Chapter – 4
RESEARCH METHODOLOGY

Chapter Contents

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Research methodology is frame work about how research is to be carried out. Essentially, the procedures by which researchers deal with their work of describing, explaining and predicting phenomena are called research methodology. To obtain accurate and relevant information for solving any research problem, methodology is an important tool[1].

This chapter presents various aspects of the research methodology for present study. It discusses the research methodology adopted for the analysis of primary data and secondary data with the detailed discussion of the Sample selection, data collection and methodology adopted for analysis of the data collected through the questionnaire related to the performance of Regional Rural Water Supply Schemes (RRWSS). This chapter is divided into two sections: Section – I deals with research methodology used for analysis of secondary data to evaluate the overall performance of RRWSS in different states of India and different districts of Gujarat. The RRWSS supplies adequate and potable drinking water to villages, where local drinking water sources yield insufficient water or water that is not potable or where water is fetched from remote water sources. The RRWSS are based on reliable underground sources such as tube wells or surface water sources.

Section – II deals with the research methodology used for analysis of primary data to understand the various aspects of selected water supply schemes based on responses. This section intends to discuss the scope and coverage of the research study, research design, and collection of primary data through the questionnaire. The section explains the contents of questionnaire. The chapter further discusses hypotheses, data analysis tools and limitations of the study.

SECTION – I

RESEARCH METHODOLOGY: SECONDARY DATA ANALYSIS

An attempt is made to analyze the data published by NRDWP about various schemes working in different states of India and in different districts in Gujarat with important financial indicators to understand the financial viability of the water supply scheme of India.

4.1 SOURCE OF DATA

The data are collected from NRDWP and Gujarat Water Supply Sewerage Boards Administrative report. Following paragraph presents the process of analysis.

4.1.1 National Rural Drinking Water Supply Programme

Safe drinking water for all, at all times, in rural India[2]

NRDWP publishes the financial and operational data from 2009-10 onwards. Government of India allocates the fund and the proportion of Centre and States share. The financial data are available for allocation of funds as well as release of funds during the year. It also provides the amount of expenditure incurred during the year. The information is available state wise for the whole nation and district wise for a given state. Operationally, it also provides the data about ongoing schemes, new schemes, achieved schemes, total habitations covered etc. All these data are available for each state separately. The data are available for a period of six years from 2009 to 2015. Prior to 2009 Government data were not available for the water supply schemes.

For the smooth supply of potable water the Central Government is putting sincere efforts and at all India level, scenario has improved substantially. 1028 million habitats were covered in 2001. This has improved to 1210 million habitats by 2011[3]. To supply the water, various programmes like NRDWP, ARWSP, Swajaldhara, MNP, DDP, and Sujalam Suphalam are undertaken. For programme like NRDWP, funding is by Central Government. For programme

like MNP, funding is by State Government. Huge amount of the funds are allocated.

Based on the data collected, an analysis is carried out using percentage analysis. This is applied state wise for release as a percentage of allocation and expenditure as percentage of release. Moreover, to have an idea about the status of state in relative terms, the percentage allocation of funds, release and expenditure in comparison to total figures for India are also derived for each state for the six years. Further, taking all six years together, the average percentage of release to average funds allocation and average expenditure to average release are derived for each state. To have an idea about relative status of state, percentage of allocation, release and expenditure, in comparison to total for India are also derived for each state on an average for six years.

As part of analysis of the operational aspect, for a time span of six years, the percentage of ongoing schemes, new schemes, achieved schemes, habitations covered, cost per schemes and cost per habitation are derived for all states and union territories.

As part of analysis of the operational aspect, for a time span of six years, the ongoing, new and achieved schemes, habitations covered, cost per schemes and cost per habitations are derived for all districts of state of Gujarat.

In the second part of secondary data analysis, based on the information available in GWSSB administrative report, details are compiled for 3 years *viz*., 2011-12, 2012-2013 and 2013-14. The data is related to R_nWSS – General and Sardar Sarovar Canal. This was further divided into non-divisible expenditure, expenditure for tribal development etc. Simple percentage analysis is applied to the same, to analyze structure of expenditure.

In addition to the above, the details were also gathered about number of schemes, habitations covered, estimated cost and total expenditure for the years 2012-13 and 2013-14 with breakup of type of schemes and completed schemes and schemes under program. Here also, percentage analysis is applied.

