Bhoochetana

Mission Project on Rainfed Agriculture:
Bridging Yield Gaps through Science-led Interventions for Sustainable Use of Natural Resources in Karnataka

Annual Report (2010-2011)

International Crops Research Institute
for the Semi-Arid Tropics
Patancheru 502 324, Andhra Pradesh, India

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ICRISAT
Science with a human face
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Contents

Appendices

Executive Summary

Government of Karnataka has upscaled the learnings from Sujala-ICRISAT initiative for enhancing agricultural productivity in dry land areas of the state through bridging the yield gap between the farmers' fields and achievable yields with the help of science-based productivity enhancement interventions. The main objectives of the program are:
1) to identify and scale-up best-bet options (soil, crop and water management) including improved cultivars to enhance productivity by 20% of the selected crops in selected 24 (later extended to 30) districts; 2) to train DoA staff in stratified soil sampling at villages, analysis of macro- and micronutrients, preparation of GIS-based soil maps; and to guide DoA, to establish high quality soil analytical laboratory at Bengaluru and to undertake stratified soil sampling, their analyses and sharing results in nine districts; and 3) to build capacity of the stake holders (farmers and consortium partners) in the sustainable management of natural resources and enhancing productivity in dryland areas.

The mission project on rainfed agriculture was launched by the Government of Karnataka during 2009-10. The mission mode project is called as "BhooChetana" meaning "reviving the soils" to benefit dryland farmers in 30 districts has adopted the principle of consortium, convergence, capacity building and collective action as proposed by ICRISAT to address the issues of efficiency, economics, equity and environmental protection. Consortium partners involved in Bhoochetana are three State Agricultural Universities (UAS, Bangalore, Dharwad and Raichur), Watershed Development Department (WDD), Department of economics and Statistics (DES), and other line departments of Government of Karnataka, ICRISAT and Department of Agriculture which is the nodal agency for the mission project. The approach to reach large number of farmers for collective action and capacity building is achieved through using the concept of Farm Facilitators and Lead Farmers as trainers to train large number of farmers. During the second year, project activities were expanded to new 10 districts in addition to the six districts of Sujala watershed program where soil health mapping was already completed earlier along with participatory selection of appropriate cultivars of the major crops. In new 10 districts 35,460 soil samples were collected by adopting stratified soil sampling method covering 1773 villages. Detailed soil analysis in new districts revealed wide spread deficiencies of sulfur, zinc and boron across the districts in addition to the deficiency of nitrogen and phosphorus in the soils. Potassium deficiency was not evident in all the districts as percentage of deficient farmers' fields varied from 0 to 41% in different taluks of 10 districts.

Soil test-based fertilizer recommendations for major crops taluk-wise were developed and promoted by the consortium in all the 16 districts. This is one of the major pillar for unlocking the potential of agriculture in the state of Karnataka through Bhoochetana. The mission program along with availability of good quality seeds of high yielding, stress tolerant cultivars of groundnut, soybean, pigeon pea, sunflower, chickpea, maize, ragi, greengram and blackgram in the targeted districts. During this year, soil health cards have been prepared and distributed to the farmers, who’s fields were sampled and suitable recommendations were provided to these farmers. Taluk-wise recommendations were widely disseminated by the consortium partners using various capacity building initiatives, awareness campaigns amongst farmers through wall writings, posters and field publicity materials (brochures, wall writing etc.,) to popularize various components of Bhoochentana in the villages of the targeted taluks in 16 districts. GIS maps using stratified soil sampling results were prepared for all the 10 districts and made available to the officials for sharing the results with the farmers.

During the 2009-10 rabi season, out of 59,340 ha, 89% area in Chitradurga, Haveri and Dharwad districts were sown (sorghum, chickpea and sunflower). Farmers with improved management practices in Bhoochetana package harvested 23-51% higher yields of different crops (sunflower, sorghum and chickpea) as compared to farmers practice. The mission program adopted the strategy of expanding the area during the second year and accordingly 50% of the targeted area in 6 districts and 33% of total area in new 10 districts was targeted during the year 2010-11.

Based on the learnings from the first year, the State Coordination Committee (SCC) guided the consortium for undertaking the awareness building campaign as well as capacity building measures in all the 16 districts which has shown very good impact even in new districts. For example, the new districts like Bidar and Bangalore Rural due to concerted efforts of the districts officials, these districts have shown remarkable coverage of 40% in Bidar and 52% in Bangalore Rural for use of micronutrients.

Capacity building measures from State-district-taluk to the village cluster level enabled the consortium partners to reach to the larger number of farmers for expanding the reach for Bhoochetana interventions. Detailed analysis on rainfall in the representative taluks of all the districts has provided good data for explaining the variable response to improved management practices with different crops in different districts as evident from the results, although, in many places, seasonal rainfall was normal in terms of total amount received, however, erratic distribution causing long dry spells affected yields badly in some of the taluks and districts.

Bhoochetana mission program is a novel and unique of its kind pilot in the country where science-led integrated approach is operatinalized on large scale covering the entire state to unlock the potential of agriculture. This is also unique initiative for developing an effective alternate extension system by adopting consortium approach for building the capacity of the DoA officials, extension agents and farm facilitators which enabled to link knowledge-generating institutions with knowledge-disseminating line departments using the farm facilitators. The mission program has also adopted and operationalized a scientific approach for data recording, data tracking and integrated crop cutting experiments into state statistics using Bhoochentana beneficiaries.

During 2010 rainy season, 1.2 million ha area covering 91% of the targeted area was covered under Bhoochetana program. However, consumption of micronutrients based on soil-test recommendations covered up to 59.3% area for different nutrients in different districts. Improved management practices under Bhoochetana program, benefited farmers during this year also. For all the major crops covered in different districts increased crop yields by 21-57% with improved management practices were harvested by the farmers in different districts in spite of the unfavorable rainfall situation in several districts in the state. Both the years improved management practices have showed increased crop yields even in the districts with unfavorable rainfall situation which suggest that improved management practices from the Bhoochetana initiative are also proving as good adaptation strategies to cope with unfavorable rains.

Farmers in the state harvested increased groundnut yields with improved management practices from 33-49% over the farmers practice yields, even in Bijapur with unfavorable condition of rain farmers harvested 47% increased groundnut yields (470 kg ha^{-1}) over the farmers practices (320 ka ha^{-1}). Application of micronutrients also helped in increasing the shelling % up to 75% (59.2 to 75%) as compared to (57.7 – 67.8%) in farmers' management yields. A short duration crop like green gram also showed increased crop yields in Bidar, Bijapur, Gadag and Yadigiri districts by 31-57% with improved management practices. Maize yields with improved management reached upto 9.7 t ha^{-1} in the district of Haveri with 29% increase over 7.5 t ha^{-1} in farmers' practices.

In other districts, benefit of improved management practices varied from 26% to 42% over the farmers practices for maize. The finger millet crop which is generally considered as non-responsive crop by the farmers as well as researchers also showed increased grain yields from 30-49% with improved management practices in Chickballapur harvesting 3.7 t ha^{-1} of finger millet yields over the farmers' yield of 2.7 t $ha^{-1.}$ Similarily, incrased grain yields with soybean varied from 24 to 27% with peral millet 21 to 37%, sorghum 25 to 39% and pigeonpea 26 to 38%.

Based on the well established, standaradised and recommended by the State Coordination Committee, the crop cutting experiments were undertaken and using the market-value of the various inputs and minimum support price for the outputs we have looked at the economic impacts of the improved technologies promoted through Bhoochetana program. The cost benefit ratio for the additional investment made by the farmers, particularly on micronutrients even taking the full cost without any incentive, the cost benefit ratio for ragi varied from 1:3.5 to 7.8, for maize, 1:7.9 to 12.6, pearl millet 1:1.7 to 4.7, green gram 1:2.4 to 6.6, pigeonpea 1:4.6 to 11.4, groundnut 1:2.5 to 14.6, soybean 1:4.0-7.4 and sunflower 1:1.2 to 2.8 in different taluks of different districts. The economic viability of the interventions even without incentives provided by the government has been proven. As evident from the demand from the farmers through science-led approach has convinced the farmers who have used the improved technologies for their benefits.

During the rabi season, the farmers have observed increased yield of chickpea from the 27% to 39%in Raichur, Bijapur and Bidar districts over the farmers management practice grain yields. Increase in chick pea yield varied from 28 to 52% in different taluks of different districts. Rabi-sorghum yields were significantly improved by 33 to 42% over the farmers management practices in Bijapur district.

Number of field days were conducted to disseminate the results from the Bhoochetana program in all the 16 districts in all 203 field days were conducted where 15,500 farmers participated which 4,500 were women farmers.

Review and planning meeting for 2011 rainy season was done at ICRISAT in the presence of Honorable Minster of Agriculture Mr Umesh Katti and an important decision of extending the benefits of Bhoochetana program to irrigated crops in the remaining 5 districts also was approved.

In conclusion, this is a novel initiative and one of its kind mission initiative in the country implemented by the Government of Karnataka and it has the potential of become the torch bearer program for the whole country to unlock the potential of agriculture through science-led approach. The innovative extension system using farm facilitators and consortium approach through out of state is also a potential exampler program for the country which is looking for a feasible alternate extension system to reach millions of small and marginal farmers. Regular state level coordination meeting has proven its benefit and we need to continue all our efforts to make the program a torch bearer program for the Government of India. It has the potential and lot more need to be done based on the learnings during the last two years implementation of the Bhoochetana program.

Background

Rainfed Crop Yield Potential

Globally rainfed areas are hot-spots of poverty, malnutrition and degradation of natural resources. In India, out of 142 million ha of arable lands, 60% (8.5 million ha) is rainfed. Karnataka has the second largest area under rainfed agriculture after Rajasthan in the country. Crop yields in dry land areas are quite low (1-1.5 t ha^{-1}) which are lower by two to five folds of the yield from researchers managed plots. Recent findings from the comprehensive assessment of water for food and water for life revealed that the millennium development goal of reducing number of poor people by half can be met only through efficient use of the scarce water resources for agriculture. Food production can be increased substantially in rainfed areas through enhanced water use efficiency measures by adopting integrated watershed management approach. Current rainwater use efficiency in dry land agriculture varies between 35-45% and vast potential of rainfed agriculture could be unlocked by using available scientific technologies including improved cultivars. The vast opportunities existing in dryland areas can be harnessed for improving rural livelihoods.

Sujala-ICRISAT Experiences

Government of Karnataka undertook an innovative approach through Sujala-ICRISAT initiative for taking the science at the door steps of the farmers in selected districts of Karnataka from 2005 to 2008 crop seasons. The Sujala-ICRISAT initiative was strongly based on building capacity of the farmers rather than only disseminating new technologies. The initiative which started with 13 watersheds in 2005 was scaled-up to 47 watersheds for demonstrating productivity enhancement measures. For that during 2008, the productivity enhancement initiative was scaled-up to large areas covering more than 3500 ha in the selected six districts by adopting the consortium approach. Under Sujala-ICRISAT initiative, ICRISAT has developed farmers' participatory stratified soil sampling in 20% of farmer's fields in a watershed and covered 20% of watershed villages in each district. In this approach farmers were trained on collecting soil samples scientifically for nutrient analysis. Further this approach was scaled-up to undertake spatial soil nutrient status mapping in the selected districts. This novel approach of soil diagnosis to build the capacity of the farmers has opened up new avenues for making farmers as our partners in the development of rainfed agriculture.

Learnings from the Sujala-ICRISAT Initiative are:

1. The yield gap analysis undertaken by ICRISAT revealed that large yield gap exists for all the major rainfed crops grown in these districts of Karnataka and there is a potential of increasing the productivity by 2 to 3 folds using available technologies in the farmers'fields.
2. Knowledge-based entry point activities enhanced the capacity of the farmers to undertake sampling by conducting the *Gram sabhas* and representative soil samples for 13 nucleus watersheds comprising 410 farmers fields were collected by the farmers.
3. Karnataka soils are not only thirsty are also hungry as 50-90% of the farmers fields are deficient in sulphur, zinc and boron. GIS maps of soil analysis revealed critical deficiency of zinc, boron and sulphur in large number of farmers' fields and policy makers can make informed decisions.
4. Soil deficiency results revealed that in the targeted six districts, there is no widespread deficiency of potassium, however, wide spread deficiency of nitrogen (31 to 81%), phosphorus (31 to 67%) and available sulfur (79 to 93%), available boron (39 to 91%) and available zinc (32 to 80%) is recorded.
5. Farmers participatory action research showed increased crop yields upto 345% with sunflower, 230% with ragi, 240% with groundnut, 150% maize, 116% soybean and 27% sorghum.
6. As a result of scaling-up initiative, farmers revealed that crop yields increased up to 58% (Table 1) even during the unfavorable year like 2008.
7. Farmers selected improved varieties based on the performance in their fields of different crops such as Ragi variety L 5 and MR 1, Groundnut ICGV 91114, GPBD 4, Kadiri 1375 and Kadiri-6 were identified along with improved hybrids of maize, sunflower by the farmers in different districts. The improved varieties like ICGV 91114 performed better almost by 148% increase in fodder as well as 159% increase in pod yields compared to

farmers' cultivars and management. Improved cultivar GPBD 4 of groundnut was identified as a good cultivar. Soybean JS 9305 was preferred because of earlier maturity and input responsiveness trait.

8. Along with improved cultivars, farmers also evaluated suitable land and water management practices to conserve rainwater in the soil as well as to cope with dry spells during the crop growing period.
9. The economic benefits because of improved management practices in case of grain crops vary from Rs. 6300/- per ha in case of finger millet (ragi) to Rs. 21000/- per ha in case of sunflower.

Table 1. Crop yield estimates from farmers' fields under Sujala-ICRISAT scaling up productivity enhancement initiative.

	Grain yield (kg ha^{-1})		
Crop	**Farmers' Practice**	**Best-et practices**	**Percent increase**
Ragi	1750	2770	58
Groundnut	1300	1940	49
Maize	4760	6490	36
Soybean	1225	1635	33

Goal of the Mission-Mode Project

The goal of Bhoochetana is to make a difference in the lives of farmers in the selected 25 districts of Karnataka (Map 1) through increasing average productivity of selected crops by 20% in four years.

Objectives

The overall goal of this mission project is to increase average productivity of selected crops in the 30 districts by 20% in four years. The specific objectives are as follows:

1. To identify and scale-up best-bet options (soil, crop and water management) including improved cultivars to enhance productivity by 20% of the selected crops in 30 districts.
2. To train DoA staff in stratified soil sampling at villages, analysis of macro- and micronutrients, preparation of GIS-based soil maps. To guide DoA, to establish high quality Soil Analytical Laboratory at Bengaluru and to undertake stratified soil sampling, their analyses and sharing results in nine districts.
3. To build capacity of the stake holders (farmers and consortium partners) in the sustainable management of natural resources and enhancing productivity in dryland areas.

Map 1. Selected 24 districts of Karnataka for Bhoochetana project

Consortium Partners

The consortium comprised of Karnataka State Department of Agriculture, with its commissioner and director as the nodal officers for implementing the project and other partners include:

- Watershed Development Department with its Commissioner as focal person to co-ordinate activities.
- University of Agricultural Sciences, Bengaluru, University of Agricultural Sciences, Raichuru, and University of Agricultural Sciences, Dharwad in the state of Karnataka with their Vice-Chancellors as SCC members supporting technical help from university scientists.
- Community-based Organizations (CBOs)

- Watershed Committees, user groups and watershed associations
- International Crops Research Institute for the Semi-Arid Tropics, (ICRISAT) for facilitation of improved technologies to all stake-holder along with participating farmers.

Project Planning and Monitoring Mechanism

The nodal officers took the responsibility to bring together all consortium partners for their inputs, constituted coordination committees at different levels and related activities for successful implementation of the Mission project. The project has been implemented in a Mission mode and coordination at different levels starting with cluster of villages in each Taluk, linking-up with Taluk level coordination committees (TCCs) and TCCs linking-up with district level coordination committees (DCCs) and state level co-ordination committee (SCC). Roles and responsibilities of each consortium partner have been defined clearly as given in the project document for implementation. The details of planning and monitoring the implementation process at different levels for Bhoochetana are presented in Figure 1 below. The proposed plan of action, responsibilities of different partners was clearly outlined in the project document as a guide book to follow timelines.

