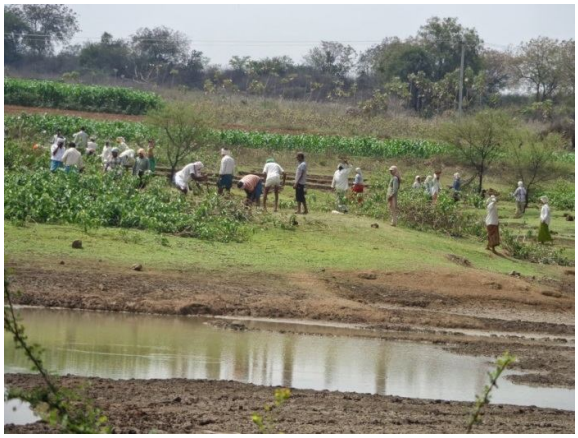
Global Water Partnership South Asia
India Water Partnership

FINAL PROJECT REPORT 2014



Development of participatory decision support tool for water resources assessment in quality affected villages of Warangal District, Telangana

Implementing Organization: Safe WATER NETWORK INDIA

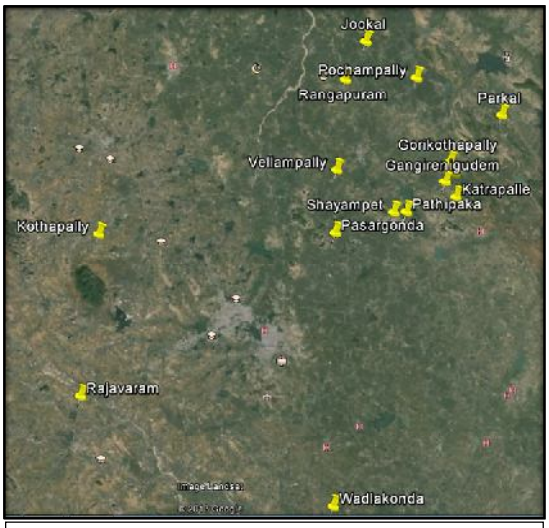
Contents

1. INTRODUCTION

Under the grant support of India Water Partnership, Safe Water Network India continued to build upon the activities undertaken in the year 2013 to the Work Plan 2014 in terms of mapping of water resources through GIS application basis 2013 activities, as well as development of IEC tools to create mass awareness on crop-water relationshipin select 15 villages in Telangana.

1.1 Project Area

In the Warangal district of a total geographical area of ~12846 square kilometres, agriculture is the main source of occupation. Total population of the district, as per Census, is 3,522,644. The population density has increased almost five fold in the last century. The growth has led to stress on the available land and water resources, resulting into adoption of intensive agriculture practices and other infrastructure development. The drinking water needs of the rural communities at large are met from groundwater sources.



Location of Selected Villages

Due to increase in application of chemical fertilizers and hydrogeological setup, the ground water sources are prone to excessive chemical contaminations. The Water Quality analysis records of PHED indicate more than 1,000 water sources having fluoride contamination beyond the permissible limits. Similarly, the presence of higher concentration of total dissolved solids and Nitrate is very common in the area. Safe Water Network India is actively engage in this area since last four years to address water quality challenge by setting up community size water treatment plant.

Under this study, Safe Water Network India selected 15 villages, where treatment plants have been setup to provide safe drinking water to community, to assess the status of water resources in these villages and water utilisation practices for different needs. The study has contributed in understanding the sustainability challenges at local level and developed a set of tools for conducting water balance study and communication material, which is used to sensitize community about the need for source protection and conservation of water resources.

