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'Slippage': The Bane of Rural Drinking Water Sector
(A Study of Extent and Causes in Andhra Pradesh)

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'Slippage': The Bane of Rural Drinking Water Sector
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V. Ratna Reddy[1]; M. S. Ramamohan Rao[2] and M. Venkataswamy[3]

ABSTRACT

Slippage is one of the main bottlenecks of achieving full coverage of water and sanitation services in India. Slippage is the term often used to reflect unsustainable service delivery of water, sanitation and hygiene (WASH) services, especially in rural areas. Off late slippage is attracting attention at the policy level though slippage is as old as the coverage of water supply services. This paper makes an attempt to identify the causes of slippage in a systematic manner. The broad objectives of the paper include: i) assess the extent of slippage at the national and state level; ii) identify the causes of slippage at various levels; and iii) provide some pointers for policy based on the analysis.

The extent of slippage is quite substantial even at the aggregate level. The situation is alarming in some of the states where the extent of slippage is as high as 60 percent. Our analysis at the national, state and habitation levels suggests strongly that policy makers should look beyond the often repeated supply sided strategies. As evident from the experience of Andhra Pradesh, the demand side and governance factors play an equally, if not more, important role in addressing the sustainability issues. So far the experiences are that large investments in water sector would not automatically lead to increase in coverage. The sector also needs a sound policy and capacity so that money is spent effectively and leads to increased water security. The policy should also address resource sustainability and behavioural change goals instead of relying upon a one-sided target driven approach. These aspects are highlighted in the proposed guidelines and their effective implementation needs to be ensured.

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'Slippage': The Bane of Rural Drinking Water Sector
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I Background

Water, Sanitation and Hygiene services are central to addressing poverty, livelihoods and health. They are also critical in addressing the needs of poor communities and in achieving the Millennium Development Goals (MDGs). The efforts of Government to reach these targets are often subjected to many challenges. Despite huge investments in the sector in India (more than $ 27,000million in the last 60 years) the objective of providing access to water and sanitation to the entire population has remained elusive. According to Government publications[1] 94 percent of the rural population of 741 million (2001 census)has access to safe drinking water through 4 million hand pumps and 0.2 million-piped water schemes. At the same time, waterborne diseases affect 37.7 million Indians annually, 1.5 million children are estimated to die of diarrhoea alone and 73 million working days are lost due to waterborne disease each year. The estimated annual economic burden is about $ 600 million a year, which is more than the annual expenditure ($ 460 million) of the sector. In the case of urban population the coverage is about 91 percent. However, the systems often provide irregular and scanty water supplies. Besides, the appalling sanitation conditions in most of the urban areas, cause severe health hazards. It is estimated that India needs to invest $6700 million in urban drinking water and sanitation alone by 2015 in order to meet its MGD target (www.indiawaterportal.org).

While India has achieved almost full coverage in terms of water supply infrastructure provision towards the new millennium, the sustainability of service delivery is not maintained over the period (GoI, 2008). Due to this the water supply and sanitation coverage of habitations has become uncertain and changes with time and habitations move back and forth of full coverage. Slippage is the term often used to reflect unsustainable service delivery of water services, especially in rural areas. Of late the term slippage is finding place in the context of sanitation and hygiene as the 'Nirmal

[1] Rajiv Gandhi National Drinking Water Mission, Department of Drinking Water Supply Ministry of Rural Development, Government of India (Presented to NAC on 26th February, 2008)

Gram Puraskar'[2] villages are also found to be slipping back (Ramachandrudu, et.al., 2009). Slippage is also attracting attention at the policy level though slippage is as old as the coverage of water supply services (GoI, 2008). One of the possible reasons is that the sector as a whole is not a policy priority of the state. It remains unclear as to why the sector is not prioritised[3], as it can be observed in the budget allocations towards the sector (Reddy, 2010). Fortunately, the MDG targets have stirred the policy attention in this direction. Further, as the infrastructure coverage becomes universal in most of the states, recurrent fund allocations for completed or covered habitations are getting noticed. WASH slippage is defined as the occurrence of a certain level of WASH services that has fallen back in a defined period of time to a lower level of services (WASH Slippage Meeting Statement, June 2009). In terms of service delivery, some systems start slipping almost immediately from the moment they are installed while others are fine for a while before they start to slip. Also the rate of slippage is not necessarily uniform. Some systems slip rapidly initially and then the rate declines and so on. In other words, habitations relapse from fully covered (FC) status to partially covered (PC) or not covered (NC) or no safe source (NSS) categories[4] (GoI, 2008). Even the habitations that achieved full Water, Sanitation and Hygiene coverage and have received the *Nirmal Gram Puraskar* (NGP) awards struggle to maintain their status, especially in terms of open defecation free (ODF) and hygiene conditions. In fact, evidence is building up that NGP habitations are slipping back.

A whole range of factors such as geohydrology, agro-climatic, socio-economic, water governance and competing water demand for other sectors influence slippage. Specifically, water supply service levels fall below prescribed norms as well as large seasonal variations in quantity in large number of habitations every year due to many factors, as reported officially (GoI, 2008):

i) depletion in groundwater table, drying up of drinking water sources;

ii) emerging water quality problems;

iii) poor Operation and Maintenance (O&M);

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[2] This award is being given at the national and state level for the villages that have achieved open defecation, drainage and litter free status.

[3] To some extent it could be historical, as local communities used to take the responsibility of managing the sector.

[4] FC= All the households having access to 40 lpcd from nearby (less than 1000 mtrs) safe source; PC= Neither some or all households getting less than 40 lpcd; NC= Households not having access to safe water source within 1000 mtrs.

iv) ever growing population;

v) lack of proper support mechanism;

vi) weak village institutions;

vii) inadequate finances;

viii) functional failures;

ix) increased demand of rural population for higher service levels;

x) improper water management, irregular power supply / power fluctuations;

xi) droughts; and

xii) emergence of new habitations.

Among these, source failure, water quality problems, poor O&M, inadequate finances, inadequate capacities and skills of Panchayati Raj Institutions (PRIs) are the major factors for slippage. The parameters that affect the sustainability can broadly be grouped into – source sustainability, system sustainability, O&M sustainability, financial sustainability, institutional sustainability, social and environmental sustainability.

Objectives

The factors identified as responsible for the slippage at the official level as given above are mostly source related and supply sided. In the absence of a systematic analysis of these factors, only the factors that have negative influence on slippage are identified and there were no attempts to identify the positive indicators i.e., factors that check slippage problem. In fact, multiplicity of factors (combined impact of all the factors) has greater influence on slippage, making it difficult to identify individual factors concretely in order to facilitate judicious policy planning. This paper makes an attempt to identify the causes of slippage in a systematic manner. The broad objectives of the paper include: i) assess the extent of slippage at the national and state level; ii) identify the causes of slippage at the macro (national) level, meso (state) and at the micro (village) level; and iii) provide some pointers for policy based on the analysis. The paper relies mostly on the secondary data published by the Government of India at the national and state aggregates. Andhra Pradesh (AP) State has been selected for a more detailed analysis of factors at the meso level and micro level. The purpose of meso and micro level are two fold: a) to provide more detailed analysis of factors, as more detailed data are available and b) the micro or habitation level probing is to validate the aggregate analysis.