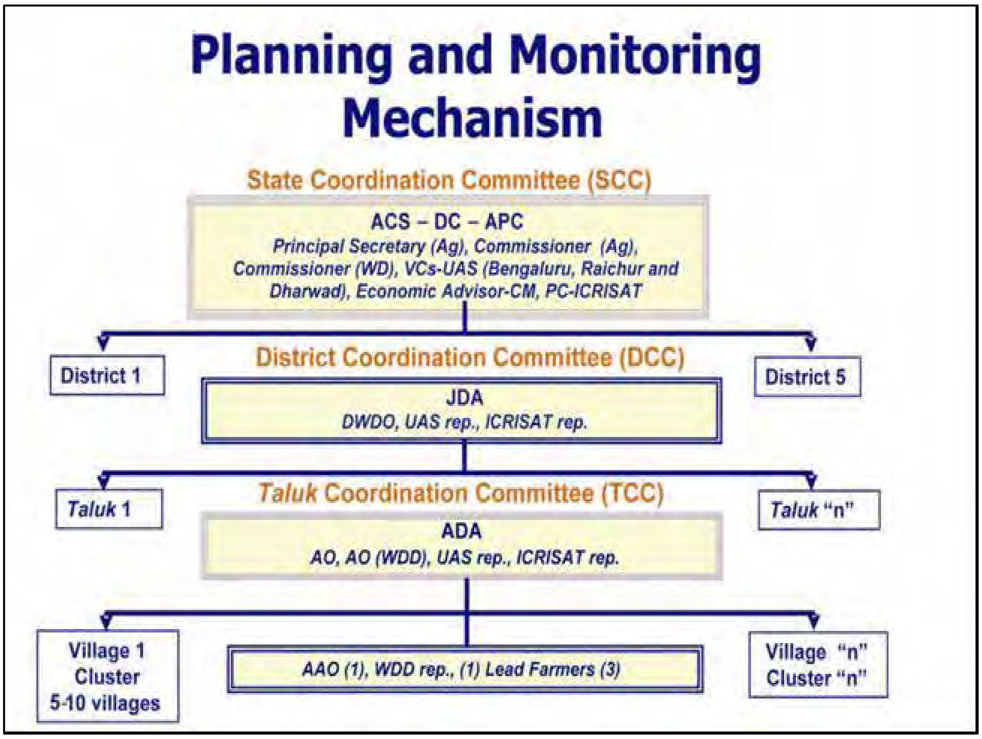


Figure 1. Planning and monitoring mechanism for implementing Bhoochetana mission mode project by DoA, Karnataka, facilitated by ICRISAT

First Year of Success for Bhoochetana

The Bhoochetana initiative which was undertaken by the Department of Agriculture; Government of Karnataka during the crop season 2009-10, has been a path breaking approach for the development and inclusive growth through enhanced productivity of rainfed crops in 1.6 lakh hectares (85%) out of the target area of 1.88 lakh hectares during kharif season in selected six districts through the use of science-based technologies and sustainable use of integrated genetic and natural resources management.

Results from first year of farmers' field evalutions during 2009-10 on scaling out science led interventions in six districts revealed that mean grain yield increase with improved management in ragi (finger millet) ranged between 36%in Tumkur district, 35% in Chitradurga district and 66% in Kolar district compared to farmers' management. In groundnut mean pod yields increase was between 32% in Tumkur and Chitradurga, 41% in Kolar and Haveri and 43% increase in Chikkaballapur. Grain yields increase in maize was 39% in Chitradurga and 44% in Haveri district due to improved management over farmers' practice. Soybean seed yield increased with improved management by 39% over farmers' management in Dharwad district.

A total of 52996 hectares (89%) out of the rabi season cropping target area of 59340 hectares in Chitradurga, Haveri and Dharwad districts was sown to sorghum, chickpea and sunflower. During post-rainy season, sorghum grain yield with improved management increased by 43% in Haveri and 51% in Dharwad compared to farmers' management practices in these districts. Chickpea grain yield increased by 23% in Chitradurga and 34% in Dharwad with improved management over farmers' practices due to introduction of improved cultivars besideds improved nutrient management even during receding moistrure regime (Figure 2). In Haveri, sunflower seed yield increased by 38% with improved management compared to farmers' management mainly because of increased nutrient use efficiency with balanced fertilizer use.

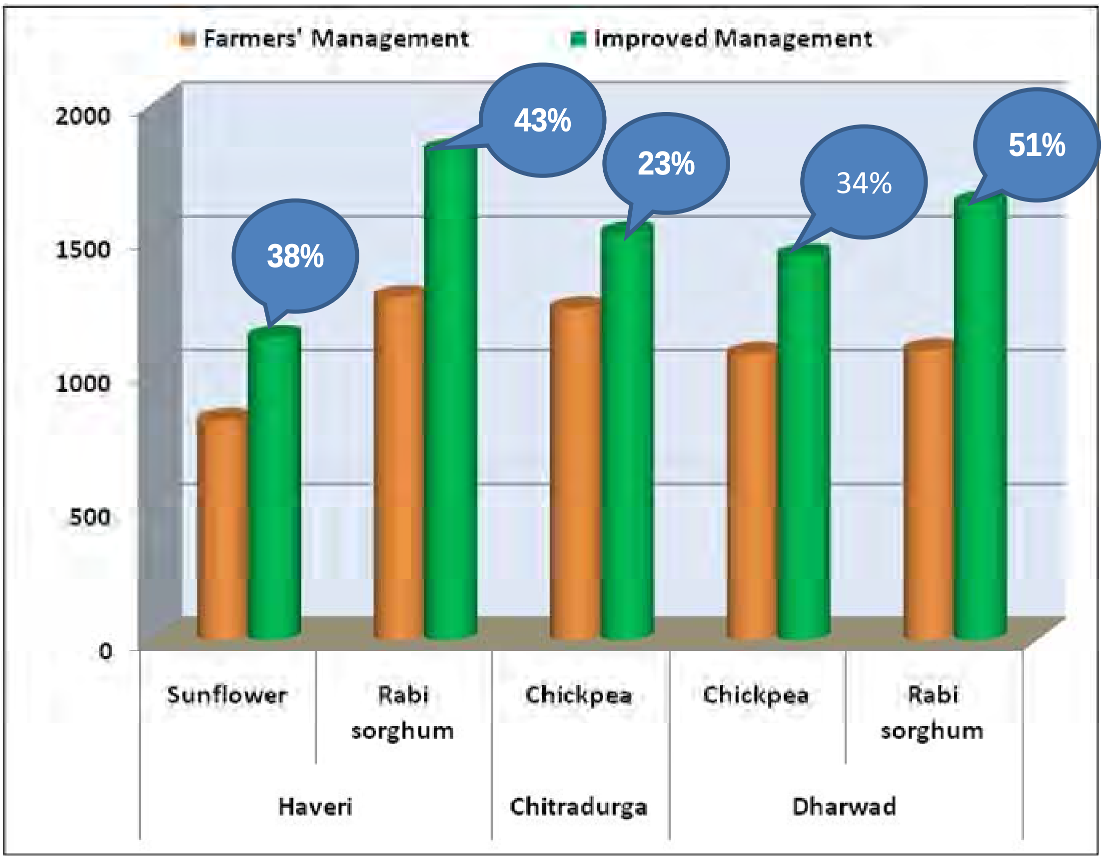


Figure 2. Rabi season crop yield increase with improved management in Haveri, Chitradurga and Dharwad districts during post-rainy season 2009-10.

Appropriate Rainfed Agricultural Technologies

Technologies performed by the farmers earlier under Sujala-ICRISAT initiative listed below are popularized and recommended during the last two years in Bhoochetana project districts.

In-situ Soil and Water Conservation Techniques

1. *Conservation furrow system*

   Contour furrows are simple and efficient method to conserve moisture. These are laid with the help of a country ploughs on a gradient of 0.2 to 0.4% at the time of sowing

2. *Cultivation across slope*

   Cultivation across the slope or contour cultivation is the most common practice for conserving soil moisture. In this method, all field activities including ploughing, planting and intercultivation are done across the slope.

3. *Broad bed and furrow (BBF)*

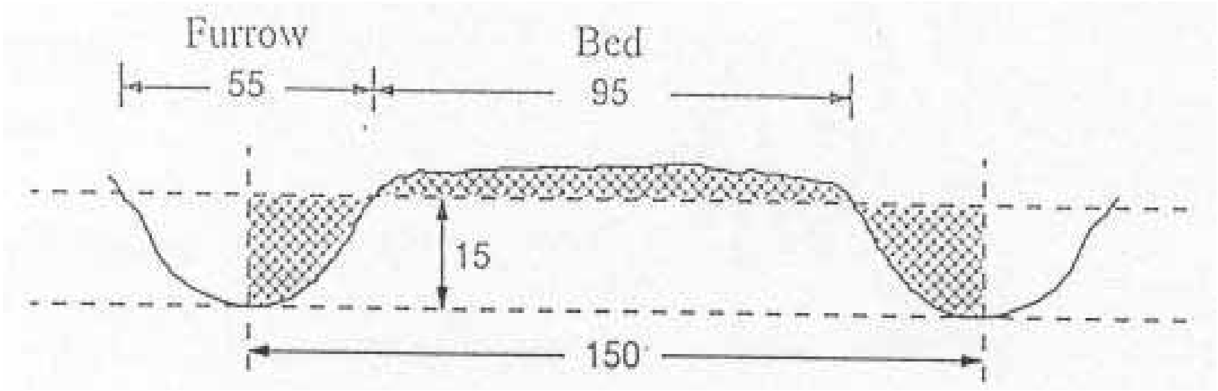


Figure 3. Diagram of Broad Bed and Furrow System depicting measurements of furrow and bed size and furrows on either side.

For *in-situ* soil and water conservation, broad-bed (0.95 m) and furrow (0.55 m) system (BBF) has been found to be satisfactory on deep black soils. BBF system is laid out on a slope range of 0.4 – 0.8% with an optimum of 0.6% slope. BBF system (Figure 3) facilitates draining of excess rainwater as runoff and furrows act as traffic zone for plough bullocks. On Alfisols, raised beds suit well for groundnut cultivation as beds facilitate good aeration, store more moisture for the roots resulting in good crop growth. BBF dimensions are shown below. Deep tillage, shallow cultivation and organic residues application are some of the promising *in-situ* moisture conservation practices.

4. *Tropicultor*

ICRISAT designed multipurpose wheeled tool carrier is known as tropicultor, were supplied to farmers during Sujala-ICRISAT watersheds. These were familiar among farmers in Chitradurga, Kolar and all other districts. Tropicultor usage saves not only work hours in land preparation but also proper inversion of soil as desired (Figure 4a). Its use during sowing is effective due to metered mechanism for uniform application of fertilizer as well as sowing of seed at uniform depth and also equidistant seeding.

During sowing operation, labor saving is critical as sowing opportunity in rainfed areas occur intensely for a short period and this equipment is quite useful to complete sowings of large holding in short period, as it has hitching arrangement to hook it to a tractor for speedier operations (Figure 4b).

Figure 4a. Applying fertilizer and seed at a time with animal drawn Tropicultor

Figure 4b. Applying fertilizer and seed at a time withTractor mounted Tropicultor in Kottur watershed, Dharwad

Integrated Nutrient Management Techniques

1. *Balanced nutrient application*

Balanced use of plant nutrients involves correcting nutrient deficiency, restoring soil fertility of degraded lands due to over exploitation, increases nutrient and water use efficiency, enhances crop yields and farmers' income, betters crop and environmental quality. In order to reap the benefits of balanced use of plant nutrients, it is important to have good quality seed, adequate moisture and better agronomic practices.

As a first step, soil sampling and diagnosing nutrient status of farmers' fields in six districts and providing soil health cards was completed. Balanced fertilizer rates differ from area to area and also from crop to crop. Hence we used soil analyses results, seasonal rainfall, as basis to recommend fertilizer doses. Availability of organic manures, crop residues, biofertilizers, was also considered to provide taluk-wise recommendations for different crops in all districts.

2. *Biofertilizers*

Biofertilizers are very important, low-cost, eco-friendly organic agro-input, supplementary to the chemical fertilizers. *Rhizobium*, *Azospirillum*, Azotobacter add nitrogen to the soil and phosphate-solubilizing bacteria make citrate soluble phosphorous available to crops and also secretes certain growth promoting substances. Biofertilizers are considered harmless and eco-friendly low cost agro-input, supplementary to chemical fertilizers. Improve soil structure (porosity) and water-holding capacity. Increase soil fertility, fertilizer use efficiency (FUE) and ultimately helps increasing yield by 15-20%.

Rhizobium strains are very selective to crops, for efficient nodulation on the roots of the leguminous plants. *Rhizobium* culture treatments for leguminous crops like groundnut, pigeonpea, soybean and chickpea were demonstrated to field facilitators and farmers during trainings and were encouraged to use by supplying them in the input package. We advised caution to farmers, use *Rhizobium* culture treatment to seeds of the crop mentioned on the packet at a dose of 250 g 10 kg^{-1} of seeds.

Azospirillum and Azotobacter cultures are useful for the cereals and cash crops viz. paddy, bajra, jowar, maize, cotton and castor. *Azospirillum* remains in association with the roots and fixes the atmospheric nitrogen. It is reported that the effective strains of *Azotobacter* or *Azospirillum* cultures fix about 15 – 20 kg ha^{-1} of atmospheric nitrogen.

Due to higher concentration of calcium in alkaline soils, large quantities of applied phosphatic fertilizers get fixed as citrate soluble tri-calcium phosphate and become unavailable to the crops. *Phosphate solubilizing Bacteria* (PSB) are useful for all the crops i.e. cereals, cash crops, leguminous crops and vegetables by secreting certain organic acids to make citrate soluble tri-calcium phosphate available to the crop in alkaline soils. The effective strains of PSB used increases the level of available P_2O_5 in the soil. About 10 to 15% increase of crop yield can be achieved with the use of this culture.

Seed Treatment with 250 g 10 kg^{-1} of seed is advised, however, PSB and *Trichoderma viride* were applied to soil in Bhoochetana project as seed treatment with *Rhizobium* and fungicides were suggested for groundnut and soybean.

Aqua sap a sea algal extract which contains growth promoting harmones and micronutrients are evaluated through PR&D to assess its impact on crop yields through folior sprays.

3. *Biocontrol agents*

Trichoderma viride is a fungus used for seed and soil treatment for suppression of various diseases caused by fungal pathogens through seed and soil. Procedure to treat seed is to mix *Tricoderma viride* (Figure 5) with cooled rice gruel or Jaggery solution and thoroughly mix this solution with seeds required for an acre to have an uniform coating over the seeds. Dry these seeds for 30 minutes in shade and sow the treated seeds within 24 hours. We have also provided caution to farmers not to **use or mix** treated seeds with fungicides if seeds are to be treated with *Tricoderma viride.*

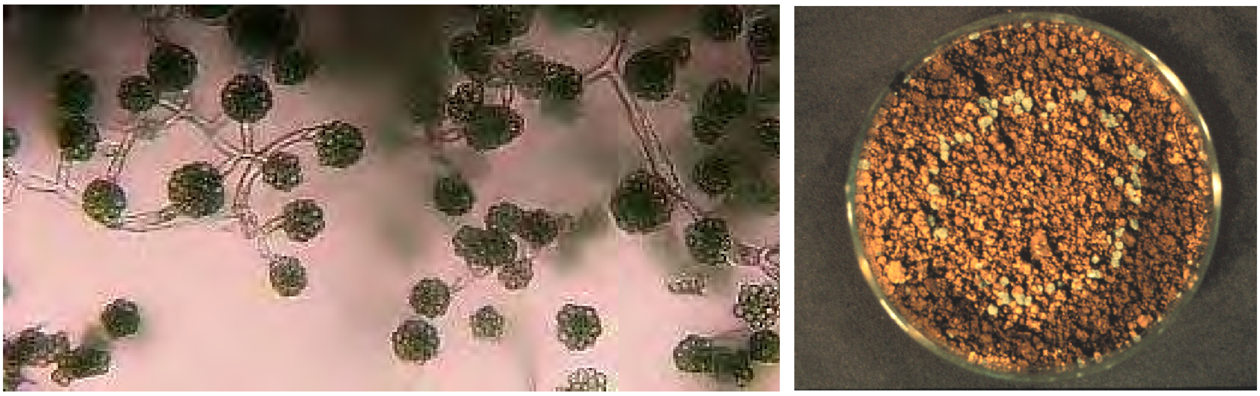


Figure 5. Trichoderma viride conidial spores in soil (left), commercial dried culture of conidial spores(right)

4. *Glyricidia planting on field bunds*

- Farmers were encouraged to plant 3-4 months aged plants from nursery or cutting of tender branches of *Glyricidia* at 50 cm apart on field bunds.
- *Glyricidia* plant produce green leaf and succulent green branches abundantly (Figure 6) which are rich in Nitrogen.
- Green leaf and loppings can be harvested leaving 1 m height plants of one year old and apply to topsoil for enriching organic carbon and nutrients in the soil.
- *Glyricidia* on bunds can be harvested thrice in a year and applied before sowing of rainy season crop, *rabi* season crop and summer season crop.

