Annual Report

Improved Livelihoods through Community Water Resources Management in Community Watersheds

Submitted to

SABMiller India

Gurgaon, India

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

Contents

Executive Summary

To address the issues of water scarcity and poverty in the rural areas surrounding the SKOL Breweries located in Medak district, the project entitled, "Improved Livelihoods through Community Water Resources Management in Community Watersheds" is supported by the SABMiller, India. The overall goal of this initiative is to develop sustainable water resources in the surrounding areas of the factory while contributing to improving the livelihoods of the people dependent on agriculture.

The specific objectives of the project were as follows:

1. To improve agricultural productivity in selected surrounding villages by adopting rainwater conservation and harvesting as well as its efficient use for improving livelihoods, and
2. To build capacity of the farmers in the selected villages to develop sustainable water management practices that enhance groundwater availability and use efficiency.

In 2014-15, community participation was ensured in the new villages (Bommareddygudem, Upparigudem and Chowtakur) by organizing village meetings and conducting transect walks and watershed committees were formed for preparation and execution of action plans. Summary of the chemical analysis of soil samples (80 fields) taken from farmers' fields in Sulthanpur, Korpole and Vendikol villages showed that the fields had a wide range in pH (6.7-8.8) and EC (0.06-1.43 dS m-1); were low in organic C (0.18 to 0.86%); low to medium in Olsen-P; and generally adequate in exchangeable K. Widespread deficiency of multiple nutrients such as S, B, and Zn were observed in farmers' fields where as summary of the chemical analysis of soil samples (90 fields) taken from farmers' fields in the three new villages (Bommareddygudem, Upparigudem and Chowtakur) showed that the fields had a wide range in pH (5.9-9.1) and EC (0.04-0.73 dS m-1), were low in organic C (0.18 to 1.0%), low to medium in Olsen-P and generally adequate in exchangeable K. Widespread deficiency of multiple nutrients such as S, B, and Zn were observed in farmers' fields which were responsible for low crop yields along with lower water and nutrient use efficiencies. All together 195 loose boulders structures (69 during 2014-15) and 51 rock-fill-dams (17 during 2014-15) were constructed in the villages to conserve rainwater as well as to minimize gully erosion. Total ten numbers of modified *Gabion* structures with masonry walls to avoid sinking and sliding in black soil areas were constructed (3 nos during 2014) in deep gullies to protect soil erosion and detain widening and deepening gullies. These structures also were used to store surface runoff. Eight masonry checkdams, two in Fasalvadi, three in Shivampet, one in Sulthanpur and two in Korpole (3 during 2014-15) were constructed to harvest and store runoff water as well as to increase groundwater recharge. Eight low-cost mini percolation tanks were constructed in Shivampet (1 during 2014) and Sulthanpur (3 during 2014-15) villages to harvest and store runoff water as well as to increase the equity of benefits to more number of farmers in the watershed. Three farm ponds were made one each in Shivampet, Venkatakishtapur and Vendikol (1 during 2014) villages to harvest as well as to store runoff water. Eight sunken ponds were made in Fasalvadi (3 nos.), Shivampet (2 nos. during 2014) and Sulthanpur (3 nos. during 2014-15) villages to trap sediment and to store runoff water. Runoff water was diverted into 8 dry open wells in Fasalvadi (5 nos.), Sulthanpur (2 nos. during 2014-15) and Korpole (1 during 2015) villages to rejuvenate defunct open wells as well as to bring them into use. Water absorption trenches (76 nos.

during 2014) were dug in Chakriyal village to trap runoff water as well as to recharge soil profile.

All the soil and water conservation measures and water harvesting structures constructed during the project period, till end of March 2015, have created additional storage capacity of more than 68,000 m^3 in the project villages. This will result in an estimated groundwater recharge of 170,000 m^3 or more water every year due to multiple refilling of rainwater harvesting structures. To assess the impact of water harvesting structures (WHS) on groundwater recharge, 18 bore wells in Fasalvadi and Shivampet villages were georeferenced and groundwater levels were recorded. There was significant improvement in the groundwater levels as well as in availability of water due to groundwater recharge with the additional storage capacity created as well as harvested water stored in these structures. Agro-forestry is promoted in targeted villages and more than 50,000 saplings of Teak, Gliricidia, Pongamia and Raintree were planted (20,000 during 2014) in all the villages to increase greenery, availability of green leaf manure and high-value timber wood. More than 11,000 saplings of different horticultural plants (2400 during 2014) were planted in the seven villages by farmers in their backyards to increase the availability of fruits and thus, nutrition. Leguminous forage seed (100 kg) of *Stylosanthes hamata* was broadcasted on field bunds and grazing lands in Sulthanpur and Vendikol villages during 2014 to stabilize the bunds as well to increase the availability of nutritious fodder.

Based on farmers' requests, the project supplied improved seeds of maize, pigeonpea and 4550 kg of gypsum, 1770 kg of zinc sulphate and 143 kg of agribor and 112 farmers used these inputs in eight villages. Soil test-based balanced nutrition increased cotton yield by 18% to 29% with mean benefit cost ratio of 6.4 in Venkatakishtapur village; 13% to 20% with mean B:C ratio of 4.3 in Vendikol village; and 12% to 16% mean B:C ratio of 3.7 in Korpole village. Cane yield in sugarcane increased by 6% to 13% with mean benefit cost ratio of Rs 6.4 in Fasalvadi village and 7% to 11% with mean B:C ratio of 6.7 in Chakriyal village. Paddy grain yield increased by 13% to 22% with mean B:C ratio of 2.2 in Fasalvadi village; 18% to 23% with mean B:C ratio of 2.3 in Venkatakishtapur village; 14% to 24% with mean B:C ratio of 2.1 in Sulthanpur village; 15% to 24% with mean B:C ratio of 2.5 in Upparigudem village; 22% to 25% with mean B:C ratio of 2.2 in Vendikol village; 17% to 24% with mean B:C ratio of 2.2 in Korpole village; and 13% to 27% with mean B:C ratio of 2.3 in Chowtakur village on each rupee of additional investment made as compared to farmers' practices.

