Progress Report
August 2013 - July 2014

Integrated Water Resource Management in Kolar District of Karnataka for Increasing Agricultural Productivity and Improved Livelihoods

Submitted to

Coca–Cola India Foundation for Rural Water Infrastructure

Gurgaon 122 016, Haryana

ICRISAT
Science with a human face

International Crops Research Institute for the Semi-Arid Tropics

This work is being undertaken as part of the CGIAR RESEARCH PROGRAM ON Water, Land and Ecosystems

Table of Contents

Executive Summary

The Kolar district in Karnataka state of India is the hotspot of water scarcity. The Kolar watershed, comprising nine villages and covering nearly 1,333 ha, was selected for developing a benchmark site in Kolar district. From 2012 onwards, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) along with district administration, Government of Karnataka, MYRADA a non-governmental organization, and local community started implementing watershed interventions in this area.

As an entry point, community mobilization and rapport building has been achieved through formation of watershed committee in collaboration with MYRADA under guidance and support of ICRISAT. The required information and knowledge sharing is achieved through regular meetings (formal and informal). Regular interactions with the community have built strong trust with each other resulting in effective planning and implementation of watershed activities in target villages.

Science led interventions comprised soil and water conservations practices, productivity enhancement activities, crop diversification and intensification, integrated nutrient and pest management and other livelihood based activities. The village community and the watershed committee identified potential locations for where different soil and water conservation practices such as farm ponds could be made. Number of farm ponds were constructed to store excess runoff water generated from farmers' fields. Total 16 farm ponds were constructed which all together developed 7000 m3 of storage capacity.

In-situ soil and water conservation practices have been promoted. Improved variety of seeds of groundnut and ragi was introduced and this has improved their crop yield by 23-26%. Steps to enhance farmer's capacity by conducting training program, exposure visits and field days were are also undertaken.

Background and Objectives

Kolar district is situated in Eastern Dry Zone of Karnataka state. Groundwater depletion is major concern for agriculture in Kolar district. Groundwater is being used for irrigating cash crops such as tomato, chili and mulberry. In addition, wide spread plantation of *Eucalyptus* has been main reason for depletion in groundwater recharge. The present status of groundwater level is greater than 300 m.

In the absence of drinking water and livelihood opportunities, a large portion of rural community migrated to nearby cities. Water for agriculture as well as domestic water sectors were adversely affected. Urban and rural communities largely depended on outside water source and private suppliers such as tankers for domestic use, especially during summers. Cattle were abandoned due to shortage of water and less fodder availability.

In such conditions, watershed development program is an effective intervention which could enhance groundwater recharge and reduce water stress situation. The Coca-Cola India Foundation for Rural Water Infrastructure and ICRISAT led consortium along with MYRADA, farmers and Government of Karnataka identified a meso-watershed in Kolar taluk of the district. This was a pilot site for improving water use efficiency and groundwater recharge and strengthening ecosystem services through community watershed

management program. The watershed development program in these selected villages started from 2012 onwards.

The specific project objectives are:

- Enhance water availability in target villages through rainwater harvesting, recharging of the wells and reuse of waste water to demonstrate that science-based interventions can increase water availability and improve groundwater quality;
- Enhance water use efficiency through various good agricultural practice (GAP) for sustainable management of water and land resources and increasing overall agricultural productivity; and
- Establish a pilot project demonstrating impact within five years of its inception and transform them as model villages with more interventions in different phases.

Strategy and Approach

The consortium approach is adopted to enhance the water resources and resource use efficiency through integrated watershed management. The important partners in ICRISAT led consortium are district administration, Government of Karnataka, MYRADA an NGO and community-based organizations. This project has adopted four principles: convergence, capacity building, collective action and consortium for technical backstopping. Ongoing scheme from GoK such as Bhoochetana is integrated into watershed program. Participatory research and development (PR&D) will be the strategy to build the capacity of different stakeholders viz. community, NGO staff and line department staff. The principle of demand driven activities to ensure tangible economic benefits will be adopted.