Figure 6. Glyricidia planting on field bunds as green manure and reduce soil erosion

5. *Vermicomposting*

With an objective of converting farm residues and organic wastes in villages with the help of earthworms into valuable manure known as vermicompost was introduced to farmers and rural women as a technology through Sujala-ICRISAT project. Several compost pits were constructed in the watershed villages during the project period. Technology components mainly include selection and use of non-burrowing type of earth worms (*Eisenia sp., Eudrilus sp.*), use of weeds and crop residues and sericulture residues, animal and poultry manures and rock phosphate as materials.

Figure 7. Adoption of Vermicompost preparation with farm waste in a village by farmer in Dharwad

During trainings, farmers and field facilitators were briefed about the benefits of vermicomposting as enriching soil organic carbon and thereby productivity, good storage quality of produce without toxic residues, fetches higher price for organic produce in the markets. Scientific methods of vermicompost preparation were provided to rural men and women SHG members (Figure 7), field facilitators during training programs in Bhoochetana project as a rural livelihood option.

Farmers' Preferred Varieties

High-yielding short-duration varieties of major rainfed crops were evaluated by large number of farmers in six districts through Sujala-ICRISAT project during crop seasons from

2005 to 2008. Farmers preferred some of these crop varieties suitable based on economic yield, acceptable quality of grain or pod and fodder in their region.

1. *Ragi (finger millet)*

Ragi is a staple food crop and is widely grown in Kolar, Chickballapur, Tumkur and Chitradurga districts. Based on some preferred traits, improved varieties of ragi released for Karnataka GPU 28, HR 911, L 5 and MR 1 were evaluated by farmers during 2005-2008 crop seasons under Sujala-ICRISAT initiative. In these evaluations farmers preferred L 5 and MR 1 varieties based on yields and hence recommended to farmers in Bhoochetana project.

L 5

- Suitable for late season sowings and requires medium inputs.
- It is a medium duration (110-115 days) to grow and possess drought and disease tolerant traits.
- L 5 produces higher grain yield and palatable fodder.

MR 1

- It is a medium-duration variety, matures in 120-125 days.
- Suitable for early season sowings and perform better with high input management.
- Produces higher grain and fodder yields when farmers take up best management practices with good rainfall.

2. *Groundnut*

Short-duration cultivars of groundnut ICGV 91114, Kadiri 1375, Kadiri 6 and GPBD 4 were evaluated by large number of farmers in their fields for three seasons in these six districts under Sujala-ICRISAT initiative during 2005-2008 crops seasons. Farmers expressed interest to adopt ICGV 91114 in Kolar, Chickballapur, Tumkur and Chitradurga while farmers in Haveri and Dharwad expressed interest to adopt GPBD 4 for their cropping.

ICGV 91114

- Short duration (100-110 days) bunchy variety developed by ICRISAT and subsequently released by the GoK in 2009, was found suitable for Kolar, Chickballapur, Tumkur and Chitradurga districts.

- Higher pod and fodder yields recorded with this cultivar during Sujala-ICRISAT project evaluations, drought tolerant, performed well during short rainy seasons with mid-season dry spells.

GPBD 4

- Short-duration (100-110 days), foliar disease resistant cultivar, most suitable for rainy season in Haveri and Dharwad which receive well distributed rainfall. This variety was released by the University of Agricultural Sciences, Dharwad.
- High-yielding cultivar that produces small well-filled pods in bunches and good quality disease-free fodder. It was consistently better performer in Dharwad and Haveri districts during Sujala-ICRISAT evaluations in farmers' fields.

3. Soybean

Soybean cultivars JS 335 and JS 9305 were evaluated by large number of farmers in Dharwad and Haveri during 2005-2008 crop seasons under Sujala-ICRISAT initiative. JS 9305 showed good growth and was found to give higher yields despite drought. The variety has been introduced in Haveri and Dharwad as preferred by farmers in these districts.

JS 9305

- This cultivar is a short duration variety of 93-95 days duration
- Tolerant to drought and foliar diseases. Its grain quality is well-accepted by farmers.

4. **Maize**

Commercially released high-yielding private hybrids used by farmers.

5. **Sunflower**

Commercially released high-yielding private hybrids and varieties accepted by farmers.

Integrated Pest Management

Farmers across all the six districts were trained on adopting cultural and biological methods of pest control, insect monitoring using pheromones traps (Figure 8), chemical control of insects on crossing threshold levels and growing tolerant cultivars.

Figure 8. Shaking pigeonpea plants to drop Helicoverpa larvae from the plants

Figure 9a. Soaked chickpea seed infected with NP virus as feed to Heliothis larvae.

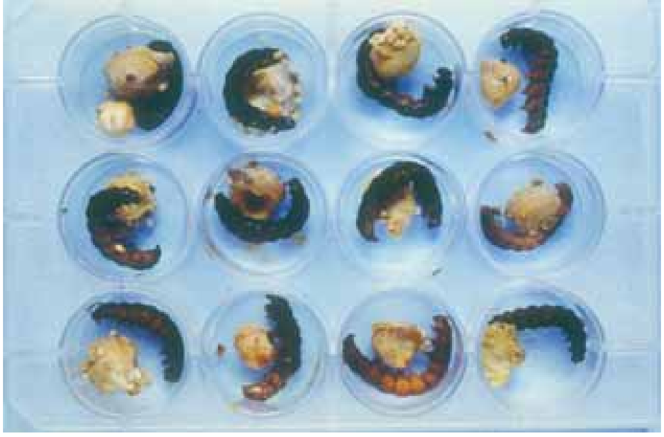


Figure 9. Dead Helicoverpa larvae by consuming NP Virus infected seed.

Figure 9b. Larval crush centrifused to isolate virus, which is sedimented at the bottonm.

Training modules on controlling the damage caused by major insect pests like *Helicoverpa sps* on pigeonpea and an epidemic causing red hairy caterpillar on groundnut; several approaches including spraying of Nuclear Polyhedrosis Virus (NPV) early stage larvae and its preparation in house were also included for the benefit of farmers' groups. Cost-effective eco-friendly biological control methods like shaking pigeonpea plants at flowering and pod formation was suggested, if *Heliothis* sps. infestation is severe in these stages. Field advisories were organized during crop season with the assistance of UAS, Bengaluru and Dharwad staff coordinating with DoA officials in the districts.

Income-generating Rural Livelihoods

1. Village seed banks

The concept of village seed banks was promoted successfully in Sujala-ICRISAT watersheds in Karnataka during 2005-2008, with an objective of ensuring quality and cheaper seed to farmers in the villages. The efforts to further strengthening the village seed banks are continued in several villages under Bhoochetana project to enhance availability of ragi (L 5 and MR 1), groundnut (ICGV 91114 and GPBD 4) and soybean (JS 9305) cultivars which were preferred by the farmers.

2. **Custom hiring centers for agricultural machinery**

Tropicultors as either animal drawn or tractor drawn and animal drawn Penugonda ferti-cum seed drill (Figure 10) were placed in the control of each ADA to provide it for **the** needy farmers on hiring. This approach helped farmers who can not afford to buy them in the season, but use them based on their operational efficiency and to reduce dependence on labor for timely operations like sowing cum fertilizer application.

Figure 10. Tropicultor and Penugonda kurgi available for farmers in custom-hiring centers.

Project Strategy

Farmers' Participatory approach for enhancing crop productivity

- The most important strategy for this initiative is to adopt the Mission mode through convergence of different line departments of Government of Karnataka along with academic institutions like University of Agricultural Sciences, Bengaluru, Dharwad and Raichur with the international institution working in the area of dryland agriculture worldwide.

- Government of Karnataka has already constituted State level Coordination Committee (SCC) for Bhoochetana programme headed by the Additional Chief Secretary & Development Commissioner to review the performance of the programme at regular intervals.

The salient points for the Mission mode are as follows:

- The Mission will adopt the principle of 4 Cs i.e., Consortium, Convergence, Capacity-building and Collective action. The consortium will be of development agencies such as line departments of state government and Field Facilitators' (FFS) along with academic and research institutions who are generators of the new technologies for improving the livelihoods of the rural poor in dryland area.

- By adopting the principle of 4 Cs we will address the Mission goal through 4 Es i.e., Efficiency, Economic gain, Equity and Environment protection, which are the important pillars of the sustainable and inclusive development in the country.

- The approach of the Mission will be to ensure all backward linkages to meet the 4 Es through 4 Cs by ensuring timely supply, availability and access to the necessary vital inputs such as knowledge-based soil nutrient management options, acquiring micro nutrients, availability of good quality seed and other best practices necessary financial incentive to undertake best-bet options for increasing agricultural productivity.

- To undertake improved best-bet management practices on large scale and share knowledge through their peer group. The lead farmers in the districts where already work has been done in the last four years under Sujala-ICRISAT initiative with the trained NGOs is an added strength for undertaking such a Mission in a short time.

- The scientific approach of mapping soil nutrient deficiencies in the remaining 18 districts will be the starting point for scaling up the soil analysis based integrated nutrient management practices for sustainable growth in dryland areas of Karnataka. The DoA is being empowered to adopt soil-test based approach for developing site specific fertilizer recommendations. This approach not only increases the productivity of the land but also reduced the cost of cultivation by advising the farmers not to apply the fertilizers, which are not required by their soils.
- Along with the improving nutrient management the other best-bet practices such as rainwater management, pest management options and organic matter building practices will support the long term sustainability and enhance productivity.
- The most important constraint in dryland areas is the establishment of good crop stand and availability of good quality seeds of high yielding, improved cultivars. The Mission is guiding for establishment of village seed banks for the self pollinated crops such as groundnut and chickpea as well as cross pollinated crops such as sorghum, pigeonpea

etc., by training the farmers and establishing seed villages and village seed banks to ensure timely supply of seeds at reasonable prices for the farmers.

- Time lines are defined clearly for covering productivity enhancements in 24 districts, soil sampling and nutrient analysis mapping and capacity building of stakeholders during the project period as shown in Table 2a (timelines) in Grantt table 2b.

Table 2a. Timeline for execution of activities in Bhoochetana districts.

Activity	Year	% activity coverage in districts		
		1-6	7-15	16-24
Productivity enhancement	2009	25		
	2010	50	33	
	2011	75	66	50
	2012	100	100	100
Nutrient status mapping	2009	100		
	2010		100	
	2011			100
	2012			
Capacity-building	2009	100		
	2010		100	
	2011			100

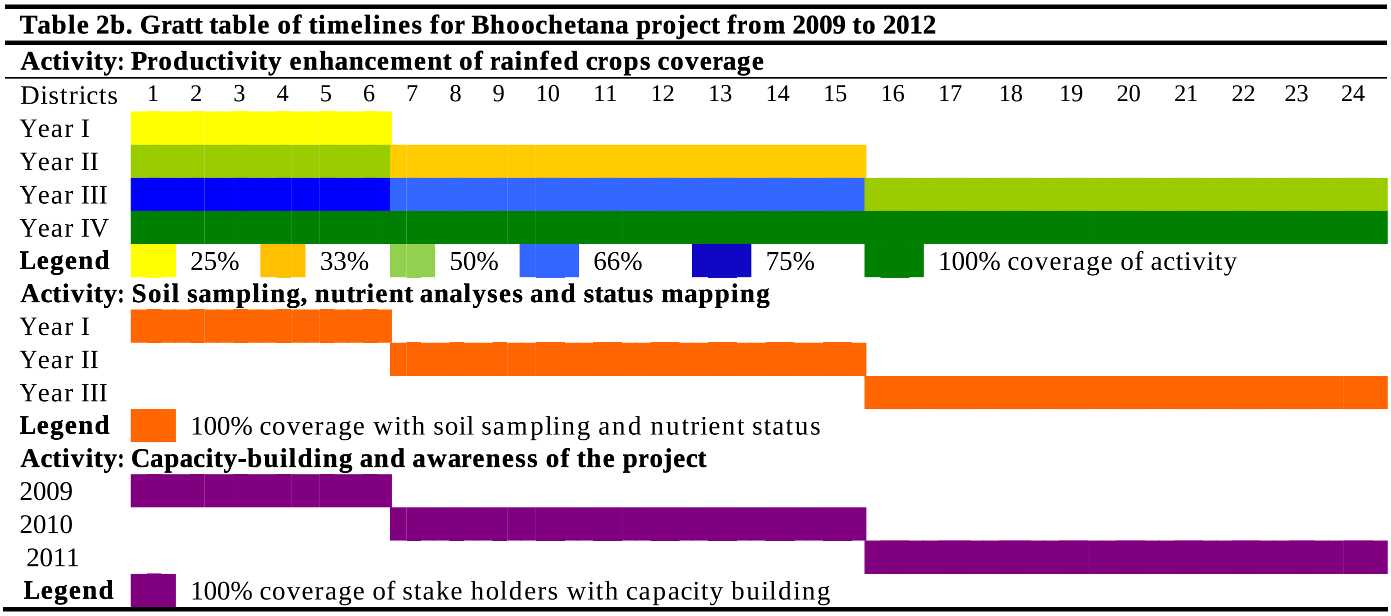


Table 2b. Gratt table of timelines for Bhoochetana project from 2009 to 2012

Activity: Productivity enhancement of rainfed crops coverage

Districts	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Year I	🟨	🟨	🟨	🟨	🟨	🟨																		
Year II	🟢	🟢	🟢	🟢	🟢	🟢	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧									
Year III	🔵	🔵	🔵	🔵	🔵	🔵	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Year IV	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩

Legend 🟨 25% 🟧 33% 🟢 50% 🟦 66% 🔵 75% 🟩 100% coverage of activity

Activity: Soil sampling, nutrient analyses and status mapping

Districts	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Year I	🟥	🟥	🟥	🟥	🟥	🟥																		
Year II							🟥	🟥	🟥	🟥	🟥	🟥	🟥	🟥	🟥									
Year III																🟥	🟥	🟥	🟥	🟥	🟥	🟥	🟥	🟥

Legend 🟥 100% coverage with soil sampling and nutrient status

Activity: Capacity-building and awareness of the project

Districts	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
2009	🟪	🟪	🟪	🟪	🟪	🟪																		
2010							🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪									
2011																🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪

Legend 🟪 100% coverage of stake holders with capacity building

Through various activities such as village seed banks and vermicomposting, women were the important stakeholders in the development and will be involved in this Mission to ensure sustainability.

- In addition to the strength of convergence through consortium, the Mission will have planning and monitoring mechanism at cluster, taluk, district and state levels. The AC includes the decision makers from the different consortium partners including line departments to take timely necessary action through suitable government orders to all the concerned Mission staff.

- The Mission has simple principle of accountability and delegation of authority atdifferent levels without diluting the individual accountability to meet the Mission goal collectively.

- The Mission adopts in addition to the above, the rewarding mechanisms for the best performers i.e., the farmers at cluster, taluq, district and state level with appropriate personal recognitions. Similarly, the Mission staff those exhibit outstanding performance are also recognized by the state government.

Project Activities

Soil Nutrient Diagnostic Studies and Nutrient Input Recommendations

Stratefied Soil Sampling in the 16 Districts

Soils samples from around 11609 farmers' fields in several taluk of each district were collected in six districts during 2008 were analyzed for diagnosing macro and micronutrients status of farmers' fields. Based on the established critical limits for each nutrient, fields were categorized as deficient or sufficient.