Name of Village	Nizampally	Pochampally	Katrapalle	Wadlakonda	Gangirenigudem	Pathipaka	Gorikothapally	Rangapuram
Development Block	Regonda	Regonda	Shayampet	Parvathagiri	Shayampet	Shayampet	Regonda	Mogullapalli
District	Warangal	Warangal	Warangal	Warangal	Warangal	Warangal	Warangal	Warangal
Population	2067	1684	1502	2462	1549	4234	3932	3590
Households	497	405	361	519	372	1018	945	863

Name of Village	Pasargonda	Jookal	Rajavaram	Kothapally	Parkal	Vellampally	Shayampet
Development Block	Athmakur	Chityal	Ghanpur Station	Bheemadevara Pally	Parkal	Parkal	Shayampet
District	Warangal	Warangal	Warangal	Karimnagar	Warangal	Warangal	Warangal
Population	2368	4788	4871	2315	10888	3760	7879
Households	570	1151	1171	700	2617	904	1894

1.2 Objectives

1. Map water resources through GIS application by adopting micro-watershed approach and estimating water balance in select project villages of Warangal District, Telangana.
2. Develop simplified IEC (Information Education & Communication) tools for creating awareness among users on water scarcity.

2. ACTIVITIES

The focus of activities during the year was mainly to develop the tools that help in assessment of water resources at local level and create awareness among the different user groups on better management practices to improve the water use efficiency. Considering these aspects as key areas of intervention, following activities are carried out.

2.1 Study Design

The project activities were initiated through a structured framework for data collection and aligning team members for collection of data from villages as well as from secondary sources. As part of preparatory work, data sheets were developed to collect information pertaining to raw water source, water resource assessment and the cropping system (please refer attached format for data collection).

2.2 Data collection

The primary data are collected from field by using participatory exercises like focus group discussion, guided dialogue and resource mapping with the help of active members of community in the villages. Beside this the water source information and water level fluctuation data are seasonally collected by the trained staff of Safe Water Network India. The volume of raw water used in each treatment plant and treated water volume is recorded on regular basis. Similarly water quality analysis is carried out as per the standard protocols adopted by Safe Water Network India i.e. raw water test once in a year and treated water test twice annually. Beside these informations, secondary source of information like Survey of India maps and satellite imageries are also used for assessment of area and preparation of different thematic maps.

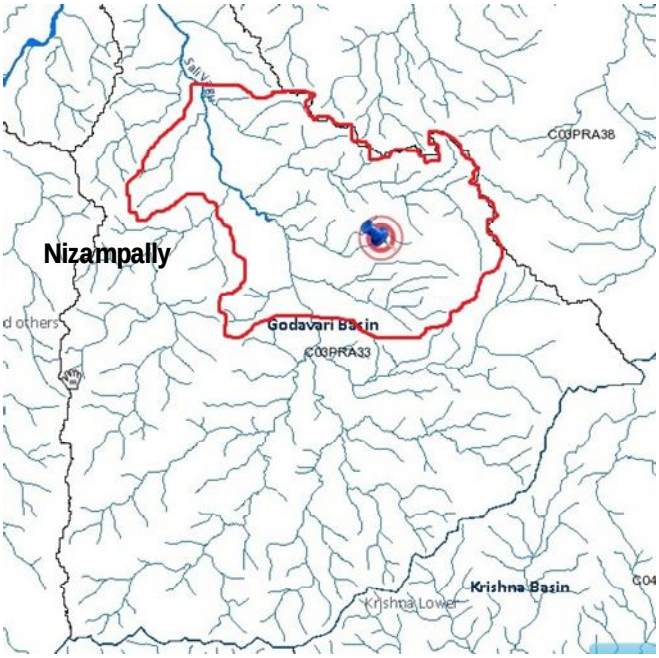
2.2.1 Water Source– Primary research was conducted in each of the 15 project villages, to collect data related to number of water sources present in the area and water requirement for drinking and irrigation needs. This included mapping of water source protection measures to mitigate any risks to drinking water source. The set of information collected under this category included yield of the sources, water quality aspects, sanitary protection measures, source strengthening measures and reject water disposal system. For the details on type of information, please refer attached format.

2.2.2 Cropping system and agriculture inputs – This included collection of information on application of fertilizers and pesticide in different types of crops, area under cultivation for each crop and water requirement. These informations were collected from the farmers through Focus Group Discussions (FGDs). A set of questionnaires were developed to conduct guided dialogue in the villages.