Challenges

Agro Climatic Characterization of Kolar, Karnataka

As per the classification of the National Bureau of Soil Survey and Land Use Planning (2000), Kolar area falls in the hot moist semi-arid Agro Ecological Sub Region (AESR) with medium to deep Red loamy soils. Available water capacity is low. Summer showers are experienced at Kolar in May. Though the southwest monsoon sets by the first week of June, rainfall more than the PET is received only during middle of September to third week of October. First week of August is likely to be dry, but may not adversely affect the crops. During the period from last week of August to the first week of September, average rainfall is comparatively low and the rainfall expected at 60% probability is almost zero. This period coincides with the flowering and late flowering phase of several crops, which are likely to experience severe moisture stress. Annual PET is 1638 mm and the annual average rainfall is 711 mm.

Site Selection

In Kolar district, based on our earlier work and close interactions with the state government department officials in Bangalore we have visited the potential sites. Secondary data sets were provided by the government officials and through rapid survey of the potential villages a meso scale-watershed has been selected (**Figure 1**). Participatory selection of project location was taken up by the team comprising the revenue officials, department of agriculture, watershed and ICRISAT officials along with *gram panchayat* members and

farmers. The proposed watershed is spread over 1333 ha area and covers 8 villages (Muduvatti, Nerahalli, Dandiganhalli, Shettikthanuru, Shettiganahalli, Konepura, Jangalahalli and Papenahalli). Following are the various activities done during November 2012 to July 2013.

Figure 1. Deputy Commissioner of Kolar Mr Manoj Kumar Meena and other officials involved in the identification of project location

Baseline Survey

In each of these villages, available secondary data was collected from village accountant and Gram panchayat on land use pattern, demographic composition, agricultural practices, etc. We also conducted a household survey based on random sampling technique. About 20 per cent of the households have been covered for the survey which includes landless and women. Well trained data enumerators have collected the information. The information was cross checked by Scientific Officer and Research Technicians located at the site and an NGO (MYRADA) helped in identifying, training and monitoring enumerators.

Registration of Farmers using Tablet-based Application

We have conducted preliminary survey to record basic information of each households in watershed area. Android based tablet devices and ODK Collect app were used to record farmers' information along with their photographs.

Baseline Information

The proposed watershed is spread over 1333 ha area with 1411 households and covers eight villages. The eight villages of Vakkaleri Hobli are in vicinity of Kolar town that is about 6-16 km distance. The selected villages in the watershed are having dry climate and average rainfall is about 710 mm. The population represents both forward and backward caste, however, majority of the population is from forward caste. About 67% of households are in small, 27% in medium, 3% each in big and landless category (Table 2). Watershed covers both common land and arable land. The arable land in the watershed is about 55 per cent of total geographical area. The common land which is about 25 per cent is the source of grazing. The watershed villages were geo-referenced and the details of the villages selected, drainage network and digital elevation map are shown in Figure 2 and Figure 3.