Individual farmers were provided soil health cards based the mean nutrient status in the soils of the village as the soils analysed were representative of the village soils as they were done following a stratified soil sampling methodology. Soil nutrient status maps were provided for each district using inter polated soil nutrient status data and GIS techniques for the benefit of policy makers.

Kolar

In Kolar, more than 80% fields were deficient in organic carbon in four out of five taluks. In Malur taluk 70% of farmers' fields were deficient in sulfur and boron and more than 80% of the fields in all taluks were deficient in boron and sulphur (Map 2). Olsen P, Potash and Zn were deficient in less than 50% of the farmers' fields in all taluks. Soils in different taluks of Kolar are light textured Alfisols. Nutrient status of different taluks is depicted in Map 2a-12 using GIS interpolation technique.

Table 3. Details of soil samples collected from farmers' fields in six districts of Karnataka during 2008-09 season.

S.No.	Name of the district	No of villages selected	No of samples collected	No of soil health cards distributed
1	Kolar	108	2161	2161
2	Chikballapur	113	2257	2257
3	Tumkur	152	3041	3041
4	Chitradurga	75	1489	1489
5	Haveri	77	1532	1532
6	Dharwad	57	1129	1129
Total	**6**	**582**	**11609**	**11609**

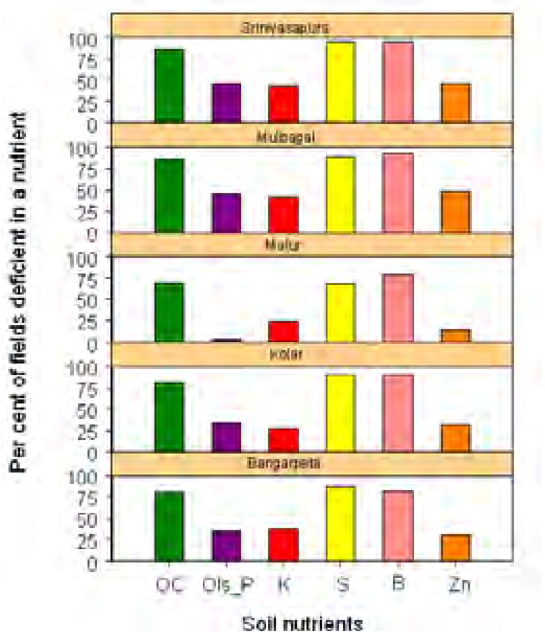


Figure 10a. Nutrient status of farmers' fields in different taluks of Kolar district

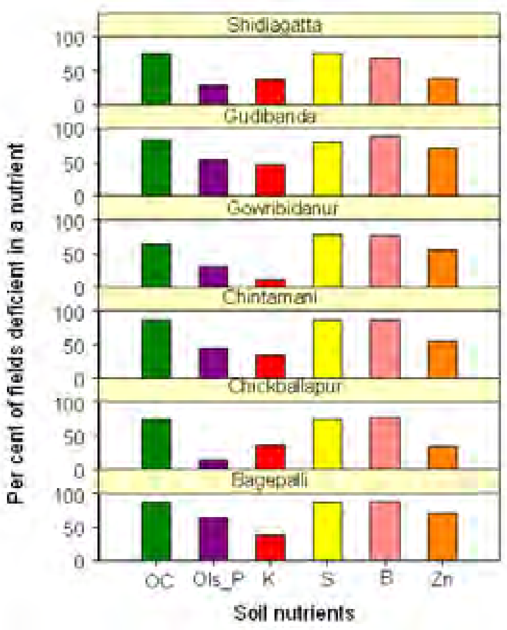


Figure 10b. Nutrient status of farmers' fields in different taluks of Chickballapur district

Chickballapur

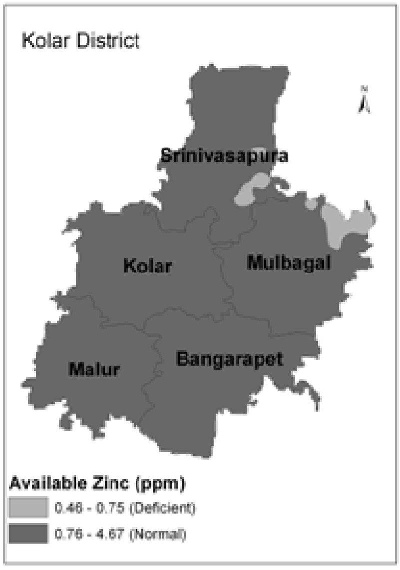
In Chickballpur, across all taluks organic carbon is low and deficient in more than 75% of fields in five taluks except in Gowribidunur where 64%.of the fields were deficient and soils in this district are mostly lighter Alfisols. Phosphorus is deficit in less than 50% of the fields in all taluks except in Bagepalli and Gudibanda taluks (Figure 10b), where application of DAP for groundnut has been a common practice. Potash is generally available sufficiently and deficient in less than 45% of the farmers' fields in this district. Sulfur and micronutrients boron and zinc were deficient in more than 50% farmers' fields in all taluks except in Chickballapur where Zn was available in 66% of the fields in the district (Map 3a-3e).

Map 2a. Taluka-wise soil organic carbon status in farmers' fields, Kolar.

Map 2b. Taluka-wise soil available Phosphorus status in farmers' fields, Kolar.

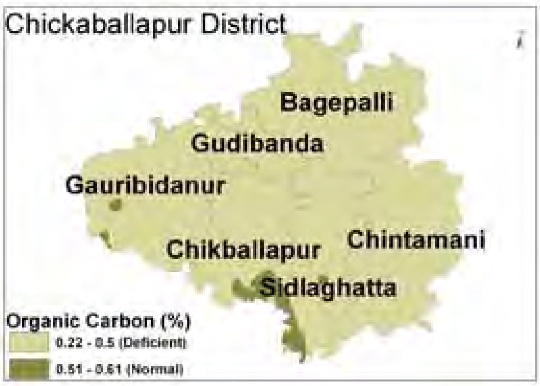
Map 2c. Taluka-wise soil available Potassium status in farmers' fields, Kolar.

Map 2d. Taluka-wise soil available Sulfur status in farmers' fields, Kolar.

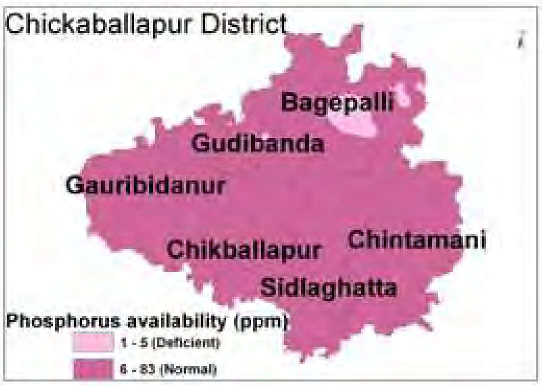


Map 2e. Taluka-wise soil available Zinc status in farmers' fields, Kolar.

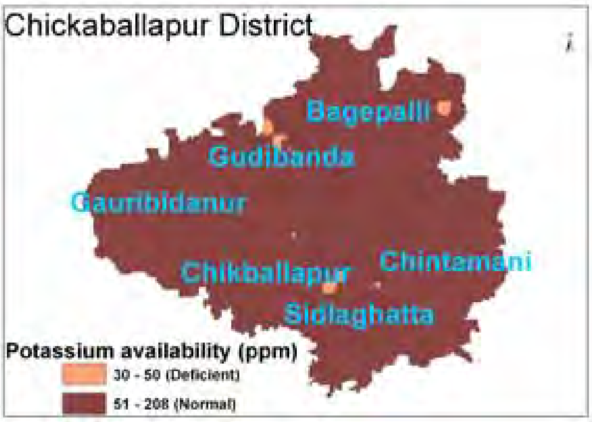
Map 2f. Taluka-wise map of soil available Boron status in farmers' fields, Kolar.



Map 3a. Taluka-wise soil organic carbon status in farmers' fields, Chickballapur.

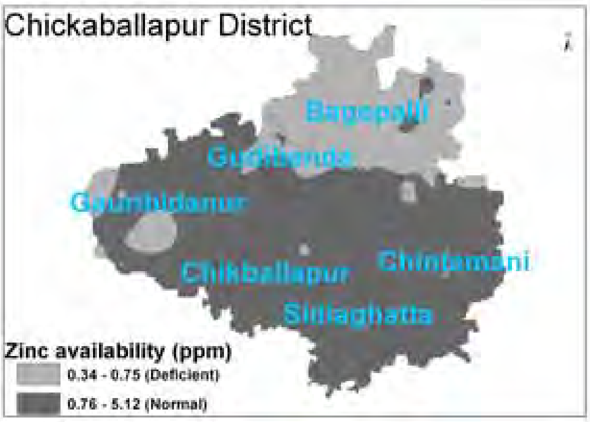


Map 3b. Taluka-wise soil available Phosphorus status in farmers' fields, Chickballapur.

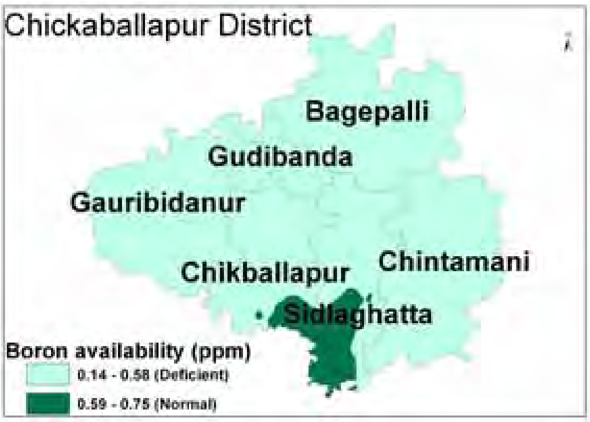


Map 3c. Taluka-wise soil available potassium status in farmers' fields, Chickballapur.

Map 3d. Taluka-wise soil available Sulfur status in farmers' fields, Chickballapur.



Map 3e. Taluka-wise map of soil available Zinc status in farmers' fields, Chickballapur.



Map 3f. Taluka-wise soil available Boron status in farmers' fields, Chickballapur.

Tumkur

Soils were poor in organic carbon, more than 75% of farmers' fields are considered deficient of OC in 8 taluks and Turuvekere was the only taluk where 48% of the fields were deficient. In the entire district of Tumkur, all other nutrients were particularly deficient that is covered by light textured Alfisols. OC, Olsen's P, sulfur, boron were deficient in all taluks (Figure 11). In this district, potassium is also becoming deficient nutrient unlike in other districts. Results of nutrient deficientices in differtnt taluk s are depicted in Map 4a-4e.

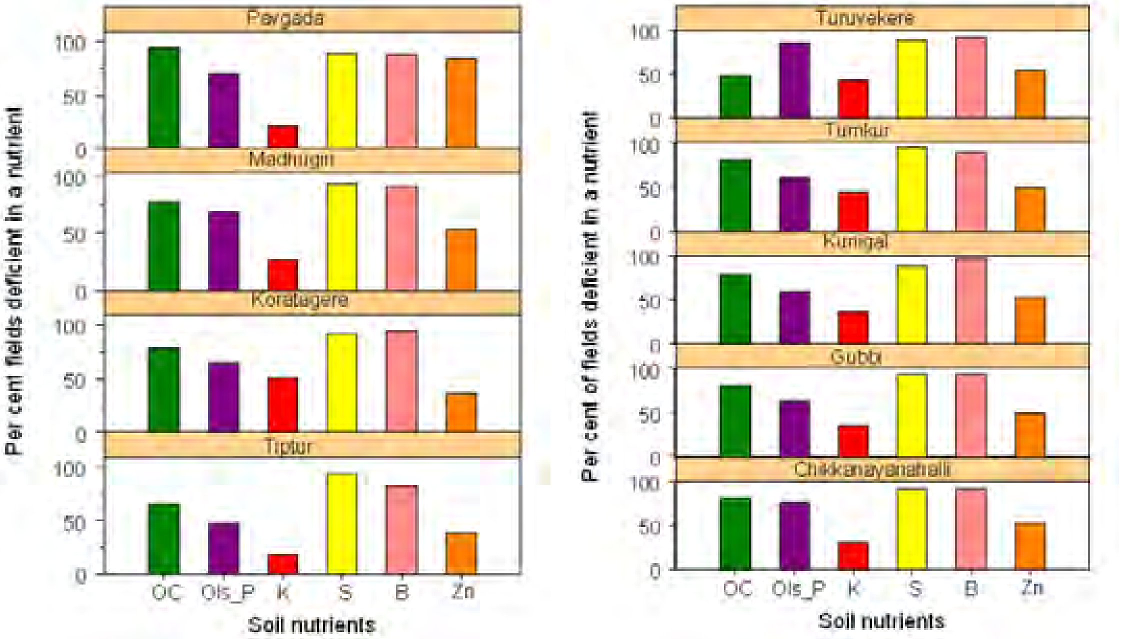
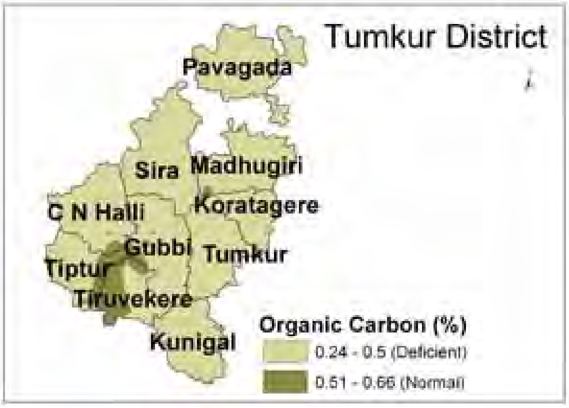
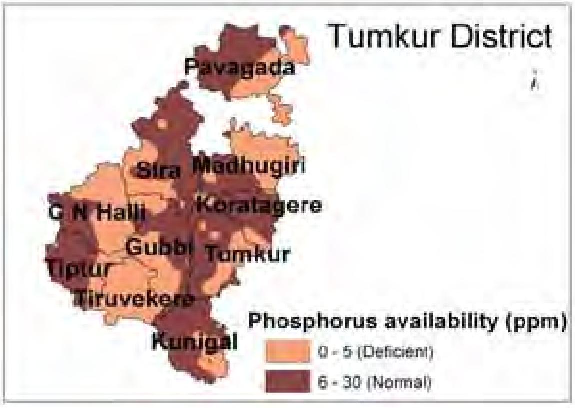


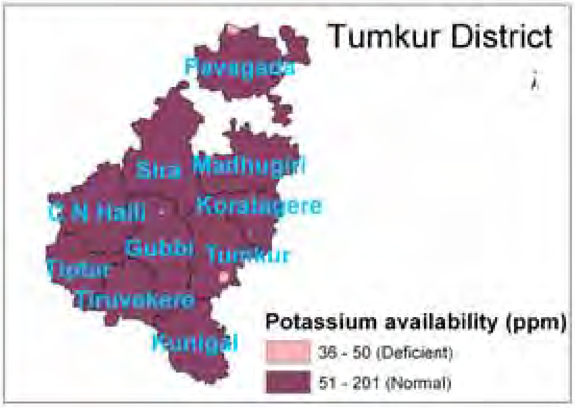
Figure 11. Nutrient status of farmers' fields in different taluks of Tumkur district



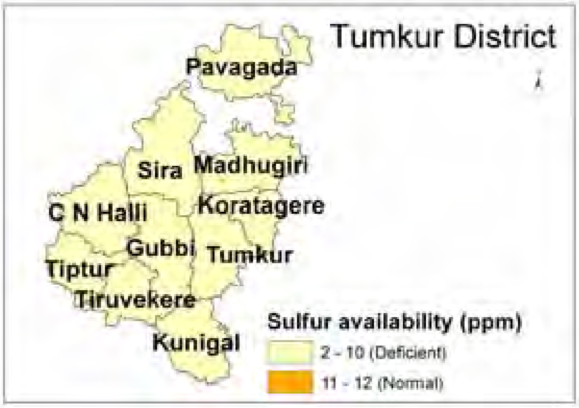
Map 4a. Taluka-wise soil organic carbon status in farmers' fields, Tumkur.