Focus Group Discussion conducted in village Pochampally, Warangal, Telangana

2.3 Application of GIS for demarcation of Watershed Boundaries

Topographical informations like geographical area, land features, vegetative cover, cropping system, hydrological features etcare critical for the study of water resources. With the advent of advance technology like GIS and Remote Sensing, it is now convenient to determine these parameters at different scale. Under the project attempt has been made to apply these techniques as supporting tool for different inputs. As first step, coordinates of each village were collected to get the right imageries of location. By applying tools available in public domain like IndiaWARIS and Bhuvan watershed boundary is demarcated based on the location of each village. This step has helpedin estimating the overall area of each village, which is the pre-requisite for conducting water resource assessment study. Based on the proximity of villages and their location in the watershed area, the boundary of micro-watershed is demarcated along the ridgeline which divides the surface water flow into different directions. Based on this understanding, the following 12 villages are located close by and these are part of the C03PRA33 watershed of Godavari river basin, as per CGWB classification of watershed. There are three villages, viz. Wadlakonda, Rajavaram and Kothapally, which are not part of the same watershed and these are located at a distance from the selected watershed area. Villages Wadlakonda and Rajavaram are located in Watershed C04KRL36 and C04KRL35 respectively and these are part of Krishna river basin. Whereas, village Kothapally is part of C03PRA32 watershed falls in Godavari river basin. Considering the scattered location of project villages, it is planned to also closely observe



Watershed C03PRA33, demarcations on micro-watershed

the administrative boundary for estimation purposes. The table given below is the list of villages with location as per watershed as well as area of villages based on revenue boundaries:

Table 1: List of Villages with watershed locations vis-à-vis Area in sq km

S.No.	Village Name	Villages Code	Block / Mandal	Watershed code	Watershed Area Sq Km	Area Sq Km
1	**Nizampally**	**NZM**	Regonda	C03PRA33	859	**30.6**
2	**Pochampally**	**PCH**	Regonda			**4.7**
3	**Katrapalle**	**KTR**	Shayampet			**4.3**
4	**Gangirenigudem**	**GAN**	Shayampet			**3.3**
5	**Pathipaka**	**PTK**	Shayampet			5.0
6	**Gorikothapally**	**GOR**	Regonda			**7.0**
7	**Rangapuram**	**RNG**	Mogullapalli			6.6
8	**Pasargonda**	**PSR**	Athmakur			9.8
9	**Jookal**	**JKL**	Chityal			10.7
10	**Parkal**	**PRK**	Parkal			**8.1**
11	**Vellampally**	**VEL**	Parkal			**8.3**
12	**Shayampet**	**SHY**	Shayampet			**6.6**
13	**Wadlakonda**	**WDK**	Parvathagiri	C04KRL36	966	10.7
14	**Rajavaram**	**RJV**	Ghanpur Station	C04KRL35	690	**31.8**
15	**Kothapally**	**KTP**	Bheemadevara Pally	C03PRA32	640	**17.1**

It can be noticed from Table 1 that the area of revenue village is very small in comparison to area of each watershed (hydrologic unit). The total area of 12 villages, which are part of C03PRA33 watershed, is 105 Sq Km, this accounts for only 12% of the watershed area,whereas altogether there are 43 villages in this watershed which is the home for more than 7.2lakh population and estimated area of watershed is 859Sq Km. Since the focus of this study is on villages which are part of Safe Water Networks' interventions, it is assumed that the other villages do have significant influence on the water resources of this watershed. The other three villages which fall in other watershed, this percentage is further low. In absence of required information for the study from the villages outside the project area, it is planned to focus on village based study instead on micro-watershed.

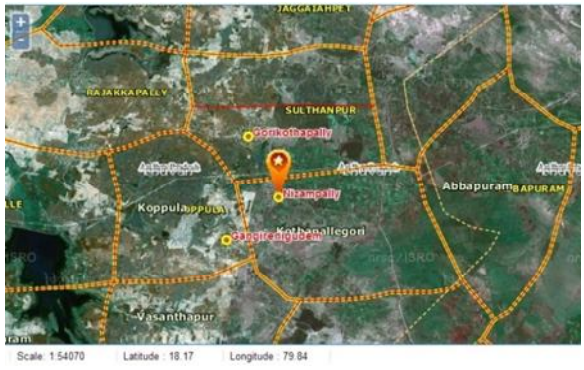
The data analysed was further shared with the **National Remote Sensing Centre (NRSC)**, Hyderabad for technical inputs on remote sensing application in water balance. National Remote Sensing Centre, Hyderabad is the sole body dealing with satellite imageries, conducting analysis and interpretation of data and disseminating results which are applicable for the different sector which ultimately benefits the society. Based on this strength, we associated with the NRSC to take advantage of information available with them sought support in data analysis and use of remote sensing for study of selected villages based on micro-watershed concept. To facilitate this joint exercise, Safe Water Network India provided primary data related to water level monitoring from observation wells and village information with longitude and latitude. In August, we also had a meeting with