While the secondary data pertaining to the state of AP is from the Department of Rural Water Supply and Sanitation (RWSS), the habitation level data are obtained from the selected habitations of the WASHCost project[5] located in Rangareddy and Mahabubnagar districts. The paper argues that water governance and demand related factors play an equally, if not more important role in explaining slippage. And the task is to identify these factors for a sustainable WASH service delivery. The paper is organised in five sections. The following section (Section II) assesses the status and causes of slippage at the national level. Section III assesses the situation in Andhra Pradesh along with identifying the factors influencing slippage across the districts in the state. While section IV presents the habitation level picture in the sample villages of AP and the last section V summarises the analysis and provides some pointers for policy.

II Slippage at the National Level

Total plan investments over the last 60 years in the sector are expected to cross Rs. 1000000 million (US$ 20000 million) by the end of 11th plan - 2012 (GoI, 2008). Fund allocations were not substantial till 8th plan while investments have increased manifold during the later plans (Fig. 1). Though the centre and states, share the investment burden equally during all the plans, the share of centre has gone up during the 11th plan. However, the actual picture would emerge only after 2012. In spite of best efforts by the Government and enormous fund flows to the sector full coverage of all the villages has become a mirage. This is mainly due to the relapse of villages from fully covered (FC) status to partially covered (PC) or not covered (NC) or no safe source (NSS) categories. The coverage has touched 98 percent with the investments in 3.7 million hand pumps and 1, 73, 000 piped water supply schemes. However, the coverage was not sustained as more than 30 percent of the fully covered (FC) habitations slipped back to partially covered (PC) status during the subsequent years (Fig. 2). On the other hand, sanitation has just reached fifty percent in terms of coverage. This is also measured in terms of infrastructure provided / available. The coverage is much less in terms of actual use of the infrastructure provided / available. Therefore, slippage problem is prevalent even in the case of sanitation. In the case of sanitation slippage could be defined as slipping back from open defecation free (ODF) status to open defecation. Low coverage of sanitation is due to the reason that focus on sanitation was

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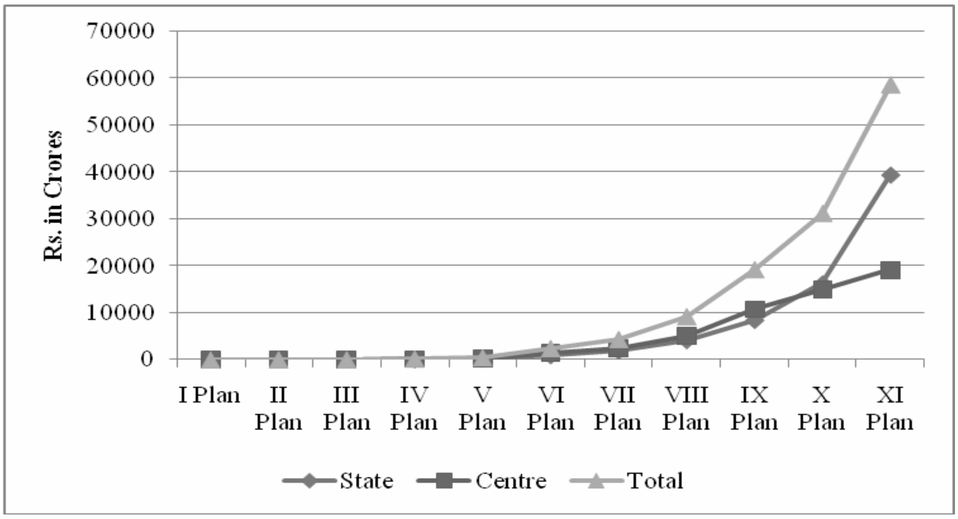
[5] WASHCost is an ***action research*** project supported by IRC, The Netherlands in four countries (India, Ghana, Mozambique and Burkino Faso). The five-year WASHCost project (2008-2012) aims at improving sustainability, cost efficiency and equity of WASH service delivery in rural and peri-urban areas by identifying the factors influencing costs at each stage of the WASH service delivery life cycle. The WASHCost project proposes to play a lead role in bringing about the transformation, working with Local and National Governments, resource centres, academic institutions, NGOs and international organizations in rural and peri-urban areas. For more information see www.washcost.info.

more than a decade behind water[6]. Moreover, sanitation is not given due policy importance, perhaps due to cultural practices[7] like open defecation that suited the low density of population. With the population explosion the sanitation problems have multiplied resulting in serious health hazards in many places. Despite the growing problems, sanitation has remained an accessory to water supply than a mainstream policy issue in itself.

Figure 1: Investments in Water and Sanitation in India over the Plan Periods

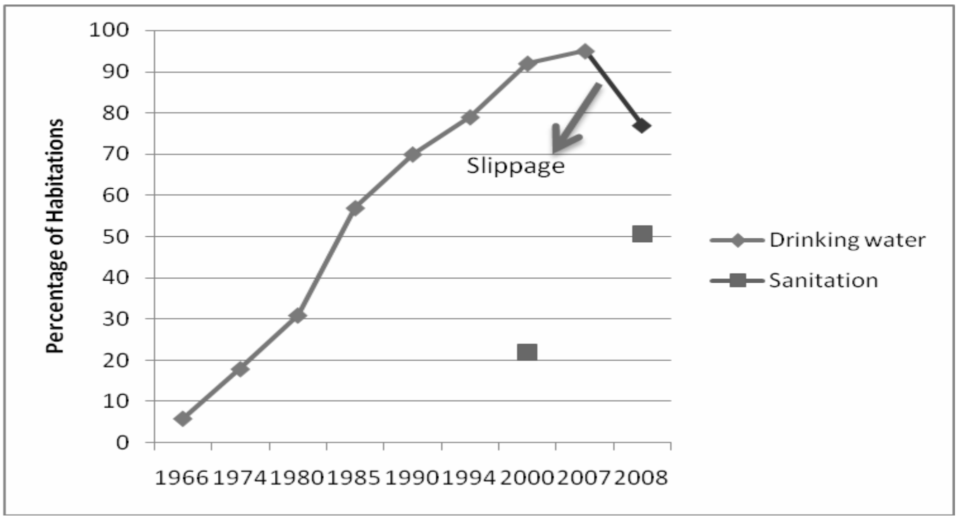


Source: Rajiv Gandhi National Drinking Water Mission, Department of Drinking Water Supply Ministry of Rural Development, Government of India (Presented to NAC on 26th February, 2008)

[6] Focus on Water Supply started in 1972-73 through ARWSP, while sanitation was given priority in 1986 – through launching of Central Rural Sanitation Programme (CRSP).