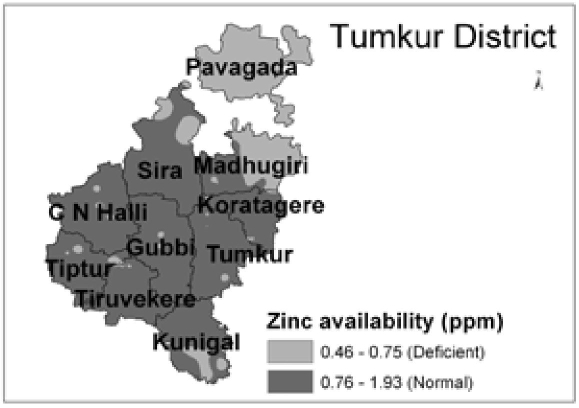
Map 4b. Taluka-wise soil available Phosphorus status in farmers' fields, Tumkur.



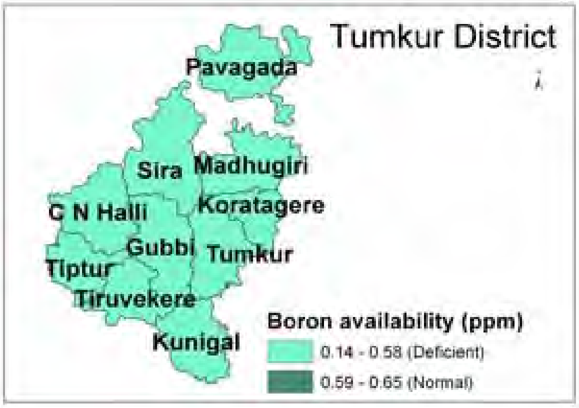
Map 4c. Taluka-wise soil available Potassium status in farmers' fields, Tumkur.



Map 4d. Taluka-wise map of soil available Sulfur status in farmers' fields, Tumkur.

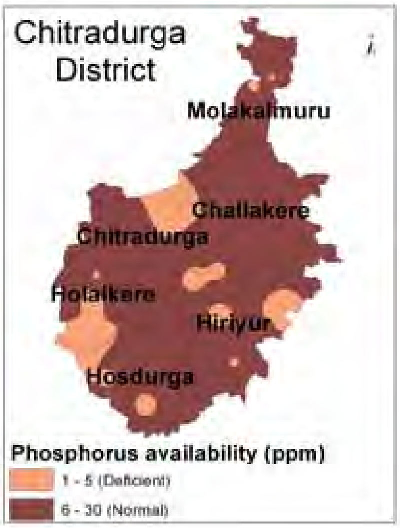


Map 4e. Taluka-wise map of soil organic carbon status in farmers' fields, Tumkur.



Map 4f. Taluka-wise map of soil available P status in farmers' fields, Tumkur.

Map 5a. Taluka-wise soil organic carbon status in farmers' fields, Chitradurga.



Map 5b. Taluka-wise soil available Phosphorus status in farmers' fields, Chitradurga.

Map 5c. Taluka-wise soil available Potassium status in farmers' fields, Chitradurga.

Source: RDS, ICRISAT, Patancheru, A P

Map 5d. Taluka-wise map of soil available Sulfur status in farmers' fields, Chitradurga.

Map 5e. Taluka-wise map of soil available Zinc status in farmers' fields, Chitradurga.

Map 5f. Taluka-wise map of soil available Boron status in farmers' fields, Chitradurga.

Chitradurga

In Chitradurga, fields in all taluks have deficiency of organic carbon, sulfur and micronutrients zinc and boron in more than 50% farmers' fields. Olsen P is deficient in black soil areas of Holalkere, Hiriyur, Chitraduraga taluks besides prominent Alfisol areas in Chellakere taluk (Map 5a-5d). Zinc deficiency is especially more pronounced in all taluk of this district (Figure 12a). However, soils in the entire district are sufficient in Potash as seen in Map 5c.

Haveri

In Haveri district, soils of farmers' fields were relatively better in terms of organic carbon with less than 50% fields were deficient in Byadagi, Hangal, Haveri and Shiggavi taluks, while soils in Hirekerur, Ranebennur and Savanur were deficient of organic carbon in more than 50% farmers' fields. Sulfur deficiency was conspicuously acute (>80% of farmers' fields) in all taluks of the district, followed by zinc deficiency in >50% fields in four taluks (Byadagi, Haveri, Ranebennur and Savanur) out of seven taluks. Boron deficiency in >50% of the fields in Hangal, Haveri and Shiggavi taluks were observed (Figure 12b) (NMap 6a-6e).

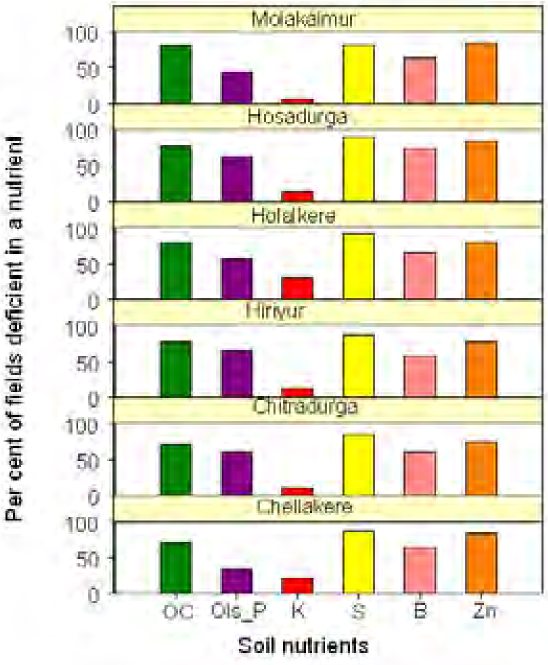


Figure 12a. Nutrient status of farmers' fields in different taluks of Chitradurga district

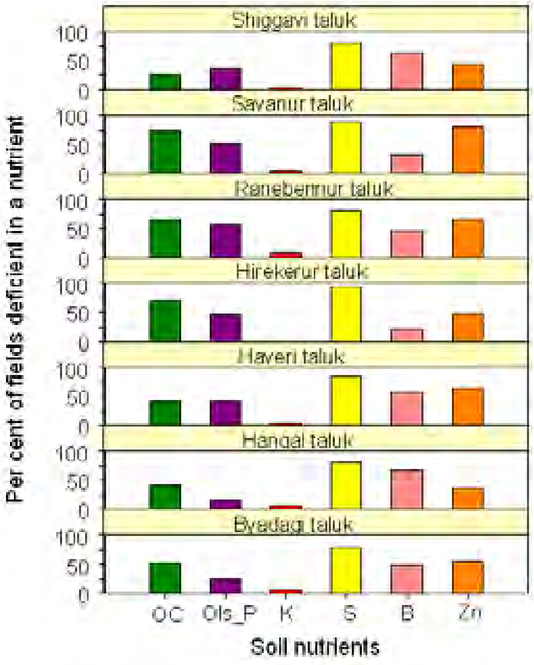
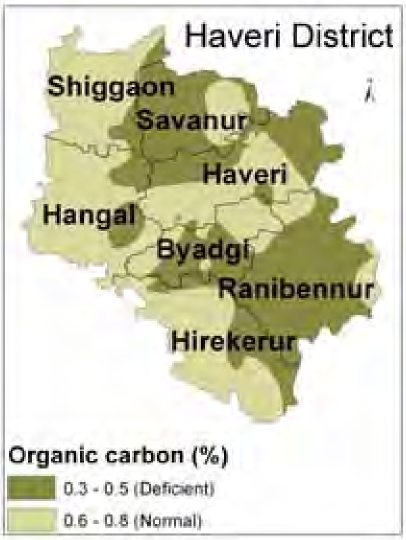


Figure 12b. Nutrient status of farmers' fields in different taluks of Haveri district



Map 6a. Taluka-wise soil Organic Carbon status in farmers' fields, Haveri.

Map 6b. Taluka-wise soil available Phosphorus status in farmers' fields, Haveri.

Map 6c. Taluk-wise soil available Potassium status in farmers' fields, Haveri.

Map 6d. Taluka-wise soil available Sulfur status in farmers' fields, Haveri.

Map 6e. Taluka-wise soil available Zinc status in farmers' fields, Haveri.

Map 6f Taluka-wise map of soil available Boron status in farmers' fields, Haveri.

Dharwad

Farmer field soils were relatively richer with organic carbon in Dharwad, Hubbali and Kalaghatagi, but >50% fields were deficient in Kundagola and Navalgund.

Olsen P was generally deficient in all taluks except Dharwad, however, potassium was not deficient in all taluks (Figure 13). Sulfur deficiency was pronounced in all taluks of the district with >60% of farmers' fields deficient. Boron was deficient in Hubbali, Kalaghatagi and zinc was deficient in >50% fields of Kundagola and Navalagund (Map 7).

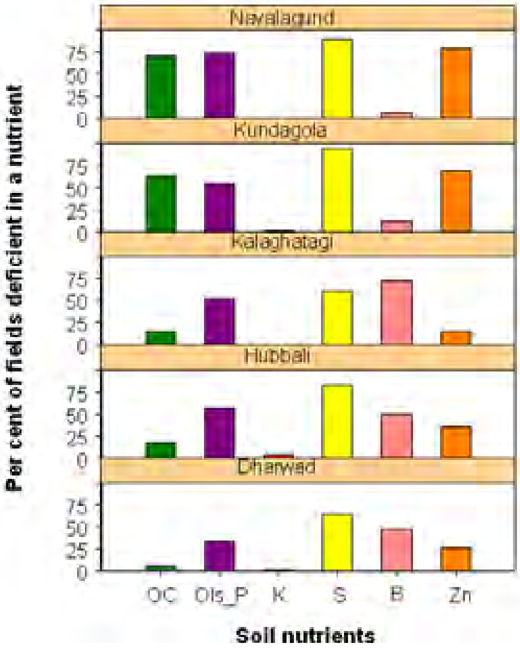


*Figure 13. Nutrient status of farmers' fields in different taluks of Dharwad district***.**

Map 7a. Taluka-wise soil organic carbon status based on farmers' fields, Dharwad.

Map 7b. Taluka-wise soil available Phosphorus status based on farmers' fields, Dharwad.

Map 7c. Taluka-wise soil available P status in farmers' fields, Dharwad.

Map 7d. Taluka-wise soil available Sulfur status in farmers' fields, Dharwad.

Map 7e. Taluka-wise soil available Zinc status based on farmers' fields, Dharwad.

Map 7f. Taluka-wise soil available Boron status in farmers' fields, Dharwad.

Soil Sampling for Nutrient Status in Nine Districts

During the year, with good coordination from DoA staff in respective districts, we conducted village meetings for farmers and emphasized the need of assessing soil nutrient status for balanced nutrient application. Hands-on trainings were organized to groups of farmers, on scientific methods of collecting representative soil samples from their fields in the village. With the active participation of farmers and DoA staff coordination, ICRISAT staff collected 35460 samples in 1773 villages of nine district from June to December as given in Table 4. In each district, 20% of the villages were selected and in each village 20 representatives fields were sampled based on stratified sampling technique considering topo-sequence of the fields in a watershed village. All these samples were transported to Hyderabad, processed by grinding, sieving and analyzing these samples in the ICRISAT's laboratory for their nutritional status.

The results of soil samples analyzed from these nine districts which becme 10 districts subsequently are presented in Table 5. The results from soil sample analysis from Bengaluru Rural district indicate Organic carbon which is a proxy for nitrogen supply, is deficient in more than 70% of soils in all taluks except Devanhalli of Bengaluru rural. While phosphorus and potasium nutrients were not deficient in majority of the fields, sulfur and micronutrient boron was found deficient in these soils. These soils probably received sufficient phosphorus as it is groundnut growing area and zinc was also sufficiently supplied because it has larger areas of orchard plantation.

Table 4. Collection of soil samples in nine selected districts of Karnataka for soil nutrient analysis.

S.No.	Name of the district	No of villages soil sampling completed by ICRISAT	Total number of farmers' fields sampled
1	Bidar	120	2400
2	Bijapur	140	2800
3	Gulbarga+Yadgir	284	5680
4	Raichur	171	3420
5	Gadag	68	1360
6	Bengaluru Rural	228	4560
7	Davangere	157	3140
8	Chamarajnagar	83	1660
9	Hassan	522	10440
Total	**9 districts**	**1773**	**35460**

In Bidar, the soils were found deficient in sulfur and micronutrients such as Zn and boron while N P K are in the normal range with majority of field possesing just enough nutrient availability. Soils in all taluks of Bijapur were poor in OC, P, sulfur and Zn while they possess sufficiently available K and Boron. Soils in Chamarajanagara are low in Organic carbon, sulfur and Zn while these soils have sufficient available P and K. In Davangere soils are quite variable across different taluk in terms of OC, available phosphorus and potash; however sulfur, Zn and boron are deficient in all taluks except in Harihara taluk where available sulfur and available boron are sufficient in the fields. Soils in all taluks of Gadag were deficient in OC, available P, sulfur and Zn and these soils hold sufficiently available K and boron in all taluks. Soils in all taluks of Gulburga were poor in OC, P, sulfur, zinc and boron, but these soils hold enough of potash as these soils are Vertisols. Soils in Hassan are rich in macro nutrients N, P, K and micronutrient Zn also. However, in all taluks sulfur and boron were found to be deficient. Boron deficiency is recorded in different taluks of Raichur except Sindanur and Lingasugur where the soils are predominantly black soils; hence these soils are also rich in K, but exhibiting deficiency of N, P, sulfur and Zn. In the newly subdivided district of Yadgir, soils in all taluks analysed showed deficiency of N, P and micronutrient exception of potassium which is available sufficiently in almost all fields.

Table 5. Soil nutrient status of farmers' fields in different taluks of 10 districts in Karnataka.

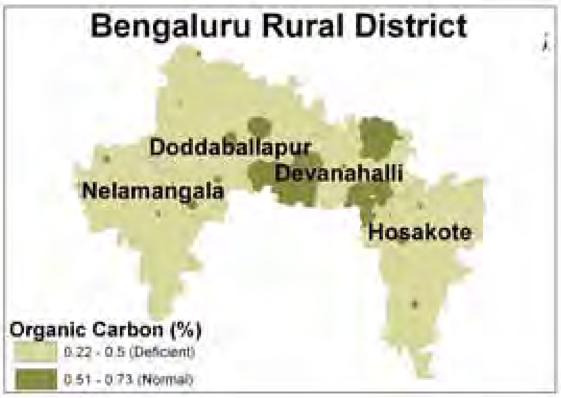
District	Taluk	Per cent of farmers' fields deficient in a nutrient					
		OC	P	K	Sulfur	Zinc	Boron
	Devanahalli	48	9	16	97	40	78
1. Bengalurur (R)	Doddaballapura	73	19	33	95	39	68
	Hoskote	81	15	39	88	15	71
	Nelamangala	82	21	29	97	47	58
2. Bidar	Aurad	56	54	0	89	84	86
	Basavakalyan	30	26	1	81	36	58
	Bhalki	57	64	0	71	81	66
	Bidar	26	41	0	93	44	60
3. Bijapur	Bagewadi	71	79	3	89	85	39
	Bijapur	77	80	3	72	92	35
	Indi	68	85	8	69	86	48
	Muddebihal	71	76	0	89	91	48
	Sindagi	65	86	3	66	90	44
	Bagewadi	71	79	3	89	85	39
4. C'raja nagara	Chamarajanagara	78	47	1	87	47	59
	Gundlupete	72	40	2	92	76	49
	Kollegaala	69	28	9	89	68	67
	Yellanduru	55	30	0	100	65	70
5. Davangere	Channagiri	41	26	14	66	52	60
	Davangere	56	29	10	87	75	74
	Harapanahlaly	61	44	12	82	87	73
	Harihara	36	35	3	35	65	32
	Honnali	37	21	10	75	62	76
	Jagalur	81	51	23	100	100	69
6. Gadag	Gadag	73	67	1	93	90	32
	Mundargi	54	63	5	77	89	41
	Naragund	77	56	0	63	92	3
	Ron	94	72	4	91	95	37
	Shirahalli	68	62	2	85	93	41
7. Gulburga	Aaland	48	68	0	89	91	70
	Afzalpur	61	72	0	74	64	89
	Chincholi	52	55	3	92	74	78
	Chittapur	77	46	0	84	71	88
	Gulbarga	51	73	0	87	69	87
	Jevargi	59	83	0	65	46	97
	Sedam	76	49	0	92	82	96
8. Hassan	Alur	23	25	18	87	36	93
	Arkalgud	30	18	8	68	48	89
	Arsikere	80	23	11	93	66	91
	Belur	33	25	35	79	50	89
	Channarayapattana	80	36	9	82	71	93
	Hassan	50	9	10	88	35	96
	Holenarsipur	57	19	19	74	55	88
	Sakleshpur	15	28	41	79	30	83
9. Raichur	Deodurg	85	54	6	70	84	46
	Manvi	64	54	4	84	86	52
	Lingsugur	79	49	0	70	85	18
	Raichur	77	45	14	73	78	63
	Sindhanur	40	31	0	26	53	12
10. Yadgir	Shahapur	85	45	4	68	53	96
	Surpur	57	54	0	67	46	86
	Yadgir	83	43	12	81	76	86

District-wise Soil Nutrient Status Mapping

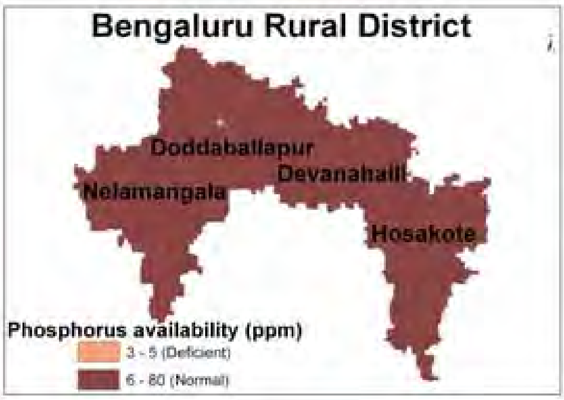
Using GIS based extrapolation techniques, district-wise nutrient status maps for OC, P, K, S, Zn and Boron besides pH and Ec of all sixteen districts (Map 2 to18) were prepared based on the geo-referencing of sampled fields initially on stratified sampling approach in each watershed with taluk boundaries are presented in the following pages for use of DoA staff.