officials of NRSC to understand the process of data analysis. NRSC assisted our work on following aspects:

- Demarcated watershed boundary – Except Rajavaram and Wadlakonda, all the villages are part of Godavari basin.
- Demarcation of sub-watershed – based on our inputs a sub-watershed has been demarcated; this covers eleven villages (Excluding Pochampally and Kothapally). These eleven villages are part of Chalivagu) a tributary of Godavari basin.
- Soil classification map (there are broadly four type of soils in the area – these were depicted by different colors)
- Rainfall-runoff analysis (NRSC calculated volume of rainfall and runoff by using 2013 data).
- Area under Kharif, Rabi and Double crop
- Hydrogeological – contours for pre-monsoon, post-monsoon and ground water draft information.

Villages with revenue boundary

2.4



Data analysis

Water Resources and Cropping Pattern

The information collected by adopting the participatory approach are summarized separately for water resources and different crops. A brief summary as compiled on (a) different crops being cultivated in each village; and (b) chemical fertilizers and pesticides are used during the crop cycle for each crop. Further, data was analysed to assess the chemical load added each year through application of chemical fertilizers and pesticide in the system. Similarly, water requirement of each crop was estimated based on the standards available in

public domain. The water requirement for domestic purpose and cattle rearing is also worked out based on the standards followed in India. This gives broad indication of total water requirement in the watershed area. The table below is presenting area covered under each crop during Kharif and Rabi seasons.

Table2. Cumulative area coverage by different crops in select 15 villages

First Crop	Total Area (in Acre)	Second Crop	Total Area (in Acre)
Cotton	17,350	Paddy	3,000
Paddy	8,650	Maize	7,550
Chilly	2,380	Watermelon	30
Banana	500	Green Gram	450
Mango	800		
Maize	660		
Sub-total	**29,990**	**Sub-total**	**11,030**
Total Crop Area	**41,020**		

The amount of chemical fertilizers and pesticide used in different crops is estimated based on the data collected through focus group discussion from each village. This analysis gives an indication about the quantity of chemicals used in the project villages (please refer table 3).

Table 3. Major Crops cultivated in project villages and quantity of chemical fertilizer applied

Crops	Total area (acre)	Average Fertilizer use tons/acre	Total use of fertilizer Tons/year
Cotton	17350	0.9	15042
Paddy	11650	0.3	3042
Chilly	2380	0.4	833
Banana	500	0.7	330
mango	900		0
Maize	8210	0.5	4105
Total			23352

It is estimated average application of fertilisers in the area is 0.56 tons per acre for the total crop area 41470 acres. The outcome of this exercise has helpedin comparing the quantity of chemicals used in the area with the quantity of chemicals disposed as reject water after the treatment of raw water. Table 4 presents the volume of water withdrawn from aquifer annually and the quantity of reject water disposed. Here an attempt has been made to estimate the quantity of chemical contaminant disposed through reject water into the local system.

Table 4: Volume of Chemicals disposed through reject water after treatment

No.	Village	Average volume of water/annum (L)	Total water withdrawal from aquifer by assuming 50% reject (KL)	TDS mg/l	Estimated quantity of Chemical disposed in Reject Water (tons/annum)
1	Nizampally	1,104,427	2209	646	1.4
2	Pochampally	876,647	1753	812	1.4
3	Katrapalle	658,560	1317	534	0.7
4	Gangirenigudem	776,063	1552	1700	2.6
5	Pathipaka	1,318,570	2637	2975	7.8
6	Gorikothapally	1,052,980	2106	1480	3.1
7	Rangapuram	982,700	1965	710	1.4
8	Pasargonda	777,227	1554	1810	2.8
9	Jookal	1,297,511	2595	2224	5.8
10	Parkal	1,589,449	3179	2660	8.5
11	Vellampally	909,830	1820	1184	2.2
12	Shayampet	1,357,040	2714	1050	2.8
13	Wadlakonda	498,387	997	740	0.7
14	Rajavaram	452,720	905	2465	2.2
15	Kothapally	793,187	1586	1200	1.9
	Total				45.5