In collaboration with BAIF institute for Rural Development (BIRD), a total of 1659 cattle (1309 buffaloes and 350 cows) were artificially inseminated, of which 789 cattle (632 buffaloes and 157 cows) have confirmed pregnancy in the diagnosis test, and 409 cattle (337 buffaloes and 82 cows) have so far given birth to cross breed calves. Priyadarshini women SHG in Fasalvadi village sold 1,570,318 kg of spent malt (till March 2015) making a net profit of Rs. 72014 during 40 months period after meeting the expenses of transportation, handling and rent for storage and labor charges for distribution. Fifty eight beneficiary farmers are utilizing the spent malt (1437 kg/day) and feeding 391 milch animals. Increased gross income on milk production is about Rs. 12565 per day with a net income of Rs. 8973 per day in the village. In total, village is getting increased net income of Rs. 269175 per month with an average net income of Rs. 4640 per family. Similar activity was started by the Tejasvi women SHG on 17 June 2013 in Adarsha watershed, Kothapally village in Ranga

Reddy district and provided 836,648 kg of spent malt to beneficiary farmers and SHG earned net profit of Rs. 98,340 during 21 months period after meeting all the expenses. Totally 65 beneficiary farmers are utilizing the spent malt (1390 kg/day) and feeding 285 milch animals. Increased gross income on milk production is about Rs. 21,120/-day with a net income of Rs. 16,950/- day in the village. In total, village is getting increased net income of Rs. 5, 08,530/- per month with an average net income of Rs. 7,820/- per family.

One hundred and forty-one women farmers from SABMiller villages were brought to participate in the women farmers' day conducted at ICRISAT on 12 September 2014. One-day exposure visit-cum-training program was organized for SABMiller farmers on 5 and 6 November 2014 at Kothapally watershed and on ICRISAT campus at Patancheru to enhance their capacity. A total of 119 farmers and 2 WDTs of READ-NGO participated in the program.

Background

Water is becoming a scarce natural resource with increasing population pressure and changing food habits, especially in developing countries. Blue water is decreasing in almost all the river basins of India and that holds true also for Krishna and Godavari basins in southern India. Medak District of Telangana State is a hotbed of poverty, hunger, malnutrition, food insecurity, water scarcity and land degradation and it is typically located in the semi-arid tropics. Annual average rainfall of the region is 800 mm with great monsoonal uncertainty. SABMiller, India's second largest beer company also has one of its breweries, Charminar Breweries, located in the Manjeera river basin of Godavari basin, and it runs a risk of poor water availability especially during dry years. Projections of greater demand for water among different sectors, such as agriculture, industry, domestic and environment is bound to put more pressure on scarce and finite water resources. Although water is limiting, more than the quantity of water per se rainwater management is critical for the overall management of water resources.

There is a direct relationship between agricultural productivity and economic growth which translates into poverty reduction. Nearly one per cent increase in agricultural productivity translates into 0.6 to 1.2% decrease in the number of absolute poor. Integrated water resource management is the key intervention that needs to be implemented for addressing problems of drylands. Therefore the current project is targeted towards managing water resources and strengthening the ecosystem services in the region. This project also aims to improve livelihoods of the community in the ten villages targeted around the brewery.

This initiative aims to develop strategies for sustainable management of water resources in the region by adopting integrated water resources management (IWRM) at the watershed level. Community participation is the main pillar for any sustainable development of natural resource management in such regions. The ICRISAT consortium with a local NGO, Rural Education and Agriculture Development (READ), government agencies, District Water Management Agency (DWMA), and farmers implemented science-led interventions for enhancing water resources availability and its efficient use. This report captures the details of various interventions, activities implemented during the year (2014-15) and its impact on water resources availability, income and livelihood status.

Goal and Objectives

The overall goal of this initiative was to develop sustainable water resources in the surrounding areas of the factory while improving the livelihoods of the people dependent on agriculture.

The specific objectives of the project are to:

1. Improve agricultural productivity in select surrounding villages by adopting rainwater conservation and harvesting, as well as efficient use of water for improving livelihoods; and
2. Build capacity of the farmers in the selected villages so as to develop sustainable water management practices that enhance groundwater availability and use efficiency.

Institutional Arrangement and Consortium Partners

- **ICRISAT** and **SABMiller India (SKOL)** recognizing the complementarity of their objectives, entered into a Memorandum of Agreement (MoA) in August 2009 for collaborative activities, such as conservation and harvesting of rainwater and increasing water use efficiency for agricultural production and sustainable development.
- **ICRISAT** and **Rural Education and Agriculture Development (READ)** have entered into a Memorandum of Agreement to cooperate on social mobilization and to provide motivation and training for the local community to implement improved practices for agricultural production.
- Watershed Committee (WC) and village sub-committees in all the ten villages were formed as per the common watershed guidelines of the Government of India.
- Self-help groups (SHGs) were formed in all the villages.

The consortium partners are:

- READ, an NGO
- District Water Management Agency (DWMA), Medak, Government of Telangana State
- Watershed committee and village organizations
- ICRISAT
- BAIF Development Research Foundation – BIRD (BAIF Institute for Rural Development)
- SABMiller India.

Project Strategy

- The Integrated Genetic and Natural Resource Management (IGNRM) approach was adopted to bring sustainable management of water and enhanced livelihoods within the watershed.
- A consortium approach used to implement holistic and integrated development of the watershed.

- We started project execution through a knowledge-based entry point for building rapport with the communities. Necessary inputs for demonstration were made available on the principle of users pay with an incentive or farmers need to pay for material support, and project provides a small incentive.
- Use of demand driven interventions rather than supply driven provision of technologies and products.
- We ensured that small and marginal farmers as well as women groups (most vulnerable and neglected groups among the village community) were involved in the project's activities.
- Project targeted with enhancing rainwater conservation and water use efficiency while improving rural livelihoods.
- Participatory monitoring and evaluation adopted.
- We conducted farmers' participatory research for development (PR4D) and adopted the inclusive market-oriented development (IMOD) approach.
- We promoted microenterprises as income-generating activities for enhancing incomes of community members.

Community Participation

Village meetings were organized in Chowtakur, Bommareddygudem and Upparigudem villages (Figure 1) in June to explain about the SABMiller-ICRISAT initiative and its objectives. Further meetings with farmers and SHG members were organized in July to identify constraints pertaining to water availability as well as crop productivity. Village communities participated in the meetings actively and identified important issues and problems in three villages on surface and groundwater availability, depth of groundwater table, crop productivity and related agricultural issues. In general, agricultural productivity is poor which is mainly due to poor understanding of water management and fertilizer use. Participatory group discussions identified the constraints, potential solutions, priorities of the community and willingness of the community to work together through the proposed initiative. The group discussed potential locations for water harvesting structures, soil and water management practices and other constraints for increasing crop production in their villages.