Bengaluru Rural

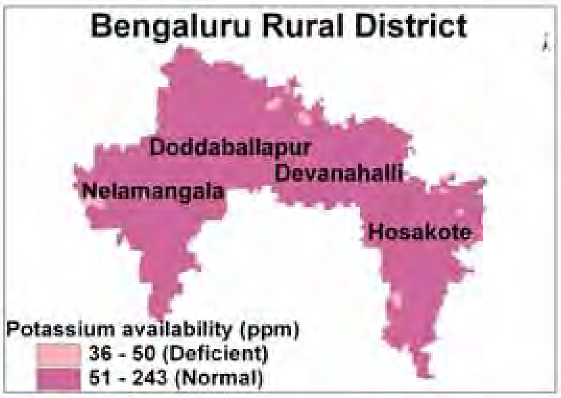
- Analysis of soil samples from 4 taluks in Bengaluru rural districts reveals that organic carbon (OC) was deficient in 70-80% of the farmers' fields in all taluk except Devanhalli where the percent of farmers' field found deficient in OC was less than 50%.
- In taluk with soils of OC deficiency, soil available N is low and soils are considered degrading and less productive.
- Sulfur and boron are severely deficient in all four taluks, and the farmers' fields deficient in sulfur were greater than 88% and were up to 97% in Nelmangala and Devanhalli.
- Zinc deficiency was found moderately between 15% and 47% of farmers' fields in different taluks of the district.



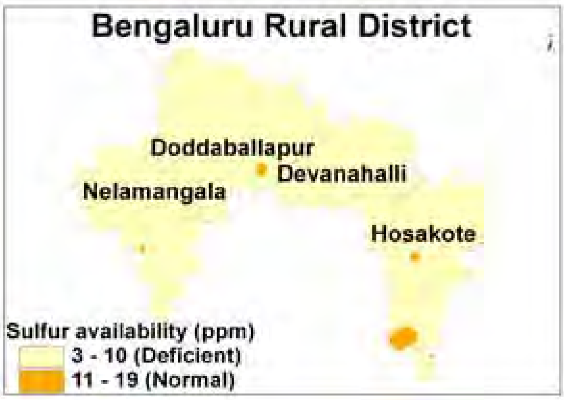
Map 8a. Taluka-wise soil organic carbon status in farmers' fields, Bengaluru Rural.



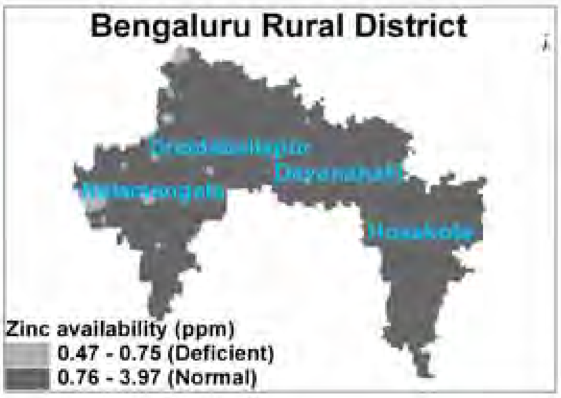
Map 8b. Taluka-wise soil available Phosphorus status in farmers' fields, Bengaluru Rural.



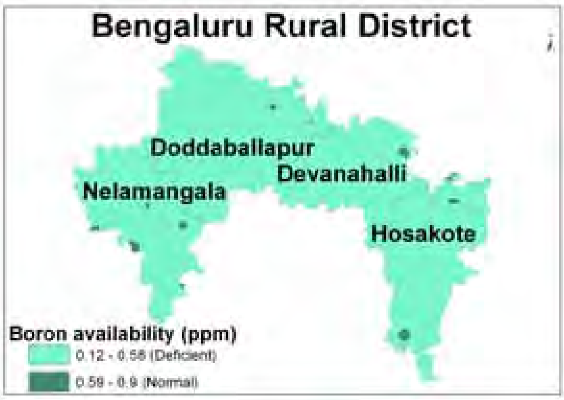
Map 8c. Taluka-wise soil available potassium status in farmers' fields, Bengaluru Rural.



Map 8d. Taluka-wise soil available sulfur status in farmers' fields, Bengaluru Rural.



Map 8e. Taluka-wise soil available Zinc status in farmers' fields, Bengaluru Rural.

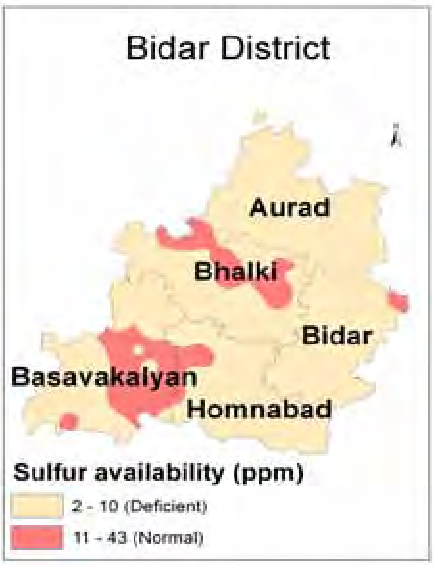


Map 8f. Taluka-wise soil available Boron status in farmers' fields, Bengaluru Rural.

Map 9a. Taluka-wise soil organic carbon status in farmers' fields, Bidar.

Map 9b. Taluka-wise soil available Phosphorus in farmers' fields, Bidar.

Map 9c. Taluka-wise soil available potassium status in farmers' fields, Bidar.



Map 9d. Taluka-wise soil available sulfur status based on farmers' fields, Bidar.

Map 9e. Taluka-wise soil available sulfur status based on farmers' fields, Bidar.

Map 9f. Taluka-wise soil available Boron status based on farmers' fields, Bidar.

Bidar

- Soils in Bidar, Basavakalyan and Homanabad taluks were considered normal with available OC content, while soils in parts of Bhalki and Aurad were low in organic carbon content indicates that soil available N is low and soils are degraded.

Sulfur and boron were deficient in soils of all taluks in Bidar; Zinc deficiency was observed in Aurad, Bhalki and parts of Homnabad.

Bijapur

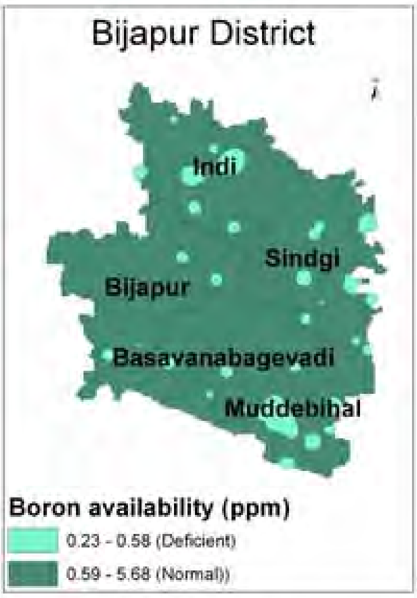
Map 10a. Taluka-wise soil organic carbon status in farmers' fields, Bijapur.

Map 10b. Taluka-wise soil available Phosphorus status in farmers' fields, Bijapur.

Map 10c. Taluka-wise soil available potassium status in farmers' fields, Bijapur.

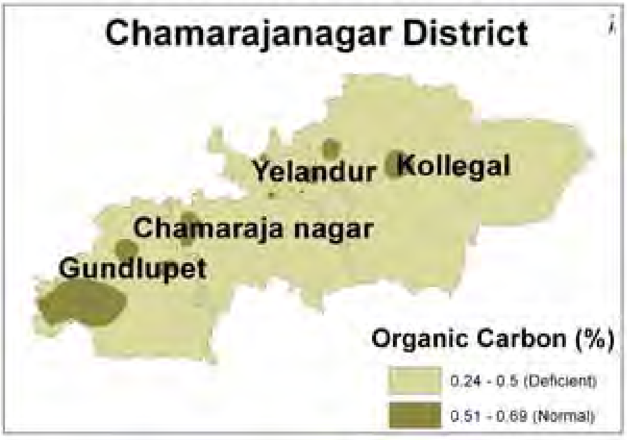
Map 10d. Taluka wise soil available Sulfur status in farmers' fields, Bijapur.

Map 10e. Taluka-wise map of soil available Zinc status in farmers' fields, Bijapur

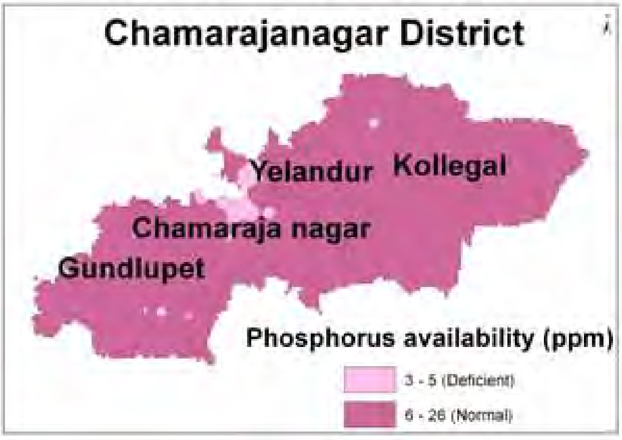


Map 10f. Taluka-wise soil available Boron status in farmers' fields, Bijapur.

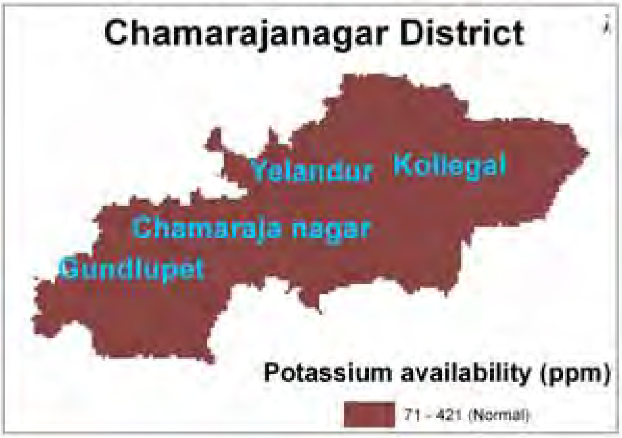
- In Bijapur, it was observed that OC is low in all 6 taluks of the district leaving out small isolated patches which were having normal levels of OC in the soils of the district.
- Similarly in all six taluks, soil available P levels were very low and deficient, but K is sufficient in all taluks of the district.



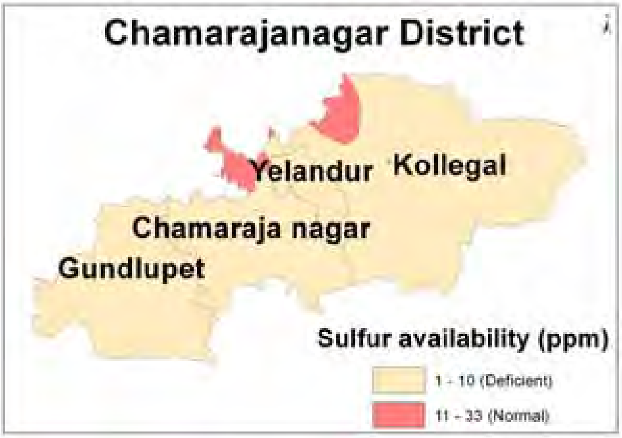
Map 11a. Taluka-wise soil organic carbon status in farmers' fields, Chamarajanagar.



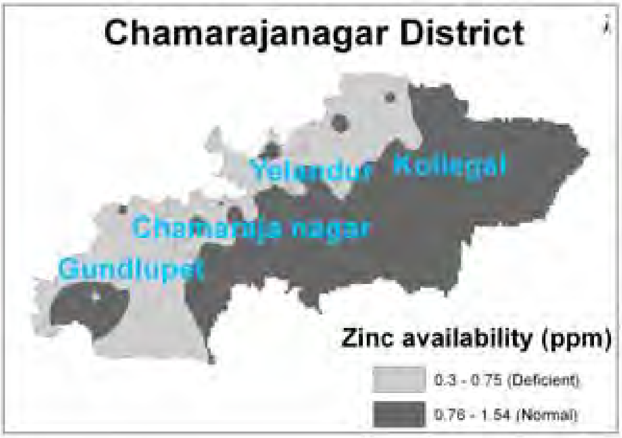
Map 11b. Taluka-wise soil available Phosphorus status in farmers' fields, Chamarajanagar.



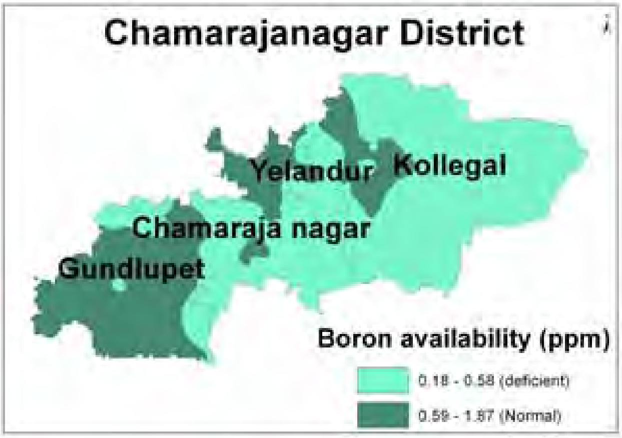
Map 11c. Taluka-wise soil available Potassium status in farmers' fields, Chamarajanagar.



Map 11d. Taluka-wise soil available Sulfur status in farmers' fields, Chamarajanagar.



Map 11e. Taluka-wise soil available Zinc status in farmers' fields, Chamarajanagar.

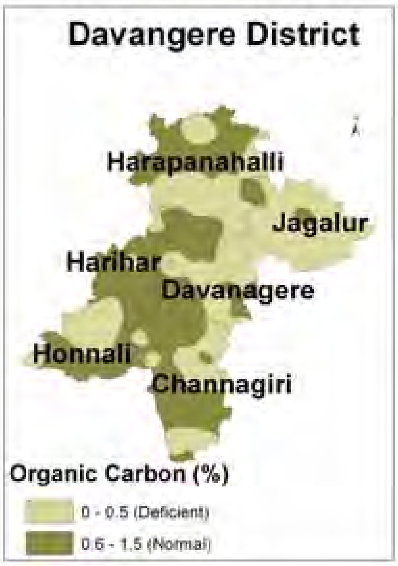


Map 11f. Taluka-wise soil available Boron status in farmers' fields, Chamarajanagar.