SECTION – II

RESEARCH METHODOLOGY: PRIMARY DATA ANALYSIS

This section presents the research methodology adopted for analysis of the primary data.

4.2 SAMPLE SELECTION

4.2.1 Sample Selection: Organization

The state government initiated and promoted the concept of RRWSS in 1980 based on a reliable source of water to cater to the drinking water requirement of the rural community. Water is also sourced from distant places and transported to the villages.

The broad objectives of these RRWSS were[4]:

(i) Ensure adequate supply of water to the storage facility created in the villages.

(ii) Improve the accessibility of safe and adequate drinking water to all.

(iii) Ensure regular availability of water throughout the year.

(iv) Reduce the incidences of water borne diseases and improve quality of life.

(v) The operation and maintenance of the in-village infrastructure created under the scheme by the *Gram Panchayat*.

(vi) The *Gram Panchayats* were required to ensure equitable distribution of water.

(vii) The *Gram Panchayats* were required to ensure collection of water tariff of ₹14/- per capita per year from the beneficiaries and deposit the same to the concerned authority.

(viii) Save precious time by providing safe water in the villages so that people can better utilize their time in economic activities.

(ix) To save public funds and precious time of Government machinery for various costly temporary measures to overcome the drinking water scarcity.

4.2.2 Sampling Procedure

Selection of Schemes:

As the main objective of the study is to examine the performance of RRWSS, and as there are 4,306 RRWSS, in Gujarat[5], it was important to select RRWSS for study carefully. All attempts are made here to include, different geographic regions, different geological conditions and different levels of water availability.

To fix up the criteria of selection, various socio economic, geographical and climatic factors need to be considered. Looking into these, water scarce area, water available area, arid region and coastal region of four districts Amreli, Bhavnagar, Kutch and Surat are selected. Bhavnagar is a coastal region, Amreli is water scarce, Kutch is an arid region, and Surat is a water rich region. All these districts have wide range of variation in hydrological scenario that is in terms of annual rainfall. Further the rainfall is very much unevenly distributed.

The regions also have variations in geology. North Gujarat and Saurashtra regions consist of rocky strata. Considerable part of Saurashtra and some part of south Gujarat is coastline and Kutch is a desert area. The availability in terms of source of water also differs in a wide range. Dividing Gujarat in four parts the available river basins are mentioned in Table 4.1.

Table 4.1 Water Available Region wise

Name of Region	No. of River Basin
Kutch Region	97
Saurashtra Region	71
Central and South Gujarat Region	12
North Gujarat	5
Total	**185**

Still they face water problems. The reason for this is that majority of rivers in Saurashtra and Kutch are non-perennial or seasonal whereas the major perennial rivers like Narmada, Tapi, Mahi mainly flow towards south west or almost west and central side. The selected schemes also have a variety of population and populated area that is rural and urban area and also industrial area. All these different categories have different levels of demands in terms of quantity of water, both for domestic and industrial purpose. The above justification satisfies

the selection of 4 schemes. The source of water may be situated at one place. Hence, some of the villages may be very near to source, whereas some may be at far off place. Thus, they are divided into Head, Middle and Tail, to have the representative sample.

Selection of village

The area selected for the purpose of study, Amreli, Bhavnagar, Kutch and Surat are the most popular districts in Gujarat state having total population of 8,85,237. The brief details of selected schemes and other relevant details are presented in Table 4.2.

Table 4.2 Population Coverage Under Scheme

Sr. No	Name of Scheme	Total Talukas	Total Villages	Number of Villages Selected	Total Population
1	Iswariya Regional Rural Water Supply Scheme (Amreli)	11	49	11	79,665
2	Gadhada Regional Rural Water Supply Scheme (Bhavnagar)	11	67	12	1,27,516
3	Mandvi Regional Rural Water Supply Scheme (Kutch)	10	71	12	72,261
4	Variyav Regional Rural Water Supply Scheme (Surat)	10	156	20	6,11,795
	Total	**42**	**345**	**55**	**8,85,237**

Each scheme as mentioned above is a multi-village scheme. The representatives from among the residents of the head, middle and tail end of the water supply scheme were selected as respondents. The geographical coverage should be representative of the schemes. For this purpose for a given scheme the sample villages are selected based on geographic region on convenience basis. From the sample villages, households were selected with a predetermined sample size for each village which was arrived at on the basis of the village population discussed below. The details about selected Talukas, Villages and respondents for each selected schemes are presented in Table 4.3, with the percentage of Taluka, village and respondents selected to total of the same. Thus, a total of 7 Talukas, 55 villages and 2,247 respondents are selected. The number of respondents in each of the villages is based on the population of the selected village. The basis of selection was as follows.