Figure 1. Village meetings conducted in Chowtakur (left) and Bommareddygudem (right) villages

Soil Samples Collection and Analysis

Knowledge- and science-based entry point activity of soil samples collection and analysis was carried out and information about soil fertility constraints and soil test-based balanced fertilizer application for different crops was provided, and distribution of soil health cards was done in the Gram Sabha to build rapport and confidence with farmers in the villages. Soil samples were collected from farmers' fields in Sulthanpur, Korpole and Vendikol villages in Pulkal Mandal, Medak district during March 2014, by adopting a stratified random sampling methodology. Farmers in village meetings identified the fields to be sampled and collected soil samples from the 20 selected farmers' fields in Sulthanpur, 40 farmers' fields in Korpole, and 20 farmers' fields in Vendikol villages for chemical analysis in order to diagnos.e nutrient constraints to crop productivity. Soil samples were analyzed in the ICRISAT laboratory and the results of soil analyses were discussed and explained to farmers in the respective villages through Gram Sabha in the first week of July and soil health cards printed with the soil test results and recommended soil test-based balanced nutrition required for different crops (Appendix 1) were distributed to all the farmers (Figure 2). A summary of the chemical analysis of soil samples (80 fields) taken from farmers' fields in the three villages showed that the fields had a wide range in pH (6.7-8.8) and EC (0.06-1.43 dS m-1), were low in organic C (0.18 to 0.86%), low to medium in Olsen-P and generally adequate in exchangeable K. Widespread deficiency of multiple nutrients such as S, B, and Zn were observed in farmers' fields which were responsible for low crop yields along with lower water and nutrient use efficiencies (Table 1).

Table 1. Summary of soil test results in the project villages

Village		pH	EC (dS m^{-1})	Organic C (%)	Olsen P (mg kg^{-1})	Exch. K (mg kg^{-1})	Extractable nutrient elements (mg kg^{-1})		
							S	Zn	B
Sulthanpur	Mean	7.8	0.18	0.45	10.5	151	9.5	0.69	1.99
	% fields deficient			70	25	5	55	70	30
Korpole	Mean	7.9	0.36	0.44	14.9	216	27.5	1.31	1.13
	% fields deficient			70	35	5	48	35	30
Vendikol	Mean	7.9	0.14	0.33	7.8	263	15.1	0.80	1.06
	% fields deficient			100	40	0	90	80	35
Bommareddyg udem	Mean	7.5	0.18	0.53	7.7	118	17.0	1.15	0.57
	% fields deficient			50	50	20	45	50	45
Upparigudem	Mean	7.9	0.16	0.42	7.7	79	11.5	0.70	0.55
	% fields deficient			65	45	25	70	85	60
Chowtakur	Mean	7.6	0.17	0.42	14.6	198	21.9	0.59	0.88
	% fields deficient			70	8	5	55	70	35

Figure 2. Soil health cards distribution in Korpole (left); and Vendikole (right) villages

Similarly soil samples were collected from new villages (Chowtakur, Bommareddygudem and Upparigudem) during June 2014, by adopting the stratified random sampling methodology (90 fields). In village meetings farmers identified the fields to be sampled and soil samples were collected from the selected 50 farmers' fields in Chowtakur, 20 farmers' fields in Bommareddygudem and 20 farmers' fields in Upparigudem villages for chemical analysis to diagnose nutrient constraints to crop productivity (Figure 3). Analyses of soil samples were completed in ICRISAT laboratory and soil health cards are under preparation. A summary of the chemical analysis of soil samples (90 fields) taken from farmers' fields in the three new villages showed that the fields had a wide range in pH (5.9-9.1) and EC (0.04-0.73 dS m-1), were low in organic C (0.18 to 1.0%), low to medium in Olsen-P and generally adequate in exchangeable K. Widespread deficiency of multiple nutrients such as S, B, and Zn were observed in farmers' fields which were responsible for low crop yields along with lower water and nutrient use efficiencies (Table 1).

Figure 3. Soil samples collection in Bommareddygudem (left) and Upparigudem (right) villages

Soil and Water Conservation and Agro-forestry Interventions

Consortium partners ICRISAT, READ-NGO and the village community discussed and prepared detailed work plans for implementing various soil and water conservation practices in targeted villages during 2014-2015. The team had identified suitable sites/locations for undertaking various soil and water conservation practices and for constructing water harvesting structures. All the works were undertaken by the Watershed Committee through community involvement (Tables 2 and 3).

- Altogether 195 loose boulder structures (69 during 2014-15) and 51 rock-fill dams (17 during 2014-15) were constructed (Table 2) in Fasalvadi, Shivampet, Venkatakishtapur, Sulthanpur, Korpole and Vendikol villages (Figure 4) to conserve rainwater as well as to minimize gully erosion.
- Ten modified Gabion structures with masonry walls to avoid sinking and sliding in black soil areas (shrinking and swelling types) (Figure 5) were constructed in Fasalvadi, 5 (2 during 2014) in Venkatakishtapur, 2 in Shivampet, 3 numbers (1 during 2014) in deep gullies to protect soil erosion and hold up widening and deepening gullies. These structures were also used to store surface runoff.
- Eight masonry checkdams, two in Fasalvadi, three in Shivampet , one in Sulthanpur and 2 in Korpole (3 during 2014-15) were constructed (Figure 6) to harvest and store runoff water as well as to increase groundwater recharge.

Figure 4. Rock-fill dam in Korpole village

Figure 5. Gabion structure in Shivampet village

Figure 6. Masonry checkdams with stored runoff water in Sulthanpur (left) and Fasalvadi (right) villages

- Eight low-cost mini percolation tanks were constructed in Shivampet (1 during 2014) and Sulthanpur (3 during 2014-15) villages to harvest and store runoff water as well as to increase the equity of benefits to more number of farmers in the watershed.
- Three farm ponds were made, one each in Shivampet, Venkatakishtapur and Vendikol (1 during 2014) villages (Figure 7) to harvest as well as to store runoff water.
- Eight sunken ponds were made in Fasalvadi (3 nos.), Shivampet (2 nos. during 2014) and Sulthanpur (3 nos. during 2014-15) villages (Figure 8) to trap sediment and runoff water.
- Runoff water was diverted into 8 dry open wells in Fasalvadi (5 nos.), Sulthanpur (2 during 2014-15) and Korpole (1 during 2015) villages to rejuvenate defunct open wells as well as to bring them into use.
- Water absorption trenches (76 nos. during 2014) with 2m x 1m x 1m dimensions were dug in Chakriyal village to trap runoff water as well as to recharge soil profile.