- ➢ Sulfur and available zinc were deficient in all taluks with 70%-80% farmers' fields analysed were observed deficient.
- ➢ Boron content is low in less than 50% of the fields in all taluks hence this nutrient availability was not severely deficient in these taluks and only maintainance dose of boron is needed.

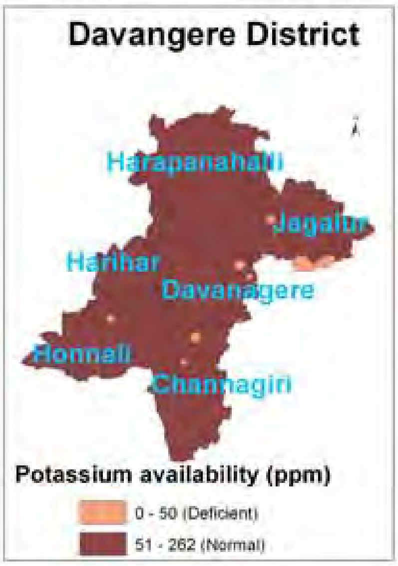
Chamarajanagar

- ➢ Soils in all taluks were low in organic carbon content and available nitrogen, indicating poor quality of soil, however, phosphorus and Potassium were sufficiently available in soils of all the taluks in the district.

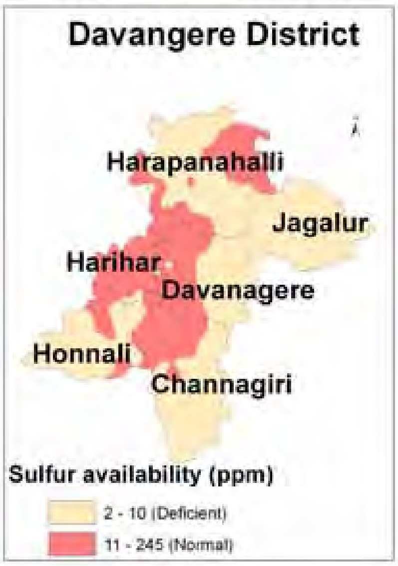


Map 12a. Taluka-wise soil Organic Carbon status based on farmers' fields, Davangere.

Map 12b. Taluka-wise soil available Phosphorus status based on farmers' fields, Davangere.

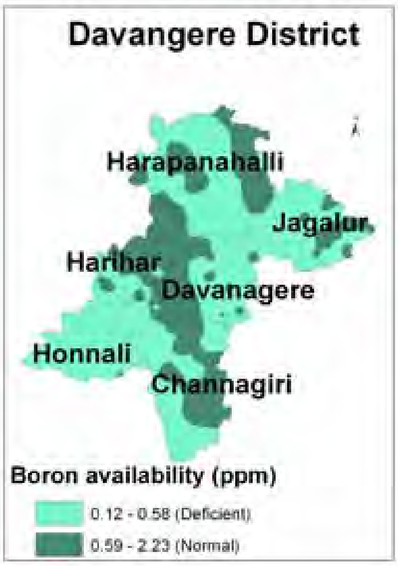


Map 12c. Taluka-wise map of soil available Potassium status in farmers' fields, Davangere.



Map 12d. Taluka-wise soil available Sulfur status in farmers' fields, Davangere.

Map 12e. Taluka-wise map of soil available Zinc status in farmers' fields, Davangere.



Map 12f. Taluka-wise soil Boron status in farmers' fields, Davangere.

- Sulfur, zinc and boron were deficient in all taluks except that Zn in soils of Chamarajanagar taluk was moderately low and boron was moderately low in Gundlupeta.

Davangere

- Soils in Davangere had organic carbon at normal levels in all taluks except Harappanhalli and Jagalur taluks where OC was low.
- Phosphorus and potash in these soils were sufficient in the entire district.
- Sulfur, zinc and boron were low and deficient in all taluks except Harihara taluk.

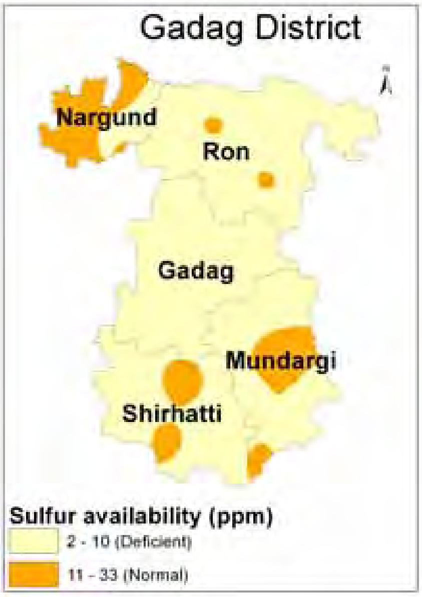
Gadag

- Soils in all five taluks of Gadag district were low in organic carbon indicating low supply of soil nitrogen and poor quality of soils.
- In all taluks farmers' field were deficient in phosphorus with sporadic patches of sufficiency of phosphorus in all taluks and rich in potash availability.
- Sulfur and zinc nutrients availability was just normal in all taluks needs maintenance dosage for good response and productivityof dryland crops.

Map 13a. Taluka-wise soil organic carbon status in farmers' fields, Gadag.

Map 13b. Taluka-wise soil available Phosphorus status in farmers' fields, Gadag.

Map 13c. Taluka-wise soil available Potassium status in farmers' fields, Gadag.



Map 13d. Taluka-wise soil available Sulfur status in farmers' fields, Gadag.

Map 13e. Taluka-wise soil available Zinc status based on farmers' fields, Gadag.

Map 13f. Taluk-wise map of soil available P status in farmers' fields, Gadag.

Gulburga

- Soils in Afzalpur and Chittapur are found deficient or low in organic carbon indicative of low available nitrogen, in all other taluks OC and nitrogen supply are normal requires maintainer dosage of nitrogen application.
- Available phosphorus was observed deficient in all the taluks of Gulburga except Chittapur and Sedam, and available potash is normal in all the taluks of Gulburga.
- Sulfur, zinc and boron were deficient in soils of all the taluks of Gulburga as was evidenced by deficiency of these nutrients in more than 70% of the farmers' field soil sample analysis except Javergi where only 46% farmers' fields in the taluk showed deficiency.

Map 14a. Taluka-wise soil organic carbon status in farmers' fields, Gulburga.

Map 14b. Taluka-wise soil available Phosphorus status in farmers' fields, Gulburga.

Map 14c. Taluk-wise soil available Potassium status in farmers' fields, Gulburga.

Map 14d. Taluk-wise soil available sulfur status in farmers' fields, Gulburga.

Map 14e. Taluk-wise soil available Zinc status in farmers' fields, Gulburga.

Map 14f. Taluk-wise map of soil available P status in farmers' fields, Gulburga.

Map 15a. Taluka-wise soil Organic Carbon status In farmers' fields, Hassan.

Map 15b. Taluka-wise soil available Phosphorus status In farmers' fields, Hassan.

Map 15c. Taluka-wise soil available Potassium status in farmers' fields, Hassan.

Map 15d. Taluka-wise soil available Sulfur status in farmers' fields, Hassan.

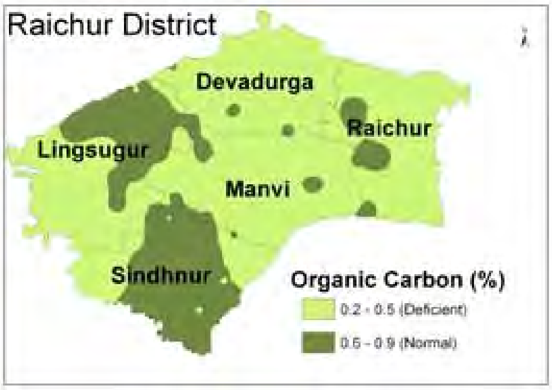
Map 15e. Taluka-wise soil available Zinc status in farmers' fields, Hassan.

Map 15f. Taluka-wise map of soil available Boron status in farmers' fields, Hassan.

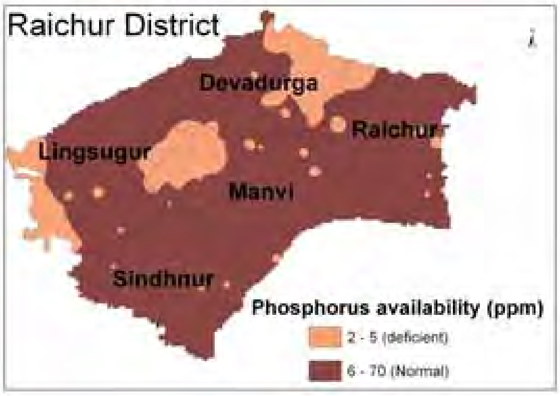
Hassan

- In six taluks of Hassan , organic carbon was sufficient, but in Arsikere and Channarayapatnam organic carbon was low in soils indicative of low supply of nitrogen from soil source and these soils are relatively degraded soils
- However, soils were found rich in phosphorus and potash in all the taluks based on farmers' field samples analysis.
- In all 8 taluks, soils were deficient in available sulfur and boron.
- Availability of zinc is normal in Hassan, Saklespur and Alur, in all other taluks of the district zinc was observed deficient.

Raichur

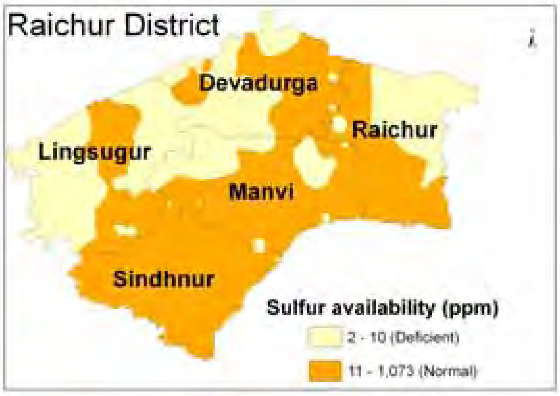


Map 16a. Taluka-wise soil organic carbon status in farmers' fields, Raichur.

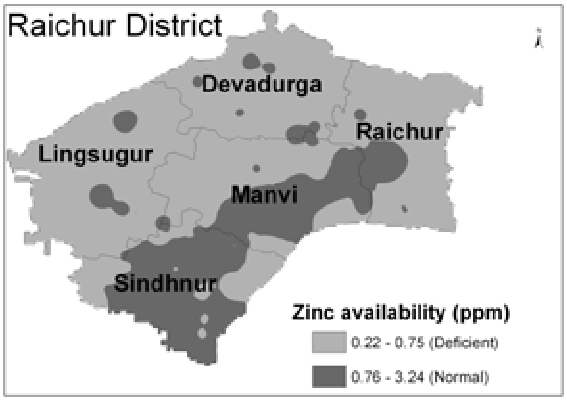


Map 16b. Taluka-wise soil available Phosphorus status in farmers' fields, Raichur.

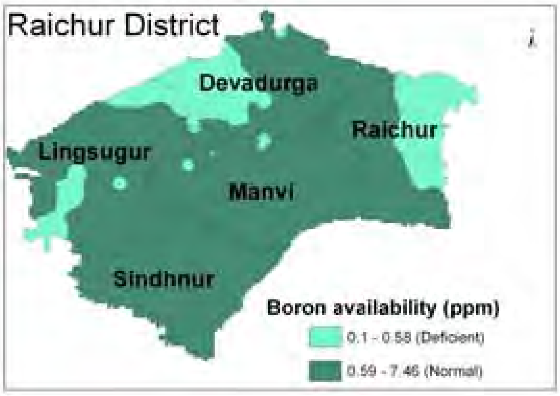
Map 16c. Taluka-wise soil available Potassium status in farmers' fields, Raichur.



Map 16d. Taluka-wise map of soil organic carbon status in farmers' fields, Raichur.

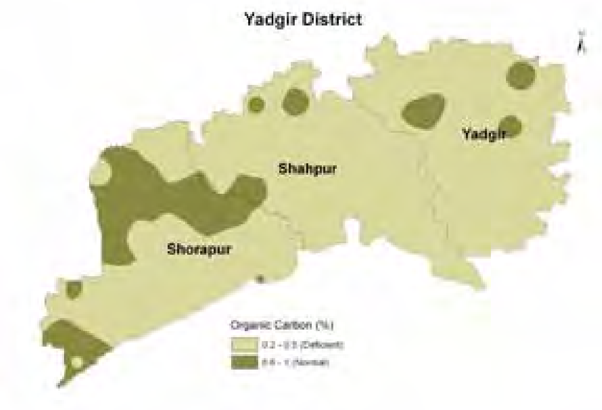


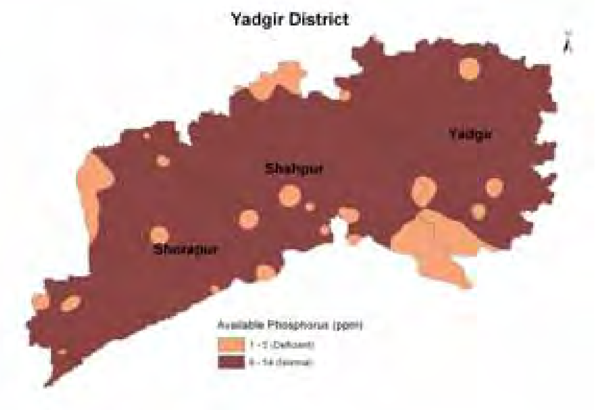
Map 16e. Taluka-wise map of soil organic carbon status in farmers' fields, Raichur.



Map 16f. Taluka-wise map of soil organic carbon status in farmers' fields, Raichur.

- ➢ Four taluk in Raichur namely Manvi, Deodurga, Raichur and Lingsugur, the soils were low in organic carbon, available phosphorus, sulfur, zinc and boron nutrients.
- ➢ Soils in Sindhanur taluk were much different with normal availability of N, P, K, sulfur and boron nutrients but deficient in zinc. Parts of Lingsugur taluk also availability of boron in soils is normal.



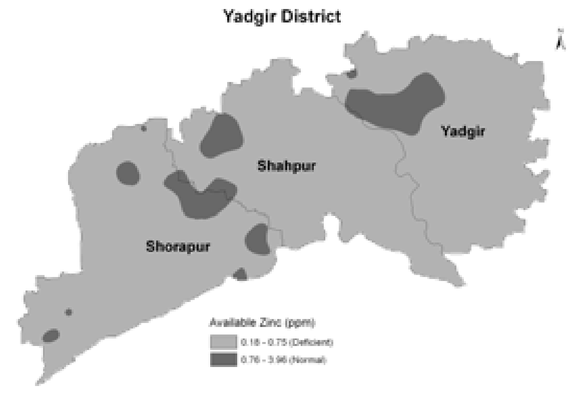


Map 17a. Taluka-wise soil organic carbon status in farmers' fields, Yadgir.

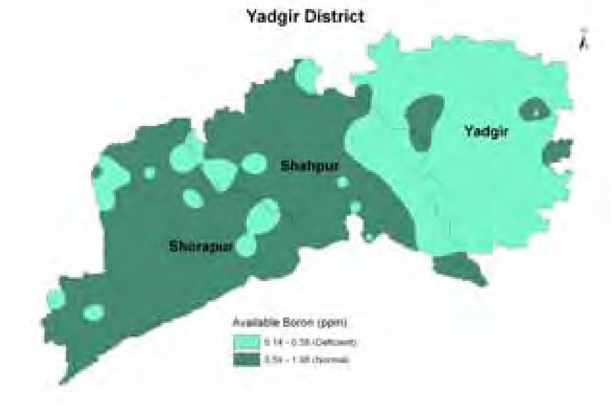
Map 17b. Taluka-wise soil available Phosphorus status in farmers' fields, Yadgir.

Map 17c. Taluk-wise soil available Potassium status in farmers' fields, Yadgir.

Map 17d. Taluka-wise soil available Sulfur status in farmers' fields, Yadgir.



Map 17e. Taluka-wise soil available Zinc status in farmers' fields, Yadgir.