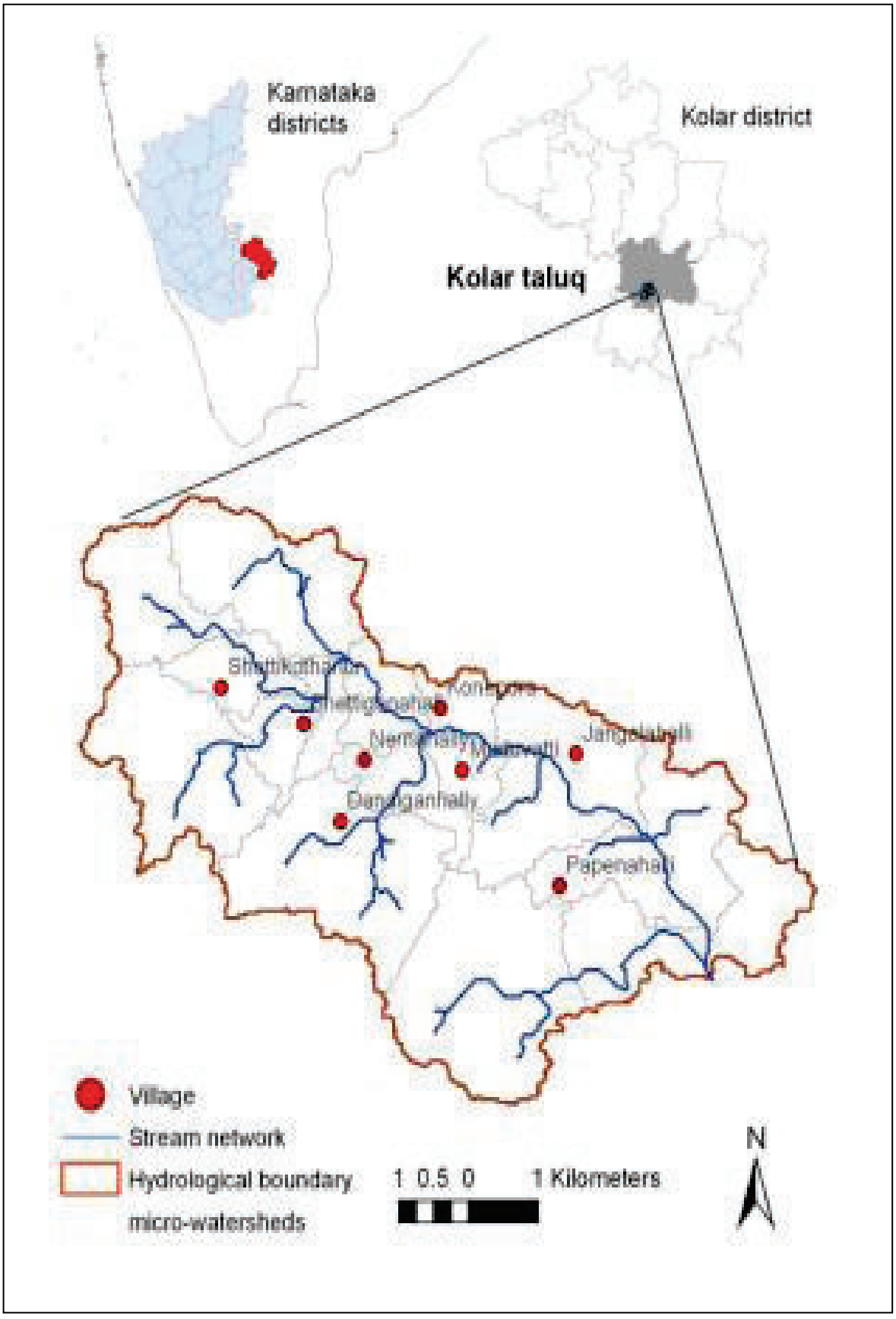

Figure 2. Location of study villages, stream network and micro-watersheds of selected pilot area