[7] The traditional practices are often considered as hygienic.

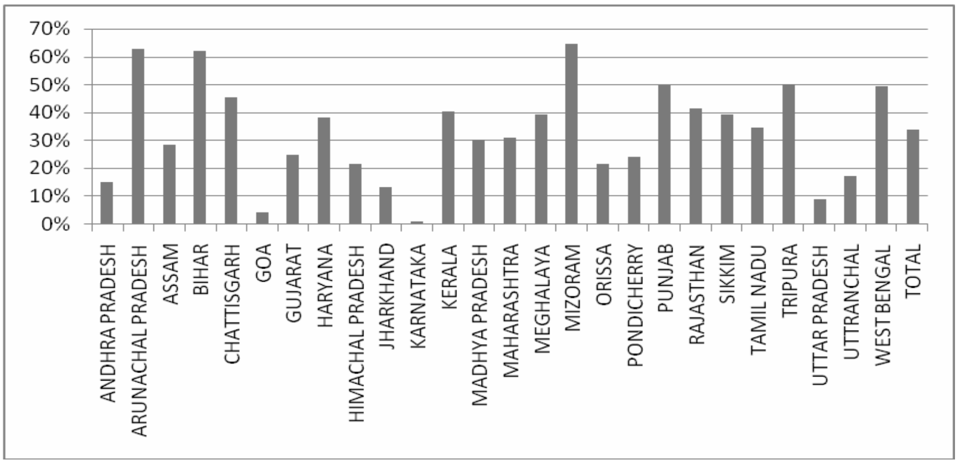
Fig. 2: Coverage of Drinking Water and Sanitation in Rural India



Source: Rajiv Gandhi National Drinking Water Mission, Department of Drinking Water Supply Ministry of Rural Development, Government of India (Presented to NAC on 26th February, 2008)

Slippage in rural water supply is more that 30 percent at all India level, which is substantial by any standards. Across the states, the extent of slippage varies widely (Figure 3). Thirteen out of 25 states record slippage at rates higher than national average. Slippage ranges from less than 5 percent in Karnataka and Goa to more than 60 percent in Mizoram, Arunachal Pradesh and Bihar (Figure 3).

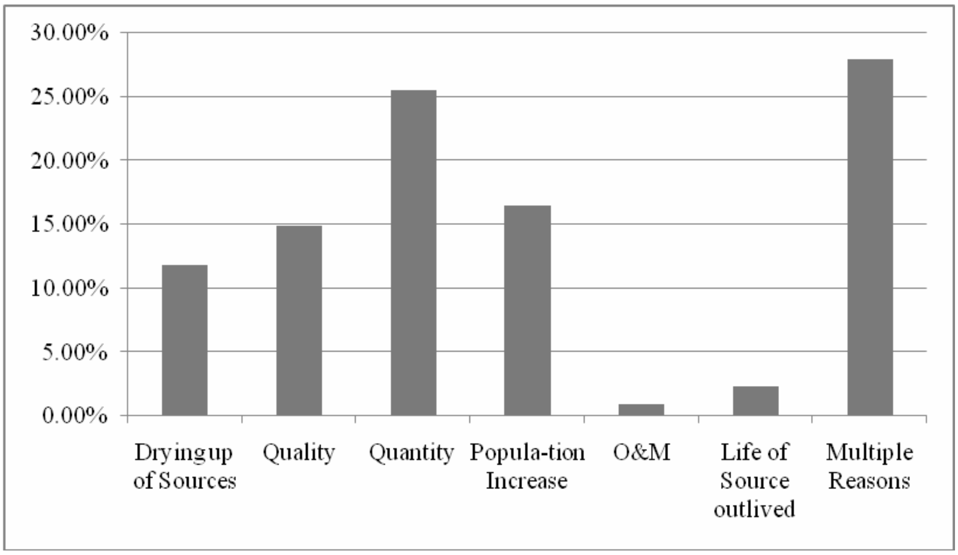
Figure 3: Extent of Slippage across States in India (Rural Water Supply)



Source: GoI (2008)

Going by the main reasons of source failure as a prime driver of slippage, it is intriguing to see Karnataka having negligible slippage despite the fact that a major portion of the state falls in the arid and semi-arid zone and it is also heavily dependent on groundwater as a source of drinking water. On the other hand, States like Mizoram, Arunachal Pradesh and Bihar receive good rainfall and have better surface water resources. This indicates that source linked factors may not be the real causes of slippage. The reliability of data is a major issue in this regard. It often tends to have under reporting problems. On the other hand, it may affect the analysis as we focus more on relative (comparative) than absolute figures of slippage[8] . Governance and demand related factors could provide a better explanation for variations in slippage across states. The decentralization in drinking water sector and devolution of drinking water management responsibilities to the village panchayats appears to be the main reason for lower incidence of slippage in Karnataka[9] . However, a systematic analysis across the states is needed in order to establish the relationship between water governance and slippage.

Figure 4: Reasons for Slippage in Rural Drinking Water at the All India Level



Source: GoI (2008)

[8] Assuming that under reporting is a common problem across the states.

[9] Karnataka is the only state in the country which has transferred all the 29 functions, funds and functionaries to the local bodies (Reddy, et. al., 2009). Field experience also suggests that decentralisation has played an important role in reducing the slippage in Karnataka (based on the personal communication with Mr. M. Kullappa, Water and Sanitation Programme (WSP), The World Bank, New Delhi).

Six main reasons viz., i) drying up of source; ii) quality; iii) quantity; iv) population; v) O&M expenditure and vi) life of the source out lived, have been identified for the slippage in the official records (GoI, 2009). Of these, quantity is the most important reason[10] followed by population pressure, quality and source drying up, while, O&M expenditure appears to have least impact on slippage (Figure 4), which again does not seem to indicate the ground realities. It is often argued, for instance, that systems become defunct prematurely due to poor operation and maintenance coupled with poor institutional setup for O&M. It is estimated that the annual O&M cost of India's rural drinking water infrastructure is over Rs. 10,000 million against the availability of Rs 2,500 million (World Bank, 2008). Low allocations for O&M and the absence of institutional arrangements (especially for revenue generation and management of the systems) reflect the poor governance of the sector.