For population of village ≤ 1000 = 30 respondents

For population of village between 1001 to 3000 = 40 respondents

For population of village >3000 = 50 respondents

Table: 4.3 Sample Selections: Critical Details

Sr. No.	Name of Scheme	No. of Sample Talukas	% of S.T to T.T	No. of Sample Village	% of S.V to T.V	Population of Selected Villages	% of S.P to T.P	Respondents	% of Total Scheme wise Responses
1	Iswariya Regional Rural Water Supply Scheme (Amreli)	3	27.30	11	22.45	24,499	30.80	472	21.00
2	Gadhada Regional Rural Water Supply Scheme (Bhavnagar)	1	9.10	12	16.42	24,781	19.40	479	21.32
3	Mandvi Regional Rural Water Supply Scheme (Kutch)	2	20.00	12	16.90	21,085	29.20	433	19.27
4	Variyav Regional Rural Water Supply Scheme (Surat)	1	10.00	20	12.82	58,560	9.60	863	38.41
	Total	**7**		**55**		**1,28,925**		**2,247**	

(S.T. = Sample Taluka, T.T= Total Taluka, S.V= Sample Village, T.V= Total Village, S.P = Sample Population, T.P = Total Population.)

As per design, all these four schemes have variation in their benefited area composition and beneficiary. Variyav scheme[6] partly covers urban area. Gadhada scheme[7] is in the region of sea water intrusion and high total dissolved solids (TDS). Iswariya scheme[8] high fluoride contamination and Mandvi scheme[9] covers desert area as well as border area. Thus, they are provided in different characteristics area. Because of topography and other characteristics of area, cost of the scheme varies in a wide range.

Secondary data from various sources were also collected. Some secondary sources which were helpful in conducting the study are:

- Census of Gujarat
- Publication of GWSSB and its concerned field offices
- Laboratories of GWSSB

4.3 DATA COLLECTION

A detailed questionnaire for collection of data was developed.

Respondents were selected from the following categories:

1) Official of *Panchayat* i.e. Sarpanch and other officers.
2) Leading educated persons from the village like doctors, engineers and teachers.
3) Common villagers were asked questions related to personal experience as housewives.

Questionnaires were given directly to the *Panchayat* official and educated persons giving them brief description and they were requested to return it after filling it completely. To carry out survey among common village persons a *"Gram Sabha"* was called and rationale of the study and the questionnaire were explained to them. After that, the people who are higher secondary cleared or graduates were selected with the consultation of Sarpanch and they were given the task of making other villagers / respondents fill up the questionnaire.

4.4 A BRIEF ABOUT STRUCTURED QUESTIONNAIRE

This part presents a brief discussion of the questionnaire. The structured questionnaires *(Appendix -1)* consist of total seven parts, consisting of sub-questions in each main question. The questions are designed to collect information and primary data from individual beneficiary. The economic viability of any scheme depends on various socio-economic factors. In order to have proper inputs for the critical analysis of schemes and regions under study questionnaire was designed incorporating questions including personal information, infrastructure, water collection storage, water shortage, water charges and social life. These questions are addressed to know or get idea about environment in which the schemes are functioning and influence of various socio-economic factors on it.

Part − 1 relates to 'Personal information'. This part has nine questions related to profile of respondents, concerning personal aspects *viz.* name, area of residence, sex, age, caste, religion, education qualification, economic class, business and members of the family. These questions relate to the profile of respondents.

Part − 2 relates to 'Infrastructure'. This part has six questions related to infrastructure availability for domestic water supply,- the source of water from where the respondent families fetch the drinking water; sources being tap (house connection, public tap, stand post), hand pump, bore well, well, river, pond, tanker or underground storage tank. This part asks regarding distance from source to residence; whether the source of water is Government, village or both and if it is Government source then whether the respondent is satisfied or not. The purpose of these questions was to find out whether respondent was depending on local source from present scheme and scheme provided for connections for the supply of water from the tap, stand post etc. or not. Further, an attempt was made to examine the reasons for satisfaction or dissatisfaction with supply of water from the selected RRWSS.

Part − 3 relates to 'water collection and storage'. This part has three questions which includes the purpose for which water is used, other than domestic use in house such as water used for animal husbandry, dairy industries and other home industries. The second question inquired is about the regularity of water supply. The third question inquires about effects of irregular water supply on routine life, business, education of children *etc*.