Figure 7. Farm pond with stored water in Vendikol village

Figure 8. Sunken pond with stored water in Sulthanpur village

- Agro-forestry is promoted in targeted villages. More than 50,000 saplings of Teak, *Gliricidia*, *Pongamia* and Raintree were planted (20,000 during 2014) in all the villages to increase greenery, availability of green leaf manure and high-value timber wood (Table 3).
- More than 11,000 saplings of different horticultural plants (2400 during 2014) were planted in the seven villages by farmers in their backyards to increase the availability of fruits and nutrition (Table 3).
- Leguminous forage seed (100 kg) of *Stylosanthes hamata* was broadcasted on field bunds and grazing lands in Sulthanpur and Vendikol villages during 2014 to stabilize the bunds as well as to increase the availability of nutritious fodder.

Impact Assessment

Estimated impact: The soil and water conservation measures and water harvesting structures constructed during the project period, till end of March 2015, have created additional storage capacity of more than 68,000 m^3 in project villages. This will result in an

estimated groundwater recharge of 170,000 m^3 or more of water every year due to multiple refilling of rainwater harvesting structures.

Improved groundwater levels: To assess the impact of water harvesting structures (WHS) on groundwater recharge, 18 borewells in Fasalvadi and Shivampet villages were georeferenced and groundwater levels were recorded in these borewells which are located near the water harvesting structures as well as away from the water harvesting structures. There was significant improvement in the groundwater levels as well as availability of water due to groundwater recharge with the additional storage capacity created and harvested water stored in these structures (Figures 9 and 10).

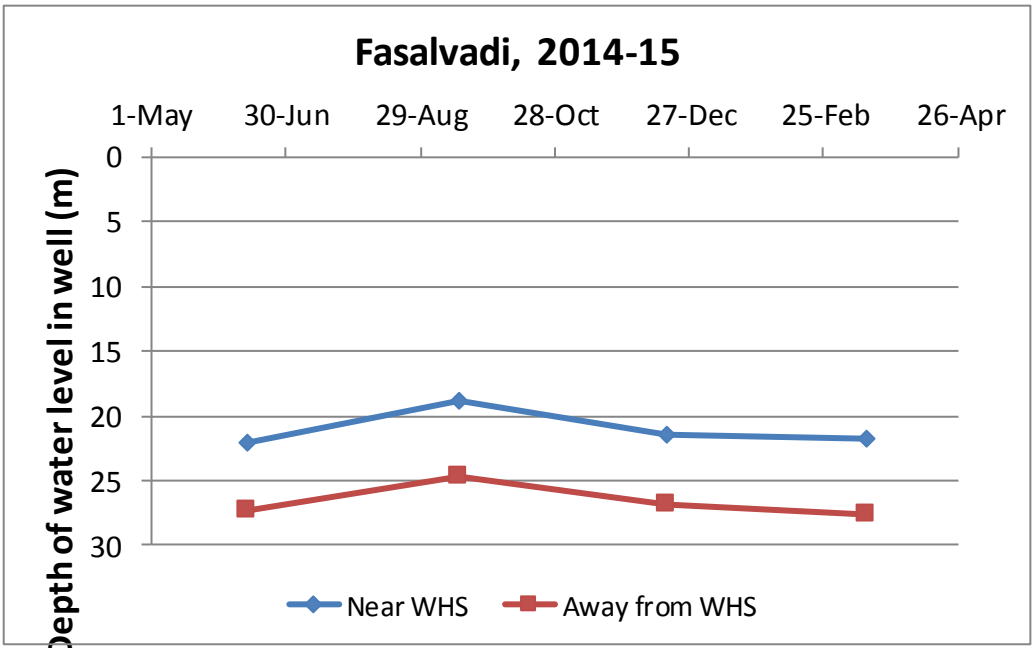

Figure 9. Groundwater levels in borewells at Fasalvadi village during 2014-15

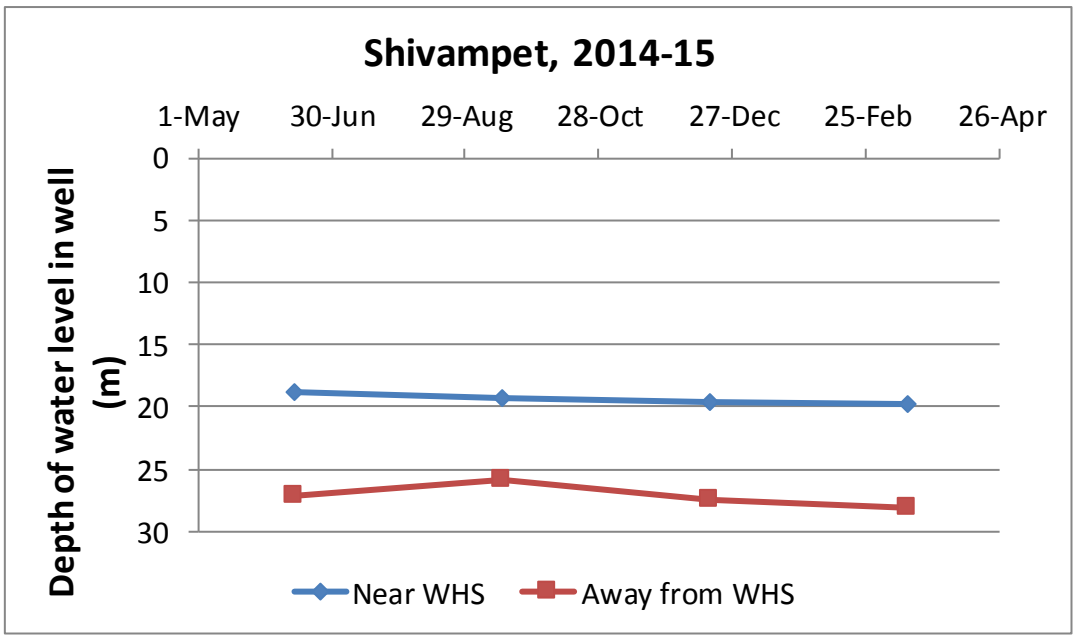

Figure 10. Groundwater levels in borewells at Shivampet village during 2014-15

Participatory Monitoring and Evaluation

As part of monitoring and evaluation of the project, Ms. Meenakshi Sharma and Mr. David Grant, Manager, Water Risk and Partnership, UK, visited ICRISAT and SABMiller project villages on 6 March 2014 to review the progress of different activities as well as to get firsthand information from the stakeholders. On ICRISAT campus, they were shown watersheds, tropicultor operations, and vermicomposting along with a general visit of the campus. Then they were taken to Fasalvadi village where they interacted with farmers, spent malt SHG, vermicomposting farmers (Figure 11) and got information about the livelihoods and income-generation activities initiated in the village. They asked questions on how much spent malt was used in the village, how frequently they were getting material from the brewery, by how much did the milk yield increase, what was the increase in average net income due to usage of spent malt and profit made by SHG, etc. Then the delegates visited checkdams where ICRISAT team explained about project activities on soil and water conservation, water harvesting structures along with the productivity enhancement initiatives. Mr. David interacted with farmers and enquired about crops grown under irrigation, irrigation methods used by farmers and profitability of sugarcane and paddy crops grown under irrigation. He also discussed about the scarcity/availability of water and benefits from water harvesting structures etc. After the Fasalvadi visit, the team went to Sulthanpur village where inauguration of the foundation work of checkdam construction was initiated by breaking coconuts (Figure 11) and laying the cement-concrete mix.