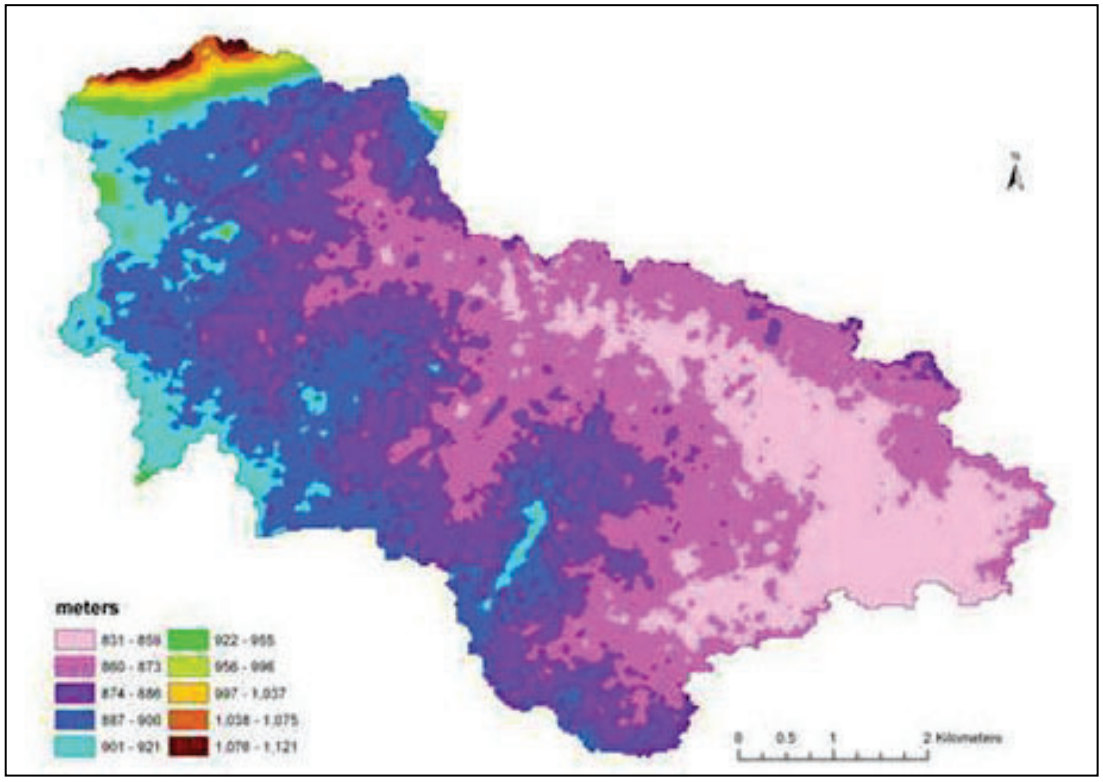

Figure 3. Digital Elevation Model (DEM) of selected villages in Kolar Taluk.

Formation of Watershed Committee

In 2012, an ICRISAT–led consortium along with MYRADA, farmers and district administration selected Kolar watershed for enhancing water resources availability and optimizing agricultural productivity. Villagers and watershed committee members were involved from the project inception stage. Watershed committee of eight villages were formed (**Table 1**) to implement the watershed work. Farmers are the primary stakeholders and beneficiaries. Hence, involvement of community was important for successful execution of project activity/interventions and to ensure long term sustainability of the project. Women and SC/ST candidate and members from Gram Panchayat were also involved in the formation of watershed committee, as per common guidelines.

Several *gram sabha* meetings were conducted with farmers to start the process of watershed committee (WC) formation. As per the guidelines 50% of members (7) are women and appropriate number of other landless and SC represent in the WC. Mr. Vemanna as a President of "Markandeya Samgra Jala Sampnmula Niravahane Samithi" Watershed committee was elected unanimously by committee members and villagers. Bank account in the name of WC is opened.

The committee was constituted in an open meeting and the objectives were briefed clearly. The committee members and villagers were involved at each and every stage of project planning and execution of proposed interventions. For example, selection and construction of water harvesting sites and types of structure, procurement of the materials, record keeping, and verification of bills and payment delivery etc. were handled by the watershed committee under the guidance of the consortium team. Transparency at every step established good rapport and resulted in large and active participation of the village community in watershed management and development.

With the technical backstopping of ICRISAT and MYRADA staff, potential locations for soil and water conservation structures were identified by the watershed committee and villagers themselves. Similarly, decisions on procurement of quality seeds, planting materials and other inputs were taken by the committee in open meetings. Right approach and knowledge based entry point enabled the village community to take up the responsibility, bring transparency and accelerate the execution process.

Table 1. Watershed Committee members of Markandeya Samgra Jala Samnmula Niravahane Samithi Watershed Committee, Muduvatti, Kolar.

S. No.	Member	Father /Husband	Village	Age	Position
1	S C Vemanna	Chokka chowdapa	Settikottanur	68	President
2	SV Mariswmy	Venkataramappa	Settiganahalli	65	Vice president
3	S Manjunath	Somanna	Kolar	35	Member Secretary
4	Sujatha	Chikkamuniswamy	Konepura	37	Treasurer
5	Marakanadappa	Venkateshappa	Jangalahalli	30	Member
6	MKS Babu	Kenchappa	Muduvatti	35	Member
7	M Nagaraju	Muniyappa	Konepura	49	Member
8	Byrappa	Reddappa	Dandiganahalli	50	Member
9	H Kolarappa	Munishamappa	Nernahalli	52	Member
10	Narayanamma	Narayanappa	Nernahalli	45	Member
11	Joythi	Manjunath	Muduvatti	25	Member
12	Venkatamma	Narayanappa	Dandiganahalli	50	Member
13	SR Sudha	V.Nagaraj	Settiganahalli	32	Member
14	T Arunamma	Rajanna	Jangalahalli	32	Member
15	Kempamma	Pillabasappa	Settikottanur	45	Member

Formation of Community-based Organizations (CBO) Capacity-building

Being a pilot project, the capacity building of various stakeholders was given very high priority. Capacity building initiative plays very important role in human resource development. The capacity building initiatives include training to CBOs, farmers and PIAs, thru hands-on trainings in participatory soil samplings, field demonstration trials like varietal, nutrient management, soil and water conservation, rainwater conservation systems, exposure visits to other watersheds, providing training materials and etc (Figures 4, 5 & 6).