Part − 4 relates to 'water shortage'. This part has five questions. These questions are about shortage and money spent for water in water scarce period. Average expenses incurred for buying water in scarce days (in the scale of daily, weekly or monthly, period) for which the respondent buys water were also inquired. The businesses affected due to water scarcity such as agriculture, animal husbandry, labour work or traditional professions are inquired to judge the effects of scarcity of water on loss of income as well as diseases due to water problem. The purpose of this part is to measure the effect of water shortage on daily expenditure and on business, if any.

Part − 5 relates to 'Water charges'. This part has six questions. Question first inquired about water charges being paid for getting water under RRWSS. The question related to payment or otherwise of the water charges and amount if any. Question second deals with the payment or otherwise of water connection charges. The next question inquired the affordability of the water charges. This section further inquired into satisfaction or otherwise with reference to water supply. In addition to this, an attempt is also made to know the existence of disagreement, if any, about the payment of water charges.

4.5 PROCESSING OF THE DATA AND ANALYTICAL DESIGN

The duly filled in questionnaires were edited, to detect any defect or error, to improve reliability of the analysis. Some questions have remained unanswered. The questions for which no answers were available have remained unanalyzed. For analysis and interpretation, it was necessary to classify the raw data. The classification of data resulted into tabulation. Raw data was summarized and displayed in a compact form for further analysis. For the present study data collected was classified and tabulated according to (i) demographic factors (ii) infrastructure factors (iii) water collection and storage (iv) water shortage (v) water charges of the respondents *i.e.* mainly as per the main parts of the questionnaire.

4.6 HYPOTHESES

Based on classification and tabulation, the analysis is carried out. The analysis is mainly divided into two parts, viz. basic analysis through discrete statistics and testing of hypotheses.

For the discrete statistics, the collected data are classified based on geographic region, for the scheme, i.e. Head, Middle, Tail and the frequency and percentage analysis is applied to the same. Moreover, the data are also classified according to the economic activities and the frequency and percentage analysis is applied to the same.

In the second part of the analysis, a hypothesis testing is carried out. For this purpose following hypotheses are framed.

Reasons for satisfaction or dissatisfaction with Government source of water

H_{01}: There is no significant correlation between the schemes regarding the response for reasons for satisfaction with the use of Government sources of water.

H_{02}: There is no significant correlation in the response for reasons for satisfaction with the use of Government water sources between the geographical regions.

H_{03}: There is no significant correlation between the schemes regarding response for reasons for dissatisfaction with use of Government sources of water.

H_{04}: There is no significant correlation in the response for reasons for dissatisfaction with use of Government sources between the geographical regions.

Payment of water charges

H_{05}: There is no significant difference in the proportion of respondents paying the water charges between the schemes.

H_{06}: There is no significant difference in the proportion of respondents paying the water charges located at different geographical regions irrespective of schemes.

H_{07}: There is no significant difference in the proportion of respondents paying the water charges depending upon their economic activities irrespective of scheme.

H_{08}: There is no significant difference in the proportion of respondents paying water charges located at two different geographical region of the same scheme.

H_{09}: There is no significant difference in the proportion of respondents paying water charges between two schemes having similar geographical region.

Payment of Water connection charges

H_{010}: There is no significant difference in the proportion of respondents paying water connection charges between the schemes.

H_{011}: There is no significant difference in the proportion of respondents paying water connection charges between different geographical regions irrespective of scheme.

H_{012}: There is no significant difference in the proportion of respondents paying water connection charges depending upon economic activities irrespective of scheme.

H_{013}: There is no significant difference in the proportion of respondents paying water connection charges for the different geographical region within the scheme.

H_{014}: There is no significant difference in the proportion of respondents paying water connection charges for the similar geographical region of two different schemes.

Affordability of water charges

H_{015}: There is no significant difference in the proportion of respondents about the affordability for water charges between the schemes.

H_{016}: There is no significant difference in the proportion of respondents about the affordability for water charges between geographical regions irrespective of scheme.

H_{017}: There is no significant difference in the proportion of respondents about the affordability for water charges depending upon economic activities irrespective of scheme.

H_{018}: There is no significant difference in the proportion of respondents about the affordability for water charges between two geographical regions within a given scheme.

H_{019}: There is no significant difference in the proportion of respondents about the affordability for water charges between two schemes for similar geographical region.