The volume of treated is recorded at each treatment plant daily, which is equal to the quantity of water withdrawn from aquifer. On an average 50% of the raw water is disposed as reject after treatment. Similarly, the chemical concentration i.e Total Dissolved Solids presence in raw water helped in estimating quantity of chemical contaminants disposed annually through reject water in the area. As a thumb rule, the chemical concentration of this normally doubles to raw water TDS. The table above represents the average volume of water treated annually and estimated chemical quantity disposed in the area. This quantity is around 45.5 tons per annum, which is around 0.19% of the chemicals used in agriculture activities. The data presented in the table indicates that the significant amount of chemical load is added to the local environment from agriculture activities.

There is no serious risk from the reject water, if managed carefully by adopting natural dilution process and at the same time people also need to be encouraged to reuse it for other purpose.

2.5 Participatory Water Budgeting

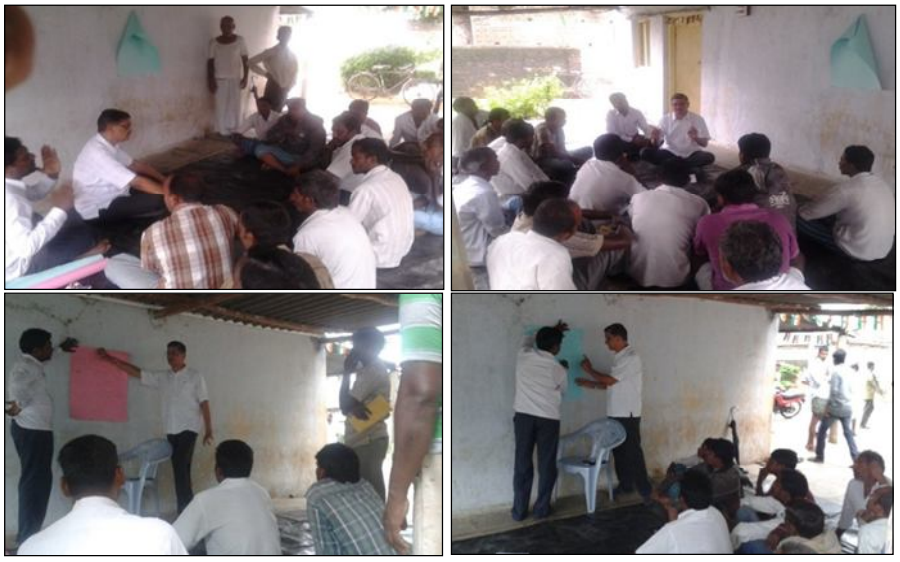
The application of remote sensing data and GIS has assisted in estimating the certain attribute like geographical area, soil type, crop seasons etc, these information further correlated with the data collected from village through participatory exercise. By adopting a simple arithmetical model water balance study was first carried out in village Jookal, District Warangal, Telangana. This was conducted along with Gram PanchayatSarpanch, Mr. K Kumarswami and 12-15 villagers. During this discussion, the tool developed for water balance estimationwas applied to collect information and calculate resource availability and utilization pattern. During discussions, our attempt was to demystify information and educate the participants through

visual method. At the same time scientific approach was adopted to maintain the importance of exercise. The water balance in simple words, is measuring the amount of water coming in and going out to assess availability in a given specific area. Table below shows water balance in village Jookal, developed as outcome of focus group discussions. At the end of this exercise, the participants liked the outcome and found appreciative of this exercise. It was suggested to adopt the following:

1. Display this outcome in each village for sensitizing the farmers on crop-water relationship
2. Develop a documentary on water budgeting exercise which can be used as mass communication media
3. A banner can be developed for each village and displayed at common places (iJal Station and Gram Panchayat office)