Figure 11. SABMiller delegates visit to project villages and interaction with farmers

Table 2. Details of soil water conservation works executed during project period									
S.No.	**Activity**	**Fasalvadi**	**Shivampet**	**Venkata-kishtapur**	**Chakriyal**	**Sulthanpur**	**Korpole**	**Vendikol**	**Number of beneficiaries**
1.	Bunding work in the fields (Rm)	2740	-	2820	-	-	-	-	38
2.	Stone outlets (Nos..)	-	-	3	-	-	-	-	2
3.	Gully control structures (Nos..)								142
	- Loose boulder structures	29	83	19	-	20	26	18	50
	- Rock fill dams	14	14	8	-	4	9	2	32
	- Gabion structures with masonry wall	5	3	2	-	-	-	-	4
	- Stone bunding (Rm)	137	-	-	-	-	-	-	128
	- Feeder channel renovation (m^3)	8838	-	-	-	-	-	-	
4.	Water harvesting structures (Nos..)								
	- Check dams	2	3	-	-	1	2	-	60
	- Percolation tank	1	-	-	-	-	-	-	24
	- Mini percolation tanks	-	4	-	-	4	-	-	10
	- Farm ponds	-	1	1	-	-	-	1	9
	- Sunken ponds	3	2	-	-	3	-	-	24
	- Dry well recharging	5	-	-	-	1	1	-	7
	- Water absorption trench	-	-	-	76	-	-	-	2

Table 3. Details of plantation works and vermicompost units executed during project period									
S.No.	Activity	Fasalvadi	Shivampet	Venkata-kishtapur	Chakriyal	Sulthanpur	Korpole	Vendikol	Number of beneficiaries
1.	Afforestation (Nos.)								
	a. Teak plants	6200	3100	2400	2900	-	-	-	655
	b. *Gliricidia* cuttings	1200	3400	1546	-	-	-	-	12
	c. *Gliricidia* seed dibbling (Nos..)	2000	-	2000	-	3000	-	3000	16
	d. *Pongamia* saplings	3520	2855	310	-	-	-	-	25
	e. *Pongmia* seed dibbling (Nos.)	-	-	-	-	6000	-	6000	32
	f. Rain tree	65	400	565	-	-	-	-	16
2.	Horticulture (Nos.)								
	- Guava	650	500	500	500	200	150	150	2136
	- Pomegranate	200	200	200	200	200	300	150	1450
	- Sapota	350	200	200	200	0	0	0	590
	- Acid lime	550	350	350	350	200	250	150	1650
	- Curry leaf	150	150	150	150	200	300	150	1250
	- Tamarind	90	768	642	-	-	-	-	750
	- *Pithecellobium dulce*	50	120	1290	-	-	-	-	292
3.	*Stylosanthes hamata* (kg)	-	-	-	-	50	-	50	100
4.	Veterinary trevis (Nos.)	1	-	1	1	-	-	-	3
5.	Vermicompost units (Nos.)	2	5	4	-	-	-	-	11

Productivity Enhancement Initiatives

Improved Seeds Availability in the Villages

Cotton, green gram, maize, sorghum, pigeonpea, chickpea, safflower, chillies and onion are the major crops grown in rainfed areas whereas sugarcane and paddy are the major irrigated crops in targeted villages. Except for Chakriyal village there are ten villages where rainfed area is significant, but a large portion of cultivable area in Chakriyal is under irrigated condition due to its location near the river. We adopted the participatory research for development (PR4D) approach for various productivity enhancement interventions in the target villages.

As the wild boar problem is increasing in the target villages, rainfed area under maize and food crops is decreasing and cotton area is increasing year after year. Improved seeds of maize and pigeonpea were supplied in Sulthanpur, Vendikol and Korpole villages during rainy season 2014 (Table 4) for evaluation and selecting superior cultivars for upscaling in follow-up season.

Table 4. Quantity of seeds supplied in the villages during rainy season 2014

Crop	Variety	Seed supplied in Sulthanpur (kg)	Seed supplied in Vendikol (kg)	Seed supplied in Korpole (kg)
Maize	Bioseed 9220	20	15	15
Pigeonpea	ICPL-87119	18	18	4
Total		**38**	**33**	**19**

Adoption of Balanced Nutrients Application Technology

Based on the soil analysis, critical deficiencies of nutrients were recorded and accordingly nutrient recommendations (Appendix 2) for different crops were developed and shared with the farmers. Balanced nutrient management PR&D trials were conducted in participatory mode with farmers during rainy season 2014. Crop cutting experiments were conducted for estimating crop yields to demonstrate the benefits with improved technology. Based on farmers' requests, the project supplied 4550 kg of gypsum, 1770 kg of zinc sulphate and 143 kg of agribor, and 112 farmers used these inputs in eight villages (Table 5).

Crop yields of cotton, sugarcane and paddy (Figure 12) were recorded to quantify the effect of these fertilizers on productivity enhancement (Tables 6 and 7). Soil test-based balanced nutrition increased cotton yield by 18-29% with mean benefit cost ratio of 6.4:1 in Venkatakishtapur village; 13% to 20% with mean B:C ratio of 4.3:1 in Vendikol village; and 12-16% with mean B:C ratio of 3.7:1 in Korpole village (Table 6). Sugarcane yield increased by 6% to 13% with mean benefit cost ratio of Rs 6.4:1 in Fasalvadi village and 7% to 11% with mean B:C ratio of 6.7:1 in Chakriyal village (Table 6). Paddy grain yield increased by

13% to 22% with mean B:C ratio of 2.2:1 in Fasalvadi village; 18% to 23% with mean B:C ratio of 2.3:1 in Venkatakishtapur village; 14% to 24% with mean B:C ratio of 2.1:1 in Sulthanpur village; 15% to 24% with mean B:C ratio of 2.5:1 in Upparigudem village; 22% to 25% with mean B:C ratio of 2.2:1 in Vendikol village; 17% to 24% with mean B:C ratio of 2.2:1 in Korpole village and 13% to 27% with mean B:C ratio of 2.3:1 in Chowtakur village on each rupee of additional investment made as compared to farmers' practices (see Table 7).