In the absence of proper recognition for water governance issues, the strategies for addressing slippage tend to be supply sided. These include: i) Providing rainwater harvesting structures, ii) Reviving traditional sources, iii) Supplementing with new schemes for habitations served by outlived schemes, iv) Rejuvenation of outlived schemes which are functioning below their rated capacity, v) Providing regional schemes from alternate safe sources by extending new pipelines, vi) Source strengthening measures, vii) Convergence of efforts of relevant Departments in watershed development, viii) Institutionalization of community participation in water quality monitoring and in O&M of intra-village drinking water infrastructure. While all these strategies are necessary conditions in dealing with slippage they are one sided and hence do not provide comprehensive solutions to the problem. Of these eight strategies only the last one on community participation deals with demand side aspects while all others focus on supply augmentation through various mechanisms. In the long run source sustainability can be assured only with better governance of source structures rather than providing more and more structures like rain water harvesting structures, percolation tanks, etc. These structures are necessary but not sufficient for sustainable resource management / protection.

Apart from these reasons, seasonal shortage of water also results in temporary or seasonal slippage. Seasonal slippage aggravates during drought years, especially in the arid and semi-arid regions. For instance, during 2005-06, drinking water had to be transported to 1.5 percent of the total habitations. Across the states the extent of water transportation ranges between 1 percent in Karnataka to 10.5 percent in Rajasthan. In Andhra Pradesh 1749 habitations (2.5 percent) were provided with water transportation, while 8.5 percent

[10] Importance is determined by the frequency of the cause reported across states.

of the habitations in Maharashtra required water transportation (GoI, 2008). Such slippages also prompt the emergence of water markets and people, especially the poor, spend substantial amounts of money on the purchase of water (Reddy, 1999).

III. Slippage in Andhra Pradesh

In Andhra Pradesh, out of the 72040 habitations in the state, 33,183(46 percent) were Fully Covered (FC); 37436 (52 percent) are Partially Covered (PC); 529(about 1 percent) habitations are Not Covered (NC) and 892 (about 1 percent) habitations have No Safe Source (NSS) of water supply for drinking purpose as on 1st April 2009 . The status of coverage varies widely across the districts (Table 1). The approximate amount spent in creating rural water supply and sanitation infrastructure including rehabilitation and extension during the last four years (2004 to 2008) is over Rs 200 millions. Groundwater schemes cover about 72 percent of the habitations while surface water schemes cover about 28 percent of the total number of habitations.

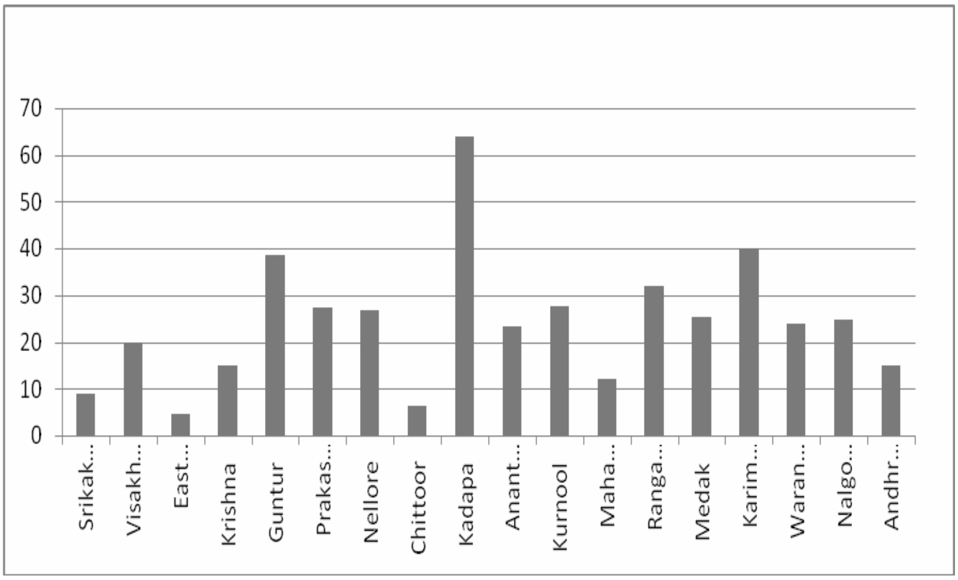
Table 1: Status of Coverage of Habitations across Districts in AP (as on 1st April 2009)

District	Total No. of Habitations	FC	PC	NSS	NC	% of FC	% of PC	% of NSS	% of NC
Srikakulam	3909	1664	2143	96	6	43	55	2	0
Vizianagaram	2874	1774	965	75	60	62	34	3	2
Visakhapatnam	5445	2006	3083	9	347	37	57	0	6
East Godavari	2899	1074	1739	30	56	37	60	1	2
West Godavari	2164	1295	869	0	0	60	40	0	0
Krishna	2491	1269	1183	37	2	51	47	1	0
Guntur	1696	637	900	156	3	38	53	9	0
Prakasam	2342	659	1379	298	6	28	59	13	0
Nellore	3012	1552	1457	1	2	52	48	0	0
Chittoor	10872	7993	2862	2	15	74	26	0	0
kadapa	4441	1103	3325	9	4	25	75	0	0
Ananthapur	3353	1914	1433	1	5	57	43	0	0
Kurnool	1518	561	949	8	0	37	63	1	0
Mahabubnagar	3420	1231	2164	15	10	36	63	0	0
Rangareddy	1686	462	964	15	0	27	57	1	0
Nalgonda	2382	582	1796	0	4	24	75	0	0
Medak	1635	974	661	0	0	60	40	0	0
Nizamabad	3565	1801	1754	9	1	51	49	0	0
Warangal	2262	293	1938	31	0	13	86	1	0
Khammam	3542	1269	3541	1	0	36	100	0	0
Karimnagar	3171	1555	1583	26	7	49	50	1	0
Adilabad	3361	1515	1772	73	1	45	53	2	0
Total	**72040**	33183	37436	892	529	46	52	1	1

Note: FC= Fully Covered; PC= Partially Covered; NSS= No safe source; NC= Not Covered.
Source: RWSS (2009).

The impacts of many water and sanitation programs are limited in the state and many systems break down and are abandoned much before their designed life. The life span norms are often calculated in terms of technical life time, economic life time and useful life time. The technical life span is often much longer than the economic and useful life span. The figures provided by RWSS for the water and sanitation components indicate that the average life span for the relevant components roughly works out to be 30-40 years in terms of technical life span, while it works out to be 15-20 years in terms of economic and useful life span. But such life spans for the components are hardly experienced in the real life (WASHCost India, 2009). The problems people experience with water supply and sanitation are numerous and complex. The nature of the problem differs depending on the context and site specific. The sustainability of water supply, in the sense of continued delivery and uptake of services, is threatened by numerous attitudinal, institutional and economic factors. Therefore, supply sided or demand sided or community participation approaches on their own are no guarantee for success. There is need for comprehensive understanding and management / governance of water resources in an integrated manner incorporating supply, demand and institutional approaches.