Table 5. Estimation of Water Balance at Jookal (Participatory Exercise held at Jookal)

Sl No	Items	Jookal
1	Village area in hectare (Crop area reported by farmers + 10% for other purpose)	1400
2	Total volume received Mm³/year	12.5
3	Ground water recharge assumed 15% Mm³/year	1.9
4	Surface flow Mm³/year (20%)	2.5
5	Absorbed by soil - available for plants & ET+PET (65%)	8.1
A	**WATER STORAGE in Tanks/Ponds**	
1	Total Volume stored in Mm³/year	0.86
2	Surface flow - Storage =	1.64
3	Total Water Available for ground water productivity (20%)	0.33
4	Total Water Available = ground water + storage	2.2
B	**WATER REQUIREMENT FOR VILLAGE**	
1	Population	0.07
2	Cattle population	0.01
3	Crops	11.22
4	Annual Water Utilization Mm³/year	11.29
C	**WATER BALANCE (Mm³/year) (-deficit)**	-9.1



Group discussion on Water Balance in Village Jookal – Sarpanch and villagers

The exercise conducted in village Jookal has contributed in learnings, specially the process for conducting the exercise is simplified and documented.

2.5.1 Tools for Water Balance Study

The following steps serve as a simplified tool for water balance study:

Step 1:Estimate water availability in a village/watershed area

- Geographical Area of Village / Watershed
- Average Annual Rainfall
- Total Water Received in village = Total Area x Annual Rainfall

Step 2: Estimate Surface Water Storage

- Number of Water Storage Structures and potential to store water annually
- Average depth of water column and Area of water storage structure will help to determine annual storage of water

Step 3: Estimate Groundwater Recharge

- Hydrogeological settings, formation type and presence of geological structures

Step 4: Estimate Runoff

- Geomorphological features and land condition

Step 5: Estimate annual water utilization in the village based on water requirement

- For domestic consumption including drinking water
- For livestock
- For crops

Step 6: Estimate water surplus/deficit in a village / watershed

- Input of water into the village/watershed and utilization

2.7 Water Balance Study in 15 villages, Warangal district

The water balance study is being carried out in selected villages by following the above steps. The one of the major limitation of this exercise is not having the estimate of canal water coming into the village area and return flow from irrigation to ground water body. These parameters do play a significant role in estimation and can enrich the overall assessment for annual estimation and increases the acceptance in scientific community, but requires installation of equipment to measure these parameters with intensive involvement in data collection. However, with the sole aim to keep the process simple, given below formula was used to estimate the water balance is each village; (Please refer annexure for village wise details):

Input	Utilization		
Rainfall (in millimeters)	Population (40 lpcpd)		
Total Geographical Area (hectare)	Cattle population (70 lpcpd)		
	Type of crops cultivated and area of each crop		
Run-off 20% (Mm³/year)	Crop type	Area in hectare	Water requirement
Ground water recharge 15% (Mm³/year)	1. Crop – A		
Absorbed by soil – available for plants & evapotranspiration 65% (Mm³/year)	2. Crop – B		
Surface water storage (Mm³/year)	3. Crop – C		
Total water available	Total utilization		
Deficit/surplus of water in village/watershed triggers the process of change. In case of deficit, farmers can be sensitized to adopt water saving techniques in cultivation and also work for harvesting the rain water.			

For this purpose of simplicity a format has been developed in local language (Telugu) that guides the team on how to conduct water balance study by involving community. Upon demonstration in one village by the Delhi team, the trained field team conducted the exercise in the following 8 villages during till now.

No	District	Mandal	Village
1	Warangal	Shayampet	Katrapalle
2	Warangal	Ghanpur Station	Rajavaram
3	Warangal	Parvathagiri	Wadlakonda
4	Warangal	Athmakur	Pasargonda
5	Warangal	Regonda	Gorikothapally
6	Warangal	Shayampet	Gangirenigudem
7	Warangal	Shayampet	Shayampet
8	Karimnagar	Bheemdevarapally	Kothapally

The exercise has contributed significantly in educating the community on water utilization trend and its impact on groundwater reserves. As a result, farmers have expressed concern over the depletion of water resources and are seeking for better management options. As a follow-up exercise, we have planned to initiate a discussion on methods available for improving water use efficiency in managing the crops.