Figure 4. Kolar district JDA and taluka ADA interacting with farmers in Mudavatti, Kolar

Figure 5. Meeting with SHGs members; farmers from Kolar visit Kothapally watershed.

Figure 6. Various capacity building trainings to SHG members in 2014

Rainwater Harvesting

Groundwater level is very deep in Kolar district, however some vegetable farmers are pumping water for cultivation. Constructing low-cost water harvesting structures is one of the important interventions considered for groundwater recharge (**Figure 7 and Figure 8**). These structures harvest substantial amount of surface runoff, allow them to percolate into aquifer and facilitate groundwater recharge. Through this project, farm ponds are promoted in these villages. Farm ponds serves as dual purpose as water storage and as groundwater recharge.

A list of water harvesting structures constructed during 2012 and 2013, along with their storage capacity, is shown in Table 2. Nearly 7000 m3 of storage capacity was developed which would facilitate on average 20,000 m3 of runoff water to groundwater recharge.

Figure 7. Pictures showing farm pond and Gokatte (percolation tank) constructed at different locations in watershed for rainwater harvesting during monsoon period

Figure 8. Pictures showing before and after construction of water harvesting structures in different watershed villages in Kolar

Table 2. Details of water harvesting structures and storage capacity developed in Kolar watershed, 2013-2014.

Structure	Number	Net Storage capacity (m^3)
Farm ponds	16	7000
Field drain	500m	-
Total effective storage capacity (m^3)		20000

Productivity Enhancement Interventions

The yield gap analysis undertaken by the ICRISAT revealed that large yield gap exists for all the major rainfed crops grown in the semi-arid Tropics. Further, there is a potential of increasing the productivity by two to three folds using available technologies in the farmers' fields (Wani et al., 2009; 2012). Soils in rainfed areas are not only water scarce but also deficient in essential nutrients as 50-90% of the farmers' fields are found deficient in sulphur, zinc and boron (Table 3 and Table 4).

Table 3. Soil fertility status in eight watershed villages, Kolar

Villages	EC (ds/m)	Exch-K (mg/kg)	Ols-P (mg/kg)	Org-C (%)	Avail-Zn (mg/kg)	Avail B (mg/kg)	Avail-S (mg/kg)
Jangalahalli	0.13	177	44.6	0.39	2.73	0.65	7.4
Dandiganahalli	0.08	138	51.5	0.32	1.89	0.36	10.3
Konepura	0.07	115	50.4	0.32	1.60	0.46	3.9
Muduvatti	0.25	240	79.3	0.48	4.69	0.82	12.6
Nernahalli	0.13	116	56.0	0.40	3.16	0.50	7.6
Papenahalli	0.22	222	67.3	0.43	3.18	0.83	15.0
Shettiganahalli	0.18	154	77.9	0.39	2.98	0.52	13.5
Shettikottanuru	0.15	110	43.1	0.36	2.42	0.47	7.7
Mean of villages	0.14	146	57.6	0.37	2.65	0.53	9.6

Table 4. Soil health Status: Per cent farmers' fields deficient in nutrients, Kolar.

District	% farmers fields deficient					
	OC	Av P	Av K	Av S	Av Zn	Av B
Jangalahalli	75	0	0	75	0	38
Dandiganahalli	88	0	13	88	0	88
Konepura	100	0	13	100	0	88
Muduvatti	67	0	0	0	0	0
Nernahalli	86	0	0	71	0	71
Papenahalli	80	0	0	20	0	20
Shettiganahalli	81	6	6	69	0	63
Shettikottanuru	87	7	33	87	0	67
Mean of watershed	84	3	11	73	0	61

Tropicuture an improved farm machinery was used for sowing on Broadbed and furrow system of landform as a in-situ moisture conservation practice (Figure 9a, 9b).

Figure 9a: Tropicuture used for sowing on BBF, Mudavatti, Kolar; Figure 9b: Media coverage of project activities.

In this context, farmers' participatory trials were conducted during *Kharif* 2012 to demonstrate the impact of micro nutrients (Zinc and Boron) application on groundnut crop. Crop cutting experiments were conducted for estimating crop yield in improved and farmers managed field practices. Farmers contributed 50% of fertilizer cost [Agribor (B) and Zinc Sulphate ($ZnSO_4$)] and local groundnut variety is grown at nine watershed locations. It was observed that application of B and Zn increased crop yields by 23-26 % over control plots (Table 5).