Table 5. Quantity of fertilizers used in the villages for PR&D trials during rainy season 2014

Name of the village	Gypsum (kg)	Zinc sulphate (kg)	Agribor (kg)	Total (kg)
Fasalvadi	1150	230	23	1403
Chakriyal	450	90	9	549
Venkatakishtapur	300	60	6	366
Sulthanpur	250	350	35	635
Upparigudem	100	180	14	294
Vendikol	850	370	24	1244
Korpole	1000	300	30	1330
Chowtakur	450	190	2	642
Total	4550	1770	143	6463

Figure 12. Paddy (left) and Sugarcane (right) crops under soil test-based balanced nutrition trials in Fasalvadi village

Table 6. Crop yields of PR&D trials during the rainy seasons 2014						
Village	**Crop**	**Farmer name**	**Yield in farmers' practice (t ha^{-1})**	**Yield in balanced nutrients application trial (t ha^{-1})**	**Percent increase over FP**	**B:C ratio**
Venkata-kishtapur	Cotton	R Vittalaiah	2.3	2.8	22	6.1:1
		P Ganesh	2.6	3.2	23	7.5:1
		T Srinivas	2.2	2.6	18	4.7:1
		R Ramulu	2.1	2.7	29	7.5:1
	Mean		***2.3***	***2.8***	***23***	***6.4:1***
	SE+		***0.11***	***0.13***		
Vendikol	Cotton	P Mallesham	2.5	3.0	20	6.1:1
		B Mogulaiah	2.3	2.6	13	3.3:1
		S Narsaiah	2.4	2.8	17	4.7:1
		B Ramulu	2.6	3.0	15	4.7:1
		G Anjaiah	2.3	2.6	13	3.3:1
		G Saroja	2.3	2.6	13	3.3:1
		CH Kashireddy	2.3	2.7	17	4.7:1
	Mean		***2.4***	***2.8***	***16***	***4.3:1***
	SE+		***0.05***	***0.07***		
Korpole	Cotton	K Boomreddy	2.4	2.7	13	3.3:1
		K Sushella	2.6	2.9	12	3.3:1
		D Balaiah	2.5	2.9	16	4.7:1
	Mean		***2.5***	***2.8***	***13***	***3.7:1***
	SE+		***0.06***	***0.07***		
	Cotton	***Grand mean***	***2.4***	***2.8***	***17***	***4.8:1***
		SE+	***0.04***	***0.05***		
Fasalvadi	Sugarcane	D Mallesham	97.8	104.4	7	5.1:1
		D Laxmi	95.6	101.1	6	4.1:1
		A Mallesham	90.0	98.9	10	7.2:1
		K Gopal	86.7	97.8	13	9.2:1
		G Srinivas	92.2	100.0	8	6.2:1
	Mean		***92.4***	***100.4***	***9***	***6.4:1***
	SE+		***1.97***	***1.14***		
Chakriyal	Sugarcane	Y Rajashekar	94.4	101.1	7	5.1:1
		P Ramachendrareddy	92.2	102.2	11	8.2:1
		G Pandari	91.1	101.1	11	8.2:1
		B Narsimulu	88.9	95.6	8	5.1:1
	Mean		***91.7***	***100.0***	***9***	***6.7:1***
	SE+		***1.16***	***1.50***		
	Sugarcane	***Grand mean***	***92.1***	***100.2***	***9***	***6.5:1***
		SE+	***1.15***	***0.86***		

Table 7. Crop yields of PR&D trials during the rainy seasons 2014						
Village	**Crop**	**Farmer name**	**Yield in farmers' practice** (t ha^{-1})	**Yield in balanced nutrients application trial** (t ha^{-1})	**Percent increase over FP**	**B:C ratio**
Fasalvadi	Paddy	Purra Manemma	4.4	5.1	18	2.0:1
		R Ananthaiah	4.6	5.5	20	2.6:1
		G Suresh	4.3	5.2	22	2.7:1
		P Mallaiah	5.6	6.4	13	1.9:1
		Md Saidoddin	4.8	5.6	17	2.1:1
		R Satyaiah	4.3	5.1	19	2.1:1
	Mean		***4.7***	***5.5***	***18***	***2.2:1***
	SE+		***0.21***	***0.2***		
Venkatakishtapur	Paddy	T Narsimulu	4	4.9	23	2.5:1
		Bichapathi	4.6	5.4	18	2.2:1
	Mean		***4.3***	***5.2***	***20***	***2.3:1***
	SE+		***0.34***	***0.29***		
Sulthanpur	Paddy	Bairu Kishan	3.9	4.6	19	1.8:1
		Golla Pentaiah	4.2	5.2	24	2.9:1
		Vadla Devendhar	4.9	6	22	3.2:1
		P Venkatramreddy	4.7	5.3	14	1.5:1
		Gadde Chendraiah	3.6	4.2	17	1.3:1
		Golla Devaiah	3.8	4.6	21	2.1:1
	Mean		***4.2***	***5***	***19***	***2.1:1***
	SE+		***0.21***	***0.26***		
Upparigudem	Paddy	Mamathi Shivaiah	4.5	5.5	21	2.8:1
		Kolkuri Mallesham	4.7	5.6	18	2.4:1
		CH Jaipalreddy	4.8	5.6	17	2.1:1
		M Anjaiah	4.7	5.8	24	3.4:1
		Golla Anjaiah	4.8	5.5	15	1.9:1
		Budda Ramulu	4.2	5.1	21	2.5:1
	Mean		***4.6***	***5.5***	***19***	***2.5:1***
	SE+		***0.09***	***0.1***		
Vendikol	Paddy	B Chandrappa	3.4	4.1	22	1.9:1
		N Nagaiah	3.7	4.6	23	2.3:1
		B Badrappa	3.4	4.3	25	2.4:1
	Mean		***3.5***	***4.3***	***23***	***2.2:1***
	SE+		***0.11***	***0.13***		
Korpole	Paddy	T Kistareddy	4.3	5	18	1.9:1
		Kodakanti Narshimullu	4.8	5.6	17	2.2:1
		Kumari Ravi	4.4	5.1	17	1.9:1
		Kasala Venkatreddy	4.3	5.1	20	2.3:1
		D Gopal	3.8	4.7	24	2.6:1
	Mean		***4.3***	***5.1***	***19***	***2.2:1***
	SE+		***0.16***	***0.14***		
Chowtakur	Paddy	T Raghu	4	5.1	27	3.2:1