The process adopted for estimating the water balance at micro-watershed level is enumerated below;

- Estimate quantity of water received in the village and the quantity utilized by human beings, animals and agriculture;
  - → The rainfall data was accessed from the Indian Meteorological Department (IMD) available in public domain. This data has been collected from observatories, which

are normally found at district level. In the event, the study area was notlocated close to the observatory; there is possibility of variations in the rainfall data. Nevertheless, in the absence of any reliable records, the IMD data has been used for this analysis.

- For proper estimation ofexisting water utilization practices in the area, we need:
  - → Total human population;
  - → Total Cattle population;
  - → Type of crops cultivated and the area covered for each crop

  Here, the human and cattle population figures have been sourced from the website of the Ministry of Drinking Water Supply & Sanitation (MDWS), Government of India. In cases where the data was not available at site,it was collected from villages through focus group discussions (FGDs).
- Crop details were collected through focus group discussions with farmers:
  - → Datacollection on the availability of water sources in the village (groundwater and surface water sources) for day-to-day village requirements
  - → FGDs were conducted to collect information related totype of crops cultivated in the village and area covered for each crop. This information helps in preparing a list of different crops and area under cultivation.
  - → Listing down of the crop water requirement based on the standard practices followed for estimation.
- During the FGDs data related to water consumed by human and livestock were also collected. Based on the total population and average consumption standards, the total water requirement is estimated. An alternate option is to refer to the guidelines of the Ministry of Drinking Water Supply & Sanitation for per capita water requirement for human and FAO site for the water requirement for cattle and estimate total water requirement.
- Based on the above steps, the water requirement in the project villages could be estimated and presented to the community for triangulation to get their inputs on utilization of water in the village. Participation of people in the exercise minimizes any risk of major deviation in data and also provides a platform for the people raise any clarification and contribute in water resource assessment.
- The quantity of surface water storage could be estimated on the basis of the number of structures available in the village area and the total quantity of water stored by recording average depth of each structure.
- Hydrogeological conditions vary from place to place. Based on the local hydrogeological and geomorphological conditions, the run-off water from the rainfall and percentage of rainfall that is available for ground water recharge can be calculated.
- By adopting the standard formula as explained in the below table, the water balance in the village/watershed area can be assessed.

- Deficit figures suggest adopting appropriate methods for improving water use efficiency for managing the demand. At the same time plan the supply side activities for managing the situation.

Matrix below presents a summary of different tools used for analysis

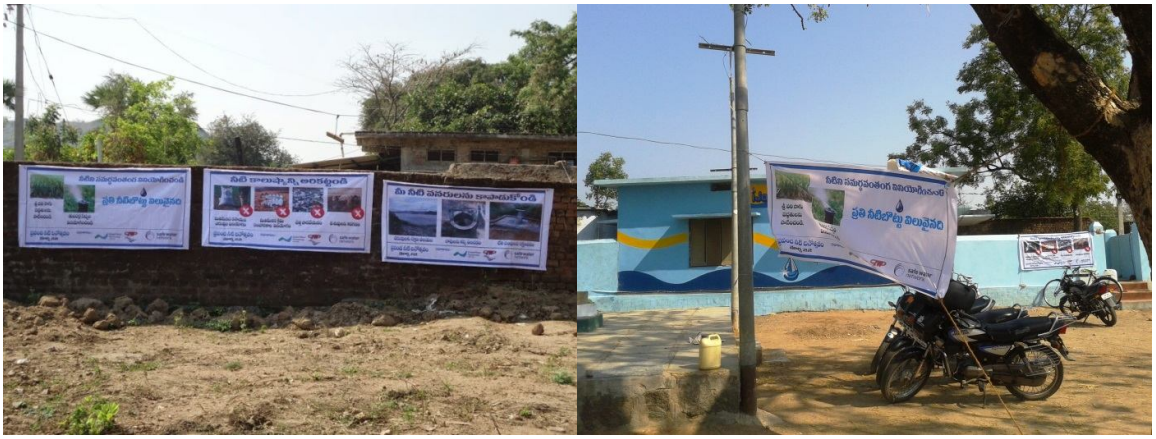
Steps	Description	Tools applied	Data source/specification
1	Understanding of geomorphological settings of the project villages	• Toposheet • Satellite imageries	• Survey of India, ref table for Index • Bhuvan 2D
2	Demarcation of watershed boundaries	• Application of Geographical Information System	• India WARIS site government of India
3	Development of a structure for data inventory, training provision to enumerators in the field to collect data, test formats and methodology of data collection with field team	• Checklist for data collection • Application of GPS to record coordinates • Data collection template • Focus group discussions with the community	• Refer to the Annexure for the format
4	Water Level data collection from observation wells (Pre-monsoon, Post-monsoon and during summer)	• Setting up of observation wells and recording data with the help of water level indicator	• Well Inventory Format
5	Study of land use pattern, soil characteristics, Agriculture practices, geological structures, drainage patterns and other related themes	• Application of Geographical Information System • Focus group discussion for cropping pattern and inputs in agriculture field	• Bhuvan 2D
6	Water requirements for different purpose, sources and utilization pattern estimation	• Reference of standards and supported with primary data	• Structured interview and format
7	Rainfall	• Indian Meteorology Department	• IMD site
8	Preparation of different thematic maps and estimation of area	• Application of Geographical Information System	• Bhuvab 2D