Figure 5: Extent of Slippage in Rural Water Supply in Andhra Pradesh



Source: RWSS (2008)

It is estimated that about 24654 habitations slipped either to PC or NSS or NC from FC category during the last 10 years in Andhra Pradesh. This is more than 30 percent of the total number of habitations in the state. However, the recent data for the years 2006-2008 indicate that the extent of slippage is about 15 percent (fig. 5). This could be due to the normal rainfall during the recent years. There are wide variations across the districts viz., ranging from zero slippage in districts like west Godavari to as high as above 60 percent in the Kadapa district. Kariminagar and Guntur districts record about 40 percent of slippage.

The reasons for slippage include depletion (quantity) and degradation (quality) of groundwater, poor operation and maintenance of the sources and systems, population growth etc., which are akin to the national level observations. It is often argued that the high dependence on groundwater (about 70 percent) for drinking water is at the core of the problem. Well population increased from 1 million to 2.2 million and area irrigated through groundwater from 1 million hectares to 2.6 million hectares during the last 3 decades. Well density increased from <5 wells/Sq Km to >20 wells/Sq Km in the last two decades. Yield of dug wells declined from 60 -150 cu.m/day to 20-40 cu.m/day and that of bore wells from 2.5-10 litres per second (lps) to 0.8 - 2.5 lps (Jain, et. al, 2009c). This reflects the poor water governance in the State. For, the situation could have been predicted or avoided through better and integrated planning across different departments that deal with water. Currently the focus at the policy level to overcome this problem is to shift to using surface water sources. While shifting to surface water sources is an easy option, provision of surface water is often difficult due to natural and geographical reasons (access) and high costs. Moreover, even surface water sources could face the risk of slippage / uncertainty in the light of neglecting governance / demand management aspects. For, surface water resources in semi-arid area are also under a lot of pressure and, arguably, overcommitted in many areas. The crux of the problem, therefore, seems to lie not with the source of water per se but the governance of water resources.

Operation and Maintenance of the systems is another critical factor that influences slippage that is basically a governance issue. What is the nature of governance that would facilitate sustainable service delivery? Important governance structures in WASH services at the village level include centralised O&M (department), decentralised O&M (Gram Panchayat), NGO managed and privately managed. All these structures have positive and negative influences in terms of service delivery. More importantly, some of the structures, especially the decentralised model, are not perfectly operational in terms of devolution of powers and capacities. The challenge is to identify appropriate governance structures and develop appropriate Information, Education and Communication (IEC) systems for enhancing capacities of the community as a whole and to inculcate necessary stewardship at the local level.

Factors Influencing Slippage[11]

At this juncture it would be pertinent to examine the factors determining the variations in slippage across districts in the state. For this purpose, a multiple regression analysis was adopted using number of indicators that influence slippage. These indicators were selected using the theoretical expectations though constrained by availability of data across the states. The basic specification is as follows:

$$ESLP_{dt} = f(HPI_{dt}, PCI_{dt}, SPOD_{dt}, HDI_{dt}, AEDU_{dt}, HI_{dt}, GDI_{dt}, GDEI_{dt}, \%SVS_{dt}, RF_{dt}, ATW_{dt}) + U_{dt}$$

Where,

$ESLP_{dt}$ = Extent of slippage i.e., % of total habitations slipped back in district 'd' at time 't'.

HPI_{dt} = Human Poverty Index of district d at time t.

PCI_{dt} = Per Capita Income of the district at time t.

$SPOD_{dt}$ = Size of population of District d at time t.

HDI_{dt} = Human Development Index of district d at time t.

$AEDU_{dt}$ = Adult education (% of literate adults) of district d at time t.

HI_{dt} = Health index of the district d at time t

GDI_{dt} = Gender Development Index of district d at time t.

$GDEI_{dt}$ = Gender Empowerment Index of district d at time t

$\%SVS_{dt}$ = % of Habitations covered under single village schemes

RF_{dt} = Average (5 year) Rain fall of district d at time t

ATW_{dt} = Access to tap water (% of Habitations) of district d at time t.

U_{dt} = Error term.

The independent variables are selected based on the theoretical considerations and the availability of data at the district level. Details of variable measurement and their theoretical/ expected impact on slippage are presented in table 2. The variables are drawn from different sources and pertain to different years. Since these indicators pertain

[11] An attempt was also made to identify the factors influencing slippage at the all India level, across states. But, the regression analysis did not provide any meaningful results, which was mainly due to multicollinearity problems and hence we dropped the analysis.

to the years around 2006-08, they may not be inappropriate in a cross sectional analysis. In the absence of actual data on some of the important variables like water quality and dependence on groundwater, proxy variables have been used. Health status of the district is taken as a proxy for water quality and proportion of habitations covered by single village schemes is taken as a proxy for dependence on groundwater. The latter is a straight forward case as majority of the single village schemes depend on groundwater. In the case of water quality it is assumed that access to quality water results in better health. Descriptive statistics of the selected variables are presented in appendix table 1.

Table 2: Measurement and Expected Signs of the Selected Variables

Variable	Measurement	Theoretical or Expected Impacts
ESLP*	% of Habitations slipped back between 2006-08	Dependent Variable
PI+	Proportion people living below poverty line (2004-05)	Positive
PCI+	Per capita income in rupees per year (2004-05)	Negative
SPOD#	Size of population in lakhs of the district (2001)	Positive
HDI+	Incorporates income, education and health indicators (2004-05)	Negative
AEDU+	Proportion of adult (>15 years of age) literates (2001)	Negative
HI+	Life expectancy at birth (years) and infant mortality rate (per 100 live births) (2001)	Negative
GDI+	Female per capita income, Adult female literacy, schooling girls, female infant mortality (2001)	Negative
GDEI+	Child sex ratio, female political participation, crime against women, female PCI, female school attendance and literacy, infant survival rate (2001)	Negative
%SVS*	Proportion of habitations served by single village schemes (2008)	Negative
RF$	Annual average rainfall in mm (2005-06)	Negative
ATW+	Proportion of habitations with access to tap water (2001)	Negative

Source: *RWSS; +Dev, et. al (2009); # population census 2001;$ season and crop report of Andhra Pradesh.

Note: For more details on measurement on indices see Dev, et. al., (2009).

Ordinary Least Squares (OLS) estimates were used to regress the dependent variable (ESLP) against the selected independent variables. Regressions were run on cross sectional data at the district level. Though data on all the indicators were available for 22 districts, some of the districts were dropped from the analysis as some of them reported negative slippage between 2006-08. As a result the number of observations (n) have come down to seventeen. Various permutations and combinations of independent variables were used to arrive at the best fit. Multicolinearity between the independent variables was checked using the Variance Inflation Factor (VIF) statistic. Multicolinearity is not a serious problem as long as 'VIF' value is below 2. The best fit specification was selected for the purpose of final analysis. The estimates are presented in table 4.