Table 7. Crop yields of PR&D trials during the rainy seasons 2014						
Village	**Crop**	**Farmer name**	**Yield in farmers' practice** (t ha^{-1})	**Yield in balanced nutrients application trial** (t ha^{-1})	**Percent increase over FP**	**B:C ratio**
		Pulugari Maipalreddy	4.7	5.3	13	1.5:1
	Mean		***4.4***	***5.2***	***20***	***2.3:1***
	SE+		***0.32***	***0.09***		
	Paddy	***Grand mean***	***4.3***	***5.2***	***20***	***2.3:1***
		SE+	***0.09***	***0.1***		

Improving Livelihoods and Strengthening SHGs through Income Generating Activities

Improving Breed of Cattle through Artificial Insemination (AI)

Breed improvement of cattle is promoted in targeted villages. Improving cattle breeds through artificial insemination is an important component. This activity helped in developing cross breeds, increasing milk yield, improved livelihoods and income of the farmers and nutrition of the village people. In collaboration with BAIF Institute for Rural Development (BIRD), a total of 1659 cattle (1309 buffaloes and 350 cows) were artificially inseminated, of which 789 cattle (632 buffaloes and 157 cows) have confirmed pregnancy in the diagnosis test (Figure 13), and 419 cattle (337 buffaloes and 82 cows) have so far given birth to cross breed calves (Figure 13).

Figure 13. Pregnancy diagnostic test (left) and first generation cross breed calf (right) in Fasalvadi village

Provision of Spentmalt as Cattle Feed

- Spent malt is a byproduct of the brewing industry, consisting of the residues of malt and grain which contains carbohydrates, proteins and lignin. Spent grain is considered to be a good source of protein and water-soluble vitamins for animals. It is quite palatable and is readily consumed by animals.

- ICRISAT, in consultation with SABMiller and consortium partners, has initiated supply of spent malt from the Charminar Breweries (7 December 2011, Figure 14) to villagers with the aim of strengthening livelihood opportunities and financial security of the women SHG as they can get higher milk yield with greater fat content for sale.
- The Priyadarshini women SHG has undertaken the responsibility of transportation and distribution of spent malt in the village.
- Training on care, handling and maintenance of spent malt was given to women SHGs; and training on precautions to be taken for feeding the animals to beneficiary farmers.
- Fifty-eight beneficiary farmers are utilizing the spent malt (1437 kg/day) and feeding 391 milch animals (Figure 15).
- Total milk production in the village is about 1562 liter/day and with use of spent malt as animal feed, farmers have observed increased milk production of 1 liter/animal /per day with improved fat content.
- Increased gross income on milk production is about Rs 12565/- per day with a net income of Rs. 8973/- per day in the village. In total, the village is getting increased net income of Rs. 269175 per month with an average net income of Rs 4640/- per family.
- Till March 2015 Priyadarshini women's SHG sold 1,57,0318 kg of spent malt making a net profit of Rs. 72,014/- during a period of 40 months after meeting the expenses of transportation, handling and rent for storage and labor charges incurred for distribution.
- Similar activity was started by Tejasri women's SHG in Adarsha watershed, Kothapally village in Ranga Reddy district on 17 June 2013, and they provided 836,648 kg of spent malt (till March 2015) and earned a net profit of Rs 98340 during a period of 21 months. Totally 65 beneficiary farmers (51 beneficiaries in Kothapally, 7 in Gollapally, 4 in Urella and 3 in Enkepally villages) are utilizing the spent malt (1390 kg/day) and feeding 285 milch animals. Total milk production in the village is about 1608 liter/day and with use of spent malt as animal feed, farmers have observed increased milk production of 1.5 liter/animal per day with improved fat content. Increased gross income on milk production is about Rs. 21120/- day with a net income of Rs. 16950/- day in the village. In total, the village is getting increased net income of Rs. 5, 08,530/- per month with an average net income of Rs. 7820/- per family.

Figure 14. Launching of Spent malt activity in Fasalvadi village on 7 Dec 2011

Figure 15. Distribution of Spent Malt to the beneficiary farmers; and examining the acceptability of spent malt by milch animals in Fasalvadi village

Training and Capacity Building

Women Farmers' Day-cum-Training Program at ICRISAT

ICRISAT conducted women farmers' day on 12 September 2014 for recognizing the contribution of women to agriculture as it is critical for achieving global food security. One hundred and forty-one women farmers from SABMiller villages (Fasalvadi 64, Venkatakishtapur 21, Vendikol 24, Sulthanpur 11 and Upparigudem 21) were brought to ICRISAT to participate in the event. Addressing over 1500 women farmers from across 12 states of India at the Women Farmers Day at ICRISAT's global headquarters, Dr. William Dar, Director General of ICRISAT (Figure 16) stressed that with "women farmers as the backbone of agriculture, meeting their needs equals (to) a better world."

Figure 16. Dr. William Dar, Director General of ICRISAT addressing women farmers

Figure 17. Inauguration (left) and field visits (right) of women farmers at ICRISAT

The ICRISAT Women Farmers Day is a celebration of the achievements of India's outstanding women farmers whose ingenious and resourceful ways have placed them at the forefront of the fight against poverty, hunger, malnutrition and environmental degradation. Of the 2 billion smallholder farmers in the developing world producing most of the world's food, 70 percent are women, and most are living in extreme poverty. "If we are to eradicate hunger and poverty, we need to level the playing field by economically empowering women farmers," Dr Dar continued. He added that a UN study showed that empowering women farmers with new technologies and resources could result in yield increases by 20-30% and reduce the number of hungry people in the world by 100 to 150 million people. ICRISAT regularly conducts Farmers Days to share new technologies, best practices and information about science-based innovations to benefit the farmers (Figure 17). The Women Farmers Day of 2014 was particularly meaningful as it was designated as the 'Year of Family Farming', and it was also ICRISAT's 'Year of Gender'.