3. INFORMATION EDUCATION AND COMMUNICATION ACTIVITIES

3.1 World Water Day

The World Water Day was celebrated in all 15 project villages during March 13-22, 2014, with the aim to create awareness among the community. We organized the activities as a means to focus the community attention on critical water issues, in terms of the need to conserve the available water resources and water drawal for their agriculture, sustenance of livestock and drinking water and other household consumption needs, and how we can together solve this challenge.

Banners and posters were placed at all iJal Stations in these villages, to raise awareness on the importance of water resources and advocating for the sustainable management of freshwater resources.



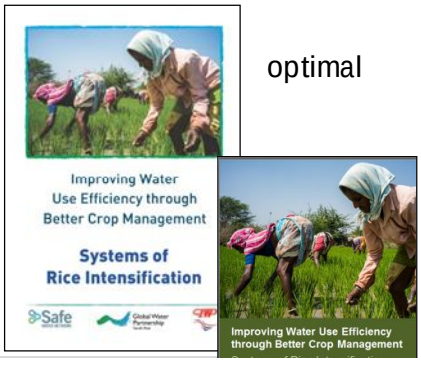
3.2 Application of IEC Tool for Water Balance Study

The participatory exercise of conducting water balance study in the village by involving the community is a good tool to sensitize them on trends related water table depletion, problem related to water scarcity and future challenges, and educate them to adopt appropriate options to manage the available water resources. Therefore, options related to crop water relationship need to be discussed and methods for improving water use efficiency are to be disseminated. The paddy and cotton crops are predominant in the area. These crops require maximum water from the available sources in the area, hence it is planned to focus on IEC activity on these two crops only.

It was then also planned to use available IEC material in public domain to develop a reference guide in local language which could help field executives to share the information on crop-water relationship and options available for improving water use efficiency. In this context WWF, Hyderabad was contacted for reference material on Better Cotton Initiatives, who were already executing a project along with MARI, a local NGO in Warangal District. WASSAN was also contacted for information on Systems of Rice Intensification.

Basis the fact that the paddy crop requires highest quantity of water as compared to other crops cultivated in the area, we have planned to improve the water use efficiency of this crop by educating farmers on **crop management practices** that are widely accepted and recognized for water saving.

This month, Safe Water Network India initiated with the development of IEC tool to sensitize the community on the use of existing water resources, comprising crop management practices in the form of Flipcharts that shows step-by-step visuals of systems of rice intensification. These flipcharts will be made available in each iJal Station village to educate farmers, by our field executives and village youth.



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Another booklet form shall be released shortly after the activity is implemented in all villages, for dissemination.

Format for data collection

Exhibit 1: Format for data collection

IWP_SWNI WRM Flipchart.pdf

Exhibit 2: Flip chart for IEC on better crop management

Exhibit 3: Water balance study in 15 selected villages

Water Balance in 15 Villages