Table 4: Regression Estimates of the Factors Influencing Slippage

Variable	*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*VIF*
Intercept	20.122	44.977	0.447	0.665	
SPOP	-1.374	0.548	-2.506	0.034	1.457
HI	132.045	32.859	4.019	0.003	1.958
%SVS	0.016	0.284	0.058	0.955	1.408
RF	-0.036	0.013	-2.685	0.025	1.425
Access-TW	0.284	0.166	1.715	0.120	1.505
PCI	0.001	0.001	0.410	0.691	1.629
AEDU	-0.661	0.328	-2.017	0.074	1.940
R Square	0.77				
R Bar Square	0.61				
F	4.29				
N	17				

Note: Regression analysis was carried out using the SPSS package.

The selected specification provided a good fit with 77 percent explanatory power with an R bar square of 61 percent. Most of independent variables have turned out significant with expected signs. Some of important factors like Poverty, Human Development Index (HDI), Gender Development Index (GDI) and Gender Empowerment Index (GEI) did not turn out to be significant and hence they were dropped from the specification[12] .

[12] These are also highly multicollinear. We are not presenting various specifications estimated. These estimates can be obtained from the authors.

More People Less Slippage: It is often argued that population pressure leads to slippage as the systems may not cope with increased demand for water. Contrary to this our estimates show a significant inverse relationship between population size and extent of slippage. In other words, highly populated districts have lower incidence of slippage. This could be due to the reason that higher population may lead to better resource generation and hence better management of the systems (O&M). Further, higher population is also associated with economic development i.e., developed districts may have less incidence of slippage. But, the variable measuring per capita income did not turn out significant.

Slippage and Health: Contrary to the expectation, status of health revealed a significant positive impact on slippage. This positive relationship is a bit puzzling. The explanation could be: slippage due to water quality could result in better health status, as the access to poor quality of water is less. Such phenomenon is observed in some of the costal districts where communities have abandoned the systems in favour of purchased water or water purification plants set up by private people or NGOs (Reddy and Dev, 2006; Reddy, et. al., 2008). At the same time, health is not an indicator of water quality alone.

Slippage in Naturally Endowed Regions: Rainfall reflects the strength of the source be it surface water or groundwater. High rainfall regions are expected to have low incidence of slippage as high rainfall not only ensures quantity of water but also improves the quality of water. The estimates vindicate the expectation with significant negative relation between rainfall and incidence of slippage.

Education / Awareness and Slippage: Adult education also revealed a significant negative impact on slippage. Education levels reflect the strength of human capital. Better human capital is expected to result in better management of the resource due to greater awareness. The results show that the incidence of slippage tends to be low in the districts with higher adult literacy level. This indicates that improving the literacy in the rural areas could improve the sustainability of the WASH service delivery.

Better the Service Greater the Slippage: Access to tap water is often equated to better availability of water in terms of quantity as well as quality. The negative relation, which is significant at 12 percent level, between access to tap water and the incidence of slippage indicates that greater access to tap water may in fact lead to slippage. This could be due to the reason that access to tap water means better supply. This may put pressure on the source and reduce its life resulting in source failure and slippage. The low slippage rates in Karnataka are also attributed to low access to tap water in the rural areas by some.

Source of water is also expected to determine the extent of slippage in a significant manner. It is presumed groundwater dependent water systems run greater risk of source failure and slippage. In the present estimates, though the coefficient of source (proxy) variable (%SVS) has the expected positive sign it did not turn out to be significant. This indicates that, contrary to expectations, source is not all that important when compared to other indicators like rainfall and governance related (education) indicators.

IV Slippage: The Ground Reality

As on date no statistics and standards are available to determine whether the slippage is due to source failure, water quality problem, expansion of the habitation, etc. In general the increase in coverage is given by adding the number of new schemes installed without subtracting the number that have failed or unusable. For this reason the tenth five year plan document stated that "reliable data on the ground reality of rural water supply is lacking". Small scale surveys organized by the planning commission revealed that coverage is much less than often claimed (Table 5).

Table 5: Brief Review of Studies at the Village Level

Organisation	Year	No. of states	No. of villages	Observations
PEO	1996	16	87	40% complained less water. 30% Not dependable Frequent breakdowns. Shortage of funds. Shortage of Man power.
ORG	1998	1	8 Districts(M.P)	30% of the villages with HPs and 88% of PWS reduced from FC to PC
SAMTEK	1998	1	4 Districts (Bihar)	55%of HH did not get adequate water for the 2 months and more. 52% HH received only 20 litres of water.
WAI	2001	2 (A.P & Tamilnadu)	___	Against 32% of FC only 15% is noticed.

Source: WAI - 2005, Drinking Water and Sanitation in India

These studies have clearly brought out the serious problem of operation and maintenance. These surveys established that i) lack of prioritization and funds for O & M, ii) falling groundwater levels in dry land areas iii) contamination of groundwater through mining and iv) salinity ingress in coastal areas are the major explanatory factors of why water sources have been deteriorating into a state of disrepair. An attempt has been made to understand the ground realities pertaining to WASH services in four different situations. Accordingly three habitations and one peri-urban locations were selected as test bed areas from the agro climatic zone of Southern Telangana namely Tekulapalle (fully covered); Malreddyguda (no safe source) and Ankushapur (partially covered). And Ward 9 of Vikarabad town in Ranga Reddy district was selected for the purpose of peri-urban study. The information was generated by using qualitative and quantitative methods such as qualitative information systems (QIS) using Focus Group Discussions (FGDs) and quantitative technical information was generated from the department and water men.

All the test bed habitations are located on the ridge, sloping in different directions with slopes ranging from 5 to 20 percent. The size of the habitations varied from 0.45 ha to 4.26 ha. The rainfall data collected at the Mandal level indicates that the rainfall in the area varies from 750 mm to 960 mm. Traditionally water requirements for domestic purposes are met from the wells located in the villages. These sources can very well be recharged by harvesting rainwater which varies from 0.28 ha m to 2.24 ha m assuming 70 percent of the rainfall will result as runoff under such conditions (Table 6).

Water Supply Systems

The status of sources created in these habitations over the years indicates that probability of bore well failure varies from 0 in Ankushapur to 83 percent in Malreddyguda, while for hand pumps it varies from 9 percent in Tekulapalle to 33 percent in Malreddyguda (Table 7). No evidence on the attempts made to ensure source protection in these habitations. Besides, no scientific survey was undertaken to locate source points. The community is not pro-active in ensuring maintenance of hand pumps, which are so essential in meeting requirements. The apathy on the part of community is well established in a village like Malreddyguda, where only hand pump water is free from fluoride and safe to drink as the deep bore well water is unfit for drinking.