Table 5. Impact of balanced micronutrient application on groundnut and ragi during *Kharif* – 2013.

Crop	Treatment	Pod yield (kg/ha)
Groundnut	Improved Practice (IP) (RDF* + Agribor + Zink Sulphate)	2450 (26)
	Farmers Practice (FP) (RDF)	1950
Ragi	Improved Practice (IP) (RDF* + Agribor + Zink Sulphate)	2860 (23)
	Farmers Practice (FP) (RDF)	2320

* RDF: Recommended Dose of Fertilizers; crop variety: local; * figures in parenthesis are % increase over control.

During 2014, productivity enhancement and farmer participatory varietal trails have been taken up with Pigeonpea (Asha), castor, groundnut (ICGV 91114) with balanced nutrient application. The area sow during 2014 is very low (<30%) in watershed due to poor rainfall. Braoadbed and furrow land management was implemented using tropicultor.

Wastewater Treatment and Reuse

Water scarcity is particularly acute in Kolar where an urgent need exists to enhance water resource availability and also for demand management. Water availability for food production is not only restricted to fresh water but waste water re-use is also emerging as an integral part of demand management.

With increasing domestic water use, quantity of gray/wastewater is increasing in the same proportion. Almost 90% of total water supplied for domestic use gets generated as wastewater which could be diverted for agriculture purpose. There are several benefits and challenges on wastewater use. Grey water is a valuable resource for encouraging plant growth because of its higher nutrient content. Grey water use in agriculture contributes significantly to the supply of fresh fruit and vegetables to urban markets. Literature shows that the problem of blue green algae in sewerage ponds and water reservoirs is significantly reduced by house hold use of grey water.

In the above context, we have planned to harness the domestic wastewater and use it for vegetable cultivation after the primary treatment. Therefore one constructed wet-land setup is constructed in Mudavatti village (Figure 10).

Figure 10. Constructed wetland for domestic wastewater treatment in Mudavatti village, Kolar

About ICRISAT

International Crops Research Institute for the Semi-Arid Tropics

ICRISAT is a member of the CGIAR Consortium

The **International Crops Research Institute for the Semi-Arid Tropics** (ICRISAT) is a non-profit, non-political organization that conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners throughout the world. Covering 6.5 million square kilometers of land in 55 countries, the semi-arid tropics have over 2 billion people, of whom 644 million are the poorest of the poor. ICRISAT innovations help the dryland poor move from poverty to prosperity by harnessing markets while managing risks – a strategy called Inclusive Market-Oriented Development (IMOD).

ICRISAT is headquartered in Patancheru near Hyderabad, Andhra Pradesh, India, with two regional hubs and five country offices in sub-Saharan Africa. It is a member of the CGIAR Consortium. CGIAR is a global research partnership for a food secure future.

ICRISAT-Patancheru (Headquarters)
Patancheru 502 324
Telangana, India
Tel +91 40 30713071

ICRISAT-Liaison Office
CG Centers Block, NASC Complex
Dev Prakash Shastri Marg
New Delhi 110 012, India

ICRISAT-Addis Ababa
C/o ILRI Campus
PO Box 5689
Addis Ababa, Ethiopia

ICRISAT-Bamako (Regional hub WCA)
BP 320, Bamako, Mali

ICRISAT-Bulawayo
Matopos Research Station
PO Box 776, Bulawayo, Zimbabwe

ICRISAT- Kano
PMB 3491
Sabo Bakin Zuwo Road
Tarauni, Kano, Nigeria

ICRISAT-Lilongwe
Chitedze Agricultural
Research Station
PO Box 1096, Lilongwe, Malawi

ICRISAT-Maputo
C/o IIAM, Av. das FPLM No 2698
Caixa Postal 1906
Maputo, Mozambique

ICRISAT-Nairobi (Regional hub ESA)
PO Box 39063, Nairobi, Kenya

ICRISAT-Niamey
BP 12404, Niamey
Niger (Via Paris)

About ICRISAT: **www.icrisat.org**

ICRISAT's scientific information: **http://EXPLOREit.icrisat.org**