Map 17f. Taluka-wise soil available Boron status in farmers' fields, Yadgir.

- In all taluks, soil availability of potassium is normal in the farmers' fields

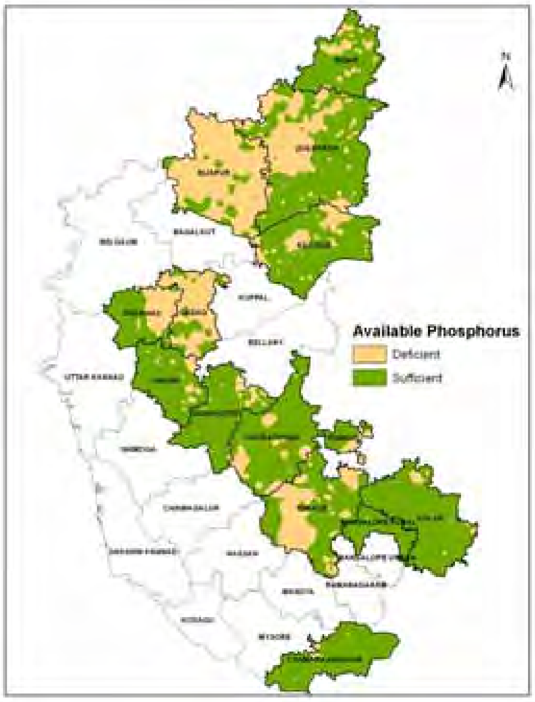
Yadgir

- In all taluks of Yadgir, organic carbon and available nitrogen were low and deficient and soils are deficient in phosphorus also, but are rich in available potash

- Soils in all taluks of Yadgir were deficient in sulfur, zinc and boron, and their low availability affecting crop productivity.

We presented complete map of Karnataka state showing OC, P, K, S, Zn, and boron nutrient status of soil in 16 district (map 18) which were done for 2010-11 crop season and provided to DoA, Karnataka

Map 18a. Soil organic carbon status status in 16 districts of Karnataka.

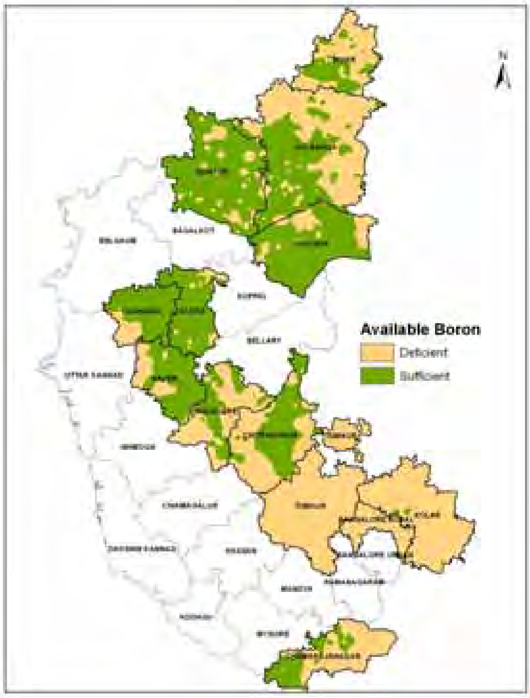


Map 18b. Soil available Phosphorus in 16 districts of Karnataka.

Map 18c. Soil available potassium status in 16 districts of Karnataka.

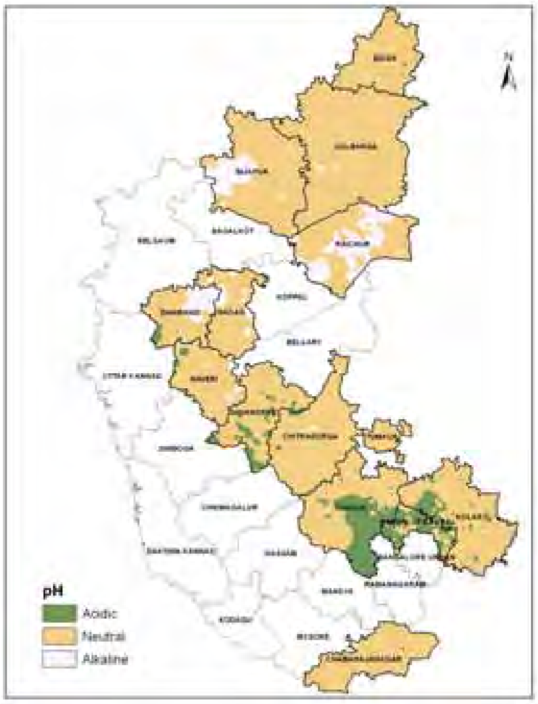
Map 18e. Soil available Sulfur status in 16 districts of Karnataka.

Map 18f. Soil available Zinc status in 16 districts of Karnataka.



Map 18g. Soil available Boron status in 16 districts of Karnataka.

Map 18d. Soil available salt concentration as indicated by EC in 16 districts of Karnataka.



Map 18h. Soil p^H status in 16 districts of Karnataka.

Taluk Wise Nutrient Recommendations, Fertilizer Dosage for Kharif Crops

Soil analysis based nutrient recommendations were provided by ICRISAT to all sixteen districts at taluk level considering it as unit. The reference nutrient recommendations for each crop were extracted from UAS, Bengalure; or UAS, Dharwad; or UAS, Raichur recommendations for their respective operational regions (Table 6). These recommendations were further adjusted for soil nutrient available status based on ICRISAT-DoA soil test analysis results and transformed them in terms of quantities in available fertilizer grades recommended for each crop, understandable by field facilitators and farmers.

Table 6. Nutrient recommendations (revised) for different rainfed crops in kharif based on crop requirements

Crop	Nutrient recommendation (kg ha^{-1})					
	Nitrogen	P_2O_5	K_2O	Sulfur	Zinc	Boron
Ragi	100	50	50	30	5	0.5
Maize	80	50	30	30	5	0.5
Groundnut	25	50	20	30	5	0.5
Soybean	25	37	25	30	5	0.5
Sorghum	60	35	0	30	5	0.5
Sunflower	50	25	25	30	5	0.5
Cotton	120	60	60	30	5	0.5
Pearl millet	50	25	0	30	5	0.5
Green gram,	25	50	0	30	5	0.5
Black gram	25	50	0	30	5	0.5
Chickpea	25	50	0	30	5	0.5
Pigeonpea (MD)	25	50	0	30	5	0.5
Pigeonpea (SD)	40	50	0	30	5	0.5

Based on farmers' affordability, locally adjustments were made as agreed by UAS scientists and DoA subject matter specialists and ICRISAT Scientists (Appendix. A: proceedings of experts meet). These recommendations were dessiminated through JDA-DoA in all sixteen districts by all possible communication methods like wall writings, Pocket diaries, soil health cards, brochures, daily news publications in local language. The JDAs of all the sixteen districts were provided with taluk wise crop specific nutrient recommendations for all major crops grown in the districts and fertilizer dosage at the beginning of the crop season. As example some variable crop specific fertilizer dosage based on soils analsis for each taluk are provided in the report (Table 7).

Table 7. District/Taluk-wise Fertilizer dosage adjusted for soil test nutrients status and recommended nutrient requirement for rainfed crops in various districts for Kharif 2010-11

Crop	District / Taluk	Fertilizers recommended (kg ha^{-1})					
		Urea	DAP	MoP	Gypsum	$ZnSO_4$	Agribor
Ragi	Chikkaballapur / C'ballapur	196	54	42	200	13	2.5
	Kolar / Kolar	294	82	32	200	13	2.5
	Tumkur / Korategere	175	109	83	200	13	2.5
Maize	Haveri / Byadagi	294	82	32	200	25	1.25
	Haveri / Shiggavi	131	82	32	200	13	2.5
	Chitradurga / Chitradurga	262	163	32	200	25	2.5
Groundnut	Kolar / Chintamani	33	54	17	200	25	2.5
	Tumkur / Pavgada	12	109	17	200	25	2.5
	Dharwad / Kundagola	12	109	17	200	25	1.25
Soybean	Dharwad / Dharwad	12	40	21	200	13	1.25
	Dharwad / Kalaghatagi	0	80	21	200	13	2.5
	Dharwad / Navalagund	23	80	21	200	25	1.25
Sorghum	Haveri / Hirekerur	116	38	0	200	13	1.25
	Dharwad / Kundagola	101	76	0	200	25	1.25
	Raichur / Raichur	116	38	0	200	25	2.5
Pearl millet	Bijapur / Bijapur	167	130	21	200	25	1.25
	Raichur / Manvi	192	65	21	200	25	1.25
Chickpea	Haveri / Ranebennur	44	109	0	200	25	1.25
Blackgram	Bijapur / Bijapur	12	109	0	200	25	1.25
Greengram	Bidar / Bidar	6	54	0	200	13	2.5
Pigeonpea (MD)	Gulburga / Chincholi	12	109	0	200	25	2.5
Pigeonpea (SD)	Manvi	66	54	0	200	25	1.25

If borax is applied in stead of Agribor, quantity needs to be doubled

Awareness Campaign in the Villages

Soil Health Cards as shown (front and back pages) in figure 14, were provided to individual farmers whose fields were sampled n local language (Kannada) with details of individual nutrient status and critical limits along with a comment on the nutrient status of the field.

Second side of the card contains recommend dose of nutrients for each crop as well as quantity of nutrients available in commercially marketed fertilizers, for the understanding of farmers.

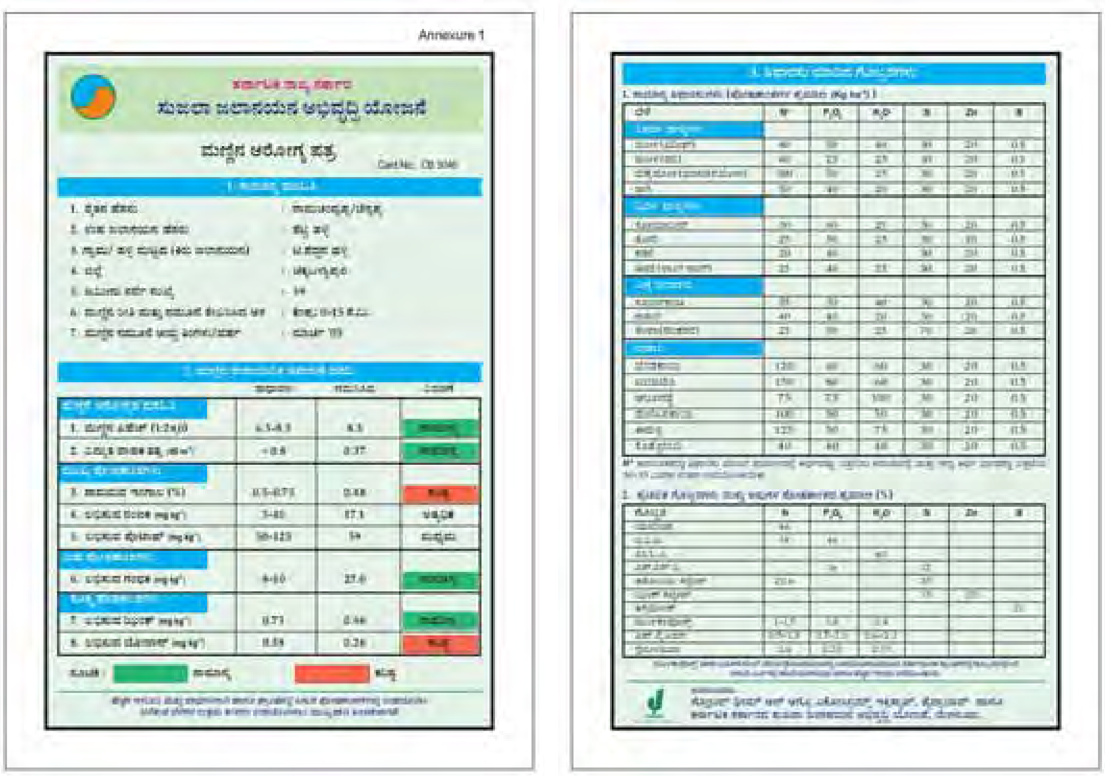


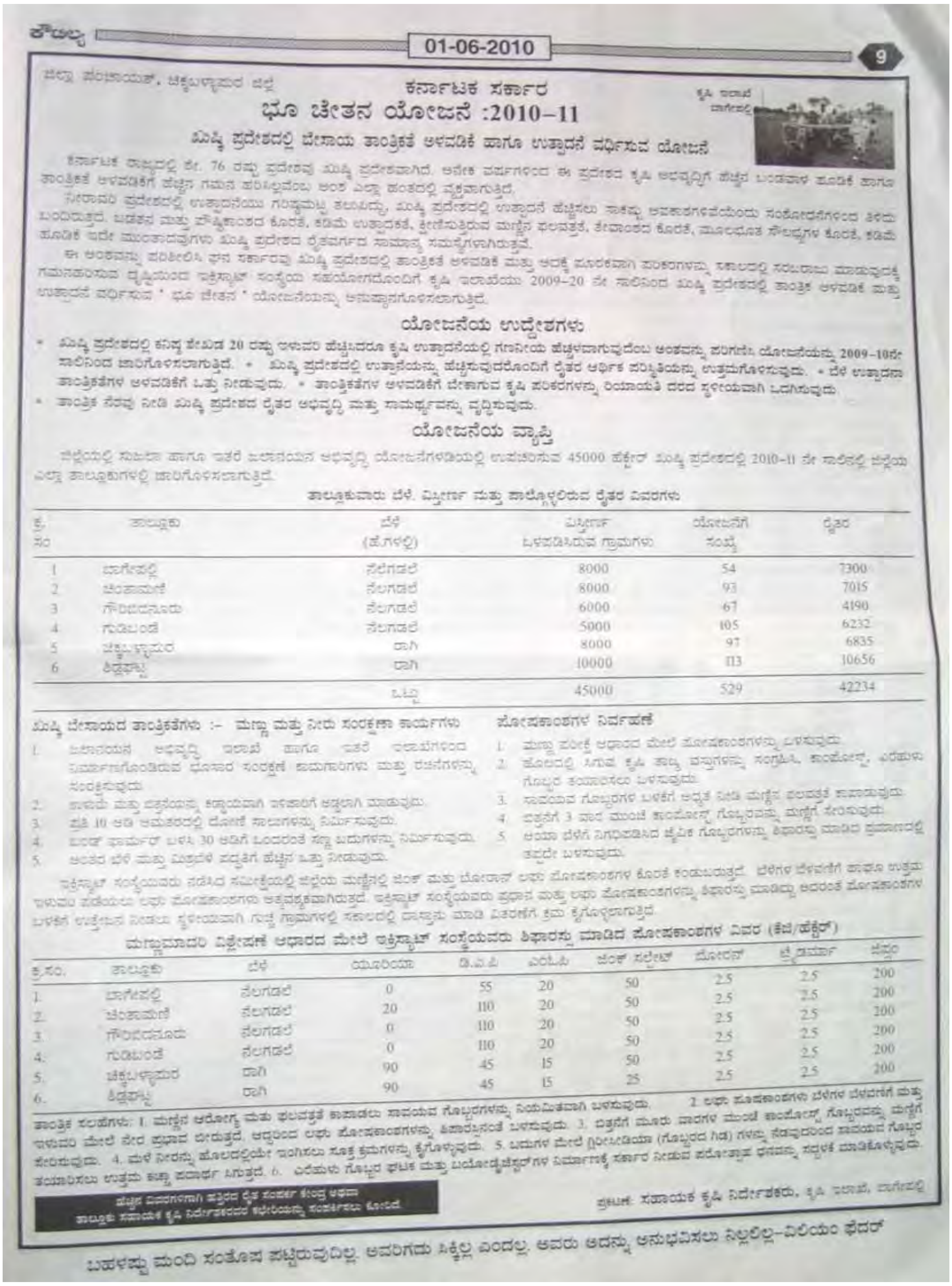
Figure 14. Soil health cards with details printed on both sides of the sheet

Wall writings were quite conspicuous with details (Figure 17) of input quantities supplied to the farmer per hectare, component of subsidy; inputs cost to be borne by the farmer under Bhoochetana initiative. Due to issues of subsidy to different categories of farmers, some farmers did not apply balanced nutrients as recommended, instead discreetly applied nutrients in parts.