Table 6: Details of Test bed Areas

	Tekulapalle	Ankushapur	Malreddyguda	Ward9 (vikarabad)
Size (No. Of HH)	509	522	172	274
Location (Km from City)	75	70	40	0
Average Annual Rainfall (mm)	900	750	900	961
Quantity of Rainwater that				
can be harvested (Ha. M)	1.8	2.24	0.28	0.52
Social Composition (% of OC/BC/SC)	Balanced	Balanced	Predominantly BC (No SC)	Balanced
Economic Status	Poor	Good	Very poor	Good
Age of WASH schemes	35	30	39	—-
No. Of Open wells	4	4	3	—-
No. Of Hand pumps	11	15	6	36
No. Of Public Stand Posts	19	53	14	160
No. Of House Connections	232 (46)	460 (89)	27 (13)	56 (21)
WASH Coverage (official)	Full	Partial	NSS	Partial
WASH Coverage status (actual)	Fair	Good	Poor	Poor
WASH infrastructure (condition)	Poor	Good	Poor	Poor
Community Awareness	Poor	Good	Poor	Poor
Community Participation	Poor	Good	Poor	Poor
WASH Governance	Poor	Fair	Poor	Poor

Source: Data collected by WASHCost team from secondary sources.

Tekulapalle is located on the ridge and slopes towards north and north–east direction. Considering 7 hrs of power supply, the quantity of water pumped is around 309 lit per household per day. However, in reality 50 percent of them are not getting sufficient water. The over head tank having a capacity of 40,000 litres has a head elevation of 11.0 to 12.0 m and the water gushes to the lower levels as there are no controls in between. As the head falls, the houses located at higher elevations will have less pressure. This is evident from the fact that people make pits to gain the pressure for getting water. Further, no public stand posts has tap, causing wastage of water and pressure drop. Similarly, on the other side of the habitation about 90,000 lit of water is released at an elevation of 590, and the households living in areas having an elevation of 595 and above will hardly get any water as the hydraulic drop between highest and lowest is about 10 m with no controls.

Table 7: Number of Water Supply Sources and Systems Constructed overtime.

Village	No. of Bore Wells				Storage created (KL)		Qty. of water supplied lit/ HH
	Hand Pumps		Bore wells (PWS)		G.L.S.R	O.H.S.R	
	Failed	Working	Failed	Working			
Tekulapalle	1	10	7	4	150	130	309
Ankushapur	2	13	0	12	200	100	552
Malreddyguda	2	4	5	1	-	40	274
Vikarabad (Ward-9)	1	3	-	-		-	- -

Note: Public water supply; GLSR= Ground level Storage reservoir; OHSR= Overhead storage reservoir.
Source: Dept. of Economics and Statistics, Gap.

Malreddyguda hamlet is located on the ridge of a hill and houses are located between 581m and 570m contours. The overhead tank is located at an evaluation of 577m. The major problems in the village are that groundwater is not potable due to high fluoride levels. Further the discharge from the bore well is inadequate in summer, and it takes about 14 hours to fill the tank in summer where as it takes 7 to 8 hours in rainy season. As a result the households located in 577 to 581m do not get water because the moment water released it rushes towards the elevation of 572 to 574. Within this elevation also all the houses are not likely to get adequate water because the distribution line is not taken along appropriate contour to ensure the service to all. This only indicates that though the infrastructure is created it is not designed for proper service delivery through proper planning and maintenance.

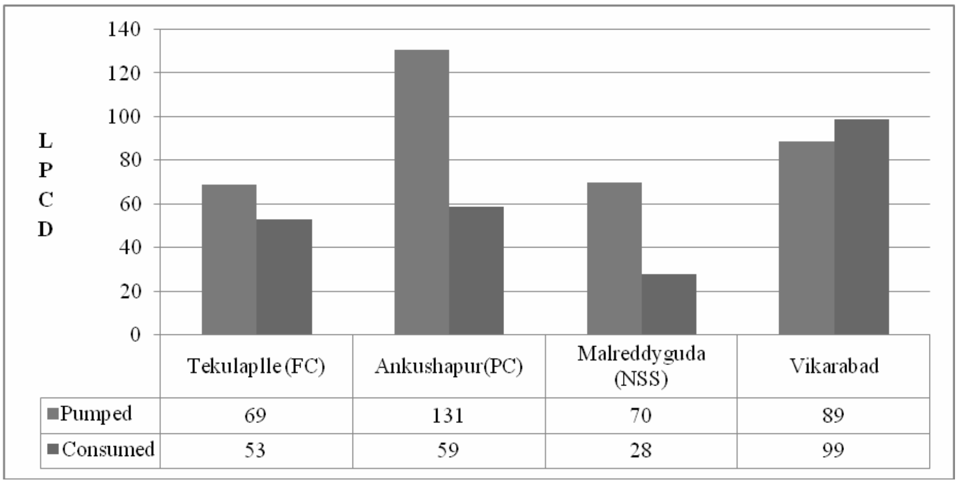
Ankushapur has 3 settlements with independent water supply courses and systems. The settlement located between levels 427 and 431 does not get adequate water as the source is located at a lower elevation and pressure is not adequate to maintain equity among the users. A part of the village gets water from the open well by direct pumping. Three bore wells are used for pumping water to the storages created and supply water to the households, in the process some get from two sources and some from only one. Besides, some households are using motors to extract water from hand pumps. As a result the bores are becoming defunct.

Vikarabad ward 9 has elevation difference of 8 m between highest and lowest points. It is often observed that only when households living down below close their taps the upper areas get water. This is mainly due to the fact that distribution lines are taken first down the slope from there again moved up to provide connection in the higher reaches as people started settling. This is purely due to unplanned development of settlements and also unscientific way of handling the services. Despite the expenditure service levels are poor and unsustainable in the absence of long term planning, execution and management.

Quantity of Water Supplied:

As per the records maintained in the 'Panchayat', the storage created is utilized everyday by filling water as per the availability of power and water in the wells. The water pumped is estimated using the horse power of the motors and the number of hours pumped. The quantum of water supplied is more than 40 litres / capita / day (LPCD) in all the habitations, which is the normative for fully covered habitations (Fig. 6). In the peri-urban case the town as a whole is supplied 89 lpcd. When compared with the actual water consumption the supply exceeds demand in all the rural habitations. The gap between supply and demand is the unaccounted water, which could be due to the leakages and other inefficiencies in the systems. The extent of un-accounted water ranges from 23 percent (Tekulapalle) to 60 percent (Malreddyguda). Personal enquiries also revealed that majority of the households are not getting proper water supplies. This is also evident from the presence of booster pumps at the household level, which are used to suck the water when it is released into the distribution system. This clearly establishes that the system is failing to ensure equity among the users due to either failure of infrastructure or its system of management. The situation is reverse in the case of peri-urban location, where consumption exceeds supply (Fig. 6). The supply level is below the normative requirement of 100 lpcd, as per the size (population) of the Vikarabad town. This reflects the poor supply situation in the peri-urban areas.

Figure 6: Unaccounted Water in the Test bed Areas



Source: Based on the Data Collected from the Pumping stations.

