Also, it is to be considered, that exclusive of the hilly area all other areas use modern sources such as house service connection and stand post for their cooking and drinking purposes. Thus, the domestic water supply provided by government distribution system in accordance with the domestic usage such as bathing, drinking, washing, cleaning utensils, etc., is definitely insufficient and not satisfactory, hence it is estimated and calculated that additional 30 litres of LPCD with the existing norms irrespective of the land towards domestic usages should be augmented by the public purse.

Hypothesis Testing - Regression Results

At the household level seventeen variables have been identified, which include area (dummy variable 1.wet, 2.mixed, 3.dry, 4.hilly), family size, total land, wetland, dryland, number of years of female education, total family income, total expenditure per month, total time spent for water collection, total distance for water collection, sources for drinking and cooking water, distribution time for drinking water, distribution time for other purpose water, sources for other purpose water, age of water collector, water collection (1.male, 2.female, 3.all family members). Correlation matrices were applied to understand and shortlist the number of variables, which influence the per capita water consumption at the household level. Of the seventeen variables area, family size, dryland, number of years of female education, total family income, total expenditure per month, total distance for water collection, sources for drinking and cooking water, distribution time for drinking water, distribution time for other purpose water,

sources for other purposes water, age of water collector, water collector for consumption of water were considered for running the regression against per capita consumption of water at households, these variables exhibit a high percentage of correlation.

Table 8: Regression Results – Determinants of Consumption Water (LPCD)

S.No.	Independent Variables	Regression Co-efficient	Std. Error	't' Value	Sig.
1	Constant	98.224	5.236	18.758	.000
2	X_1	-2.495	1.317	-1.894	.059
3	X_2	-9.309	.865	-10.763	.000
4	X_3	.178	.169	1.055	.292
5	X_4	.001	.000	3.141	.002
6	X_5	.002	.001	1.777	.077
7	X_6	-.011	.003	-3.583	.000
8	X_7	6.969	1.191	5.853	.000
9	X_8	-.668	1.238	-.539	.590
10	X_9	-.14.280	1.724	-8.284	.000
11	X_{10}	.722	.408	1.770	.078
12	X_{11}	.085	.037	2.307	.022

N = 342, R = .765, R^2 = .59
Significant at 5% level.

Functions: Y = a ± bx

$Y = 98.224 - .2.495_{(Area)} \neg - 9.309_{(FS)} + .178_{(NYEFA)} + .001_{(TMFI)} + .002_{(TEM)} - .011_{(TDWC)} + 6.969_{(SDWCW)} - 668_{(CWDT)} - 14.280_{(DTOPW)} + .722_{(SOPW)} + .085_{(AWC)} +$ Error

Where Y = Per Capita Consumption of Domestic Water (LPCD)

a = Constants

X_1 = Area (1. Wet, 2.Mixed, 3.Dry, 4.Hilly)

X_2 = Family Size (FS)

X_3 = No. of years of educated by female adult (NYEFA)

X_4 = Total Monthly Family Income (TMFC)

X_5 = Total Expenditure per Month (TEM)

X_6 = Total Distance for Water Collection (TDWC)

X_7 = Sources for Drinking and Cooking Water (SDWCW) (1.HSC, 2.Stand Post, 3.OHT (on spot) 4. Spring, 5. Own Agricultural well)

X_8 = Distribution Time for Drinking and Cooking water (CWDT) (1.Per day, 2.Two days once, 3.Four days once, 4.Weekly once)

X_9 = Distribution Time for Other Purposes Water (DTOPW) (1.Per day, 2.Two days once,

3.Three days once, 4.Four days once, 5.Weekly once)

X_{10} = Sources for Other Purpose Water (SOPW) (1.HSC, 2.Stand post, 3.Hand Pump, 4.Both HP & SP, 5.HSC & HP, 6.SP & Near Irrigation well, 7.Spring, 8.Irrigation bore/well, 9. River)

X_{11} = Age of Water Collector (AWC)

μ = Error term

Table 8 presents the regression analysis of the factors that determine per capita consumption water (LPCD). The result shows that area (X_1), number of years educated by female adult (X_3), total expenditure (X_5) distribution time for other purpose water (X_9), sources for other purposes water (X_{10}) do not significantly influence the per capita consumption of water at $P > 0.05$ level. However, family size (X_2), total family income (X_4), total expenditure per month (X_5), total distance for water collection (X_6), sources for drinking and cooking water (X_7), distribution time for other purpose water (X_8), age of water collector (X_{11}) are statistically significant at $P > 0.05$ level. The R square value turns at to be 0.60. This shows that 60 percent of the variations are explained by the variations in the independent variables. Number of years educated by female adult (X_3), sources for other purposes water (X_{10}) is positively related to family size (X_2), total family income (X_4), total expenditure per month (X5), total distance for water collection (X_6), sources for drinking and cooking water (X_7), distribution time for other purpose water (X_8), age of water collector (X_{11}) and per capita consumption of water for average consumption of water (Y). This indicates that number of years educated by female adult (X_3), sources for other purposes water (X_{10}) increases, the average consumption of water by households will also increase.

To understand the implications of the results a detailed discussion is necessary. Negative value of coefficient was found with area factor. This implies that per capita consumption goes on declining in wet, mixed, dry and hilly region. This negative trend is due to high level of per capita consumption in hill area, slightly lower in wet and mixed area, further low level in dry area. The secondary source of information for the TWAD Board also supported this view. In the regions peoples are using more modern sources as the principal sources for both drinking and cooking purposes like, house service connection. Another crucial factor, which is inversely related to water consumption was the family size. As family size increases the resultant total consumption goes up but the per capita consumption comes down. This is due to the water requirement for other domestic uses, which does not vary regardless of the number of persons in a household. For instance, water used for cooking, house cleaning, maintaining of livestock, washing clothes and bathing may not increase commensurately with the increase in family size.

Conclusion

The Government initiatives through drinking water supply programmes have started giving positive results in all the sample villages except those in dry area.The regression results confirmed a positive relationship between water consumption (LPCD) and family size, total family income, total expenditure per month, total distance for water collection, sources for drinking and cooking water, distribution time of water for other purpose water, age of water collector, water collector for consumption of water and per capita consumption of water for average consumption of water. It is clearly visible that drinking water infrastructure development has been occurring in the sample villages.

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