Satisfaction about 'water supply' and 'water charges'

H_{020}: There is no significant difference in the proportion of respondents satisfied about the 'water supply' and 'water charges' payment between the schemes.

H_{021}: There is no significant difference in the proportion of respondents satisfied about the 'water supply' and 'water charges' payment between geographical regions irrespective of scheme.

H_{022}: There is no significant difference in the proportion of respondents satisfied about the 'water supply' and 'water charges' payment depending upon economic activities irrespective of scheme.

H_{023}: There is no significant difference in the proportion of respondents satisfied about the 'water supply' and 'water charges' payment between two geographical region of given scheme.

H_{024}: There is no significant difference in the proportion of respondents satisfied about the 'water supply' and 'water charges' payment for similar geographical region of different schemes.

4.7 DATA ANALYSIS TOOLS

Methodology adopted for testing of Hypotheses

For testing of hypotheses regarding responses received from the respondents, Z Test is applied. To know the difference between the proportions according to the scheme, geographic region as well as economic activities this test of difference in proportion is applied. To examine the similarity in opinion for the satisfaction for Government source of water, Spearman's Rank Correlation Coefficient was applied. To know the significance of the calculated Coefficient of Correlation of sample data *t*-test was applied.

4.7.1 Spearman's Rank Correlation Coefficient[10]

The frequency and percentage for reasons for satisfaction and dissatisfaction for Government water sources were derived based on responses. Based on this ranks were assigned, as rank 1 for highest percentage for given reason, '2' to next

highest and so on. Thereafter an attempt is made to examine whether the reasons for satisfaction or dissatisfaction are similar between different schemes and geographical region or not. The Rank Correlation Coefficients are computed, taking two schemes or two geographical regions at a time to examine the hypotheses (H_{01} to H_{04}). The formula for computing rank correlation coefficient (RCC) is as follows:

$$R = 1 - \frac{6 \sum D^2}{N (N^2 - 1)}$$

Where R denotes coefficient of rank correlation, D denotes the difference between paired ranks and N stands for the number of pairs.

The value of R always remains between −1 to +1. It is the only method of finding out relationship when ranks are given. Further, to know whether the calculated correlation coefficient of sample data is indicative of significant correlation or not the *t*- test is used. This is calculated as follows:

$$t = r \sqrt{\frac{n-2}{1-r^2}}$$

Where r denotes the correlation coefficient and (n−2) is degree of freedom.

This calculated value of *t* is then compared with its table value and if the calculated value is less than the table value, the null hypothesis is accepted at a given level of significance and one may infer that there is no relationship of statistical significance between the two variables.

4.7.2 Test for Difference Between the Proportions[11]

To examine the difference in proportion of respondents for water charges, water connection charges, affordability and satisfaction for payment of water charges, test for difference in proportion is applied for the hypotheses H_{05}, H_{06}, H_{07}, H_{08}, H_{09}, H_{010}, H_{011}, H_{012}, H_{013}, H_{014}, H_{015}, H_{016}, H_{017}, H_{018}, H_{019}, H_{020}, H_{021}, H_{022}, H_{023}, and H_{024}. Here, the difference between p_1 *i.e.* the proportion of successes in one sample and p_2, *i.e.* the proportion of successes in another sample, is due to

fluctuations of random sampling or otherwise is to be examine. If two samples are drawn from different populations, it has to be seen whether the difference between the proportion of successes is significant or not. The standard error of the difference between proportions is calculated by applying the following formula:

$$\text{S.E. } (p_1 - p_2) = \sqrt{pq\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

Where p = the pooled estimate of the actual proportion in the population. The value of p is obtained as follows:

$$\text{p} = \frac{n_1\, p_1 + n_2\, p_2}{n_1 + n_2}$$

where, $n_1\, p_1$ and $n_2 p_2$ stand for the number of occurrences in the two samples of sizes n_1 and n_2 respectively. If $\frac{p_1 - p_2}{S.E.}$ is less than 1.96 S.E. (5% level of significance) the difference is regarded as due to random sampling variation, *i.e.* as not significant.

4.8 LIMITATIONS OF THE STUDY

(1) The research study is limited only for the state of Gujarat.

(2) The study is limited to only four schemes in Gujarat.

(3) Only rural areas of Amreli, Bhavnagar, Kutch, and Surat districts are covered here.

(4) The responses given by the respondents are subject to their personal biases and choices as the case may be.

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