The preceding analysis clearly indicates that the problems are not due to resource failure per se but due to the poor planning and management of the sources and systems. The main lacuna observed in the test bed habitations include:

- No holistic approach was adopted. Instead ad hoc planning prevailed due to paucity of funds.
- Integration of the earlier schemes with the current / new schemes is not carried out to ensure cost efficiency.
- The elevation levels in the village have not been considered while laying distribution pipes.
- Improper operation and maintenance of water supply system and irregular collection of revenues due to absence of ownership of the assets created.
- Source protection measures are not considered as a requirement, hence source failures are common.

For ensuring sustainability of the systems, steps were initiated by the GOI in 1999 to institutionalise community participation in the implementation of drinking water supply and sanitation programmes, by adopting the following:

- ❍ Adoption of demand driven responsive and adaptable approach through empowerment of villagers to ensure their full participation in the project.
- ❍ Increasing the role of government for empowering user groups / gram panchayats for sustainable management of drinking water assets and integrated water management and conservation.
- ❍ Partial capital cost sharing either in cash or kind or both and 100 percent responsibility of operation and maintenance by end–users.

In spite of the policy guidelines the situation in the test bed habitations is exactly the opposite. Communities are not aware why the sources are failing? Why the equity is not achieved in spite of providing OHSRs? How to maintain power supply to the pumps used for supplying drinking water under existing power scarcity? Even the local level institutions which have accepted the responsibility of O & M do not have qualified staff to operate and maintain the system. The absence of tap valves to the public stand posts as well as individual household connections, valves in the distribution system to maintain pressure for ensuring equity, non – repairs to hand pumps and non – provision of air vents, clearly establishes that the institutions are not playing any pro-active role as required for ensuring that system works. The reasons for the above state of affairs are that the government has overlooked the cultural context and the level of knowledge of local institutions, communities in maintaining and operating the schemes. As a result, large amounts of water are being wasted.

V Conclusions

Slippage is one of the main bottlenecks of achieving full coverage of water and sanitation services in India. The extent of slippage is quite substantial even at the aggregate level. The situation is alarming in some of the states where the extent of slippage is as high as 60 percent. Therefore it may be argued that slippage is not directly related to source linked factors. The marginal incidence of slippage (about 5 percent) in Karnataka, which falls under fragile resource regions, amply demonstrates that resource / infrastructure provision alone may not address the slippage issues.

The regression estimates also revealed that source of water is not as important as that of rainfall and adult literacy. While rainfall is a natural factor, adult literacy is a policy variable. Similarly, population could exert pressure on the systems. At the same time population could support better management of the resource including better revenue generation. At the same time access to tap may not necessarily result in sustainable service delivery. But, the rainfall and literacy factors do not seem to be working in the case of Kerala, which is a high rainfall and hundred percent literate state. This once again brings to fore the importance of decentralised water governance in the provision of sustainable WASH services. At the same time, it cautions about the danger of generalisation of factors influencing slippage across all the states. Causes and solutions for minimising slippage could be location and state specific. Hence, policies should be framed at the state level rather than following the blanket central policies or guideline.

At the same time the analysis suggests that the policy should take notice of the factors that reduce slippage. Literacy or education appears to be a key factor. Education or awareness is observed be determining factor in number of resources like irrigation water, forests, etc., or services such as forest, land and even climate change (Reddy, et. Al., 2005; Reddy, et. al, 2010). More focus on the less endowed (naturally) regions in terms of higher allocation could fetch better results in reducing slippage. Another factor that needs further attention is population. Understanding the process of how size of population could reduce slippage assumes importance and calls further probing.

Our analysis of test bed areas also brings out the fact that policy makers should look beyond the often repeated supply sided strategies. As evident from the experience of Andhra Pradesh, the demand side and governance factors play an equally, if not more, important role in addressing the sustainability issues. So far the experiences are that large investments in water sector would not automatically lead to increase in coverage.

The sector also needs a sound policy and capacity so that money is spent effectively and leads to increased water security. The policy should also address resource sustainability and behavioural change goals instead of relying upon a one-sided target driven approach. In accordance with the above the drinking water policy states that: "some, for all, forever and together". The intention of such a policy is equity by meaning "for all", sustainability by meaning "forever" and efficiency improvement by meaning "together" being providers and users. An appropriate strategy is required to translate this into action. Notwithstanding the approaches followed earlier, the experience all over the world suggest that integrated water resource management framework based on Water Accounting principle with complete involvement of water providers and users together will bring a lasting solution. This approach identifies barriers in meeting the demand and potentials to improve the access within the systems and institutions, at user, service provider and Water Resource Manager level (IRC, 2008)).

General improvement in the status of literacy would go a long way in minimising slippage. Higher literacy also helps in stronger decentralised service delivery of WASH services. This emphasises the need for strong IEC activities at different levels for building their capacities in ensuring functional efficiency of the program. Water quality is another aspect that needs policy attention. The new guidelines of Rajiv Gandhi National Drinking Water Mission give high priority to water quality as well as decentralisation. But, how these guidelines are interpreted and implemented at the state and local level needs to be taken care off.

Decentralisation of WASH service delivery should adopt a model that rationalises the existing functions in the light of the prevailing situation at the ground level. The functions / items enshrined in the 11th Schedule of the Constitution can be broadly divided into three major areas / activities namely, Core/Basic Functions, Welfare Functions and National Resource Management (NRM) Functions. The approach should be 'bottom-up', as most of these activities currently are carried out at the village level mainly by Community Based Organisations (CBOs in AP). Besides, given the capacity of PRIs, their involvement in the activities would be different from one function to another. Such differentiation not only addresses the issue of over burdening the PRIs but also negates the arguments regarding lack of capacity with PRIs. WASH service delivery, which falls under the core/basic functions, is the function PRIs have been given mandate from its inception. In this scenario PRIs, given their long experience in handling these schemes would be the dominant bodies in terms of planning, implementation and monitoring of these functions (strong linkage) facilitated by the department. Members of the CBOs like village water and sanitation committee (VWSC) representing Standing Committees will act as pressure groups for efficient implementation and equitable distribution of the benefits.

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Appendix Table 1: Descriptive Statistics of the Selected Variables

Variable	Mean	Standard Error	Range	Minimum	Maximum
ESLP	24.75	3.49	59.41	4.61	64.02
SPOD	26.20	1.23	20.98	16.38	37.36
HI	0.65	0.02	0.33	0.47	0.80
%SVS	87.76	2.34	33.00	66.00	99.00
RF	897.12	49.50	666.00	552.00	1218.00
ATW	55.44	4.14	57.30	32.50	89.80
PCI	11463.94	579.07	8659.00	8845.00	17504.00
AEDU	53.42	2.38	39.60	37.40	77.00
HDI	0.53	0.02	0.23	0.39	0.62
GDI	0.61	0.01	0.20	0.49	0.69
GEI	0.62	0.01	0.11	0.55	0.66
HPI	0.48	0.01	0.22	0.37	0.59