Exposure visit-cum-Training Program

A one-day exposure visit-cum-training program was organized for SABMiller farmers on 5 and 6 November 2014 at Kothapally watershed and on ICRISAT campus at Patancheru to enhance their capacity (Figure 18). Totally 119 farmers (Vendikol 50, Sukthanpur 22, Bommareddygudem 19, Upparigudem 17 and Korpole 11) and 2 WDTs of READ-NGO participated in the program. The topics covered were: integrated watershed management concept with improved land and water management, integrated nutrient management, Gliricidia, vermicomposting, improved crop management, and integrated pest management practices. Farmers visited Adarsha watershed, Kothapally village, Ranga Reddy District where science-based farmer participatory consortium model for efficient management of natural resources for improving livelihood of poor rural households was implemented by ICRISAT and its partners. In the village, the farmers observed various interventions, including soil and water conservation measures, rainwater harvesting structures, well recharging, improved crop varieties and cropping systems, crop diversification with high-value crops, productivity enhancement, livestock-based improvement, livelihood initiatives, and interacted with the local community. The visiting farmers, impressed with the salient impacts that resulted due to the implementation of this model, appreciated the success arising from the collective action of the Kothapally farmers and stated that the visit had provided an excellent learning opportunity.

Figure 18. Exposure visits of farmers to Kothapally (left); and ICRISAT (right) watersheds

Appendix 1. Soil health card with the details of soil test results and soil test-based fertilizers recommendations

ICRISAT
Science with a human face

ICRISAT - SABMiller India Project

SAB MILLER | India

Soil Health Card

Card/Farmer/Lab No: SMN 1

General Information

1. Name of the farmer : K Mohan Reddy / Bheem Reddy
2. Village : Korpole
3. Mandal : Pulkal
4. District : Medak
5. Survey No : 441
6. Soil sampling depth : 0-15 cm
7. Month and year of sampling : March 2014

Soil Chemical Analyses Report

Soil health information	Critical limit	Observed	Remark
1. Soil p^H (1:2 H_2O)		8.1	Normal
2. Electrical conductivity (dS m^{-1})	<0.8	0.2	Normal
Major nutrients			
3. Organic Carbon (%)	0.5	0.5	Low
4. Available Phosphorous (mg kg^{-1})	5	25.2	High
5. Available Potassium (mg kg^{-1})	50	217	High
Secondary nutrients			
6. Available Sulfur (mg kg^{-1})	10	9	Deficient
7. Available Calcium (mg kg^{-1})	1000	3,079	High
8. Available Magnesium (mg kg^{-1})	40	1,208	High
Micro nutrients			
9. Available Zinc (mg kg^{-1})	0.75	1.68	Sufficient
10.Available Boron (mg kg^{-1})	0.58	2.28	Sufficient
11. Available Iron (mg kg^{-1})	2.00	16.36	Sufficient
12. Available Copper (mg kg^{-1})	0.5	1.92	Sufficient
13. Available Manganese (mg kg^{-1})	1.00	12.16	Sufficient

"Use improved varieties of crop recommended for the particular area to ensure better utilization of nutrients and to maximize profits"

Nutrient recommendations (kg ac^{-1})

Crop	N	P_2O_5	K_2O	S	Zn	B
Paddy (Kharif)	36	22	16	12	4	0.2
Paddy (Rabi)	48	24	16	12	4	0.2
Sugarcane	72	40	48	12	4	0.2
Maize	48	24	20	12	4	0.2
Sorghum	30	16	12	12	4	0.2
Cotton	48	24	24	12	4	0.2
Groundnut	8	16	20	30	4	0.2
Pulses	8	20	0	12	4	0.2
Pearl Millet	24	12	8	12	4	0.2
Tomato	60	24	24	12	4	0.2
Onion	80	32	24	12	4	0.2
Chilly (Irrigated)	120	24	48	12	4	0.2
Soybean	12	24	16	12	4	0.2

Use of Vermicompost and soil incorporation of *Gliricidia* leaves saves on fertilizer costs.

Soil test based fertilizer recommendations (kg ac^{-1})

Crop	Urea	DAP	MOP	Gypsum	Zn SO_4	Borax
Paddy (Kharif)	89	33	19	73	10	1
Paddy (Rabi)	121	37	19	73	10	1
Sugarcane	180	61	56	73	10	1
Maize	121	37	23	73	10	1
Sorghum	75	24	14	73	10	1
Cotton	121	37	28	73	10	1
Groundnut	13	24	23	193	10	1
Pulses	11	30	0	73	10	1
Pearl Millet	61	18	9	73	10	1
Tomato	155	37	28	73	10	1
Onion	207	49	28	73	10	1
Chillis(Irrigated)	325	37	56	73	10	1
Soybean	19	37	19	73	10	1

Apply Nitrogen preferably in 2 or 3 splits. FYM 5 t ha^{-1} *is desirable. Follow the recommended timing of fertilizer application.*

For further details, please contact
Dr Suhas P Wani
Director, ICRISAT Development Center
E-mail: s.wani@cgiar.org Ph: 040-30713466

Appendix 2. Village wise soil test-based fertilizers recommendations (kg/acre) in SABMiller project

Village	Crop	Urea	DAP	MOP	Gypsum	Zn SO_4	Borax
Korpole	Paddy (Kharif)	83	48	19	33	10	1
	Paddy (Rabi)	115	52	19	33	10	1
	Sugarcane	169	87	56	33	10	1
	Maize	115	52	23	33	10	1
	Sorghum	71	35	14	33	10	1
	Cotton	115	52	28	33	10	1
	Groundnut	9	35	23	93	10	1
	Pulses	6	43	0	33	10	1
	Pearl millet	58	26	9	33	10	1
	Tomato	149	52	28	33	10	1
	Onion	199	70	28	33	10	1
	Chilly (Irrigated)	319	52	56	33	10	1
	Soybean	14	52	19	33	10	1
Sulthanpur	Paddy (Kharif)	77	62	27	65	20	1
	Paddy (Rabi)	109	68	27	65	20	1
	Sugarcane	159	113	80	65	20	1
	Maize	109	68	33	65	20	1
	Sorghum	67	45	20	65	20	1
	Cotton	109	68	40	65	20	1
	Groundnut	5	45	33	185	20	1
	Pulses	0	57	0	65	20	1
	Pearl millet	55	34	13	65	20	1
	Tomato	143	68	40	65	20	1
	Onion	191	90	40	65	20	1
	Chilly (Irrigated)	313	68	80	65	20	1
	Soybean	7	68	27	65	20	1
Vendikol	Paddy (Kharif)	83	48	19	65	20	1
	Paddy (Rabi)	115	52	19	65	20	1
	Sugarcane	169	87	56	65	20	1
	Maize	115	52	23	65	20	1
	Sorghum	71	35	14	65	20	1
	Cotton	115	52	28	65	20	1
	Groundnut	9	35	23	185	20	1
	Pulses	6	43	0	65	20	1
	Pearl millet	58	26	9	65	20	1
	Tomato	149	52	28	65	20	1
	Onion	199	70	28	65	20	1
	Chilly (Irrigated)	319	52	56	65	20	1
	Soybean	14	52	19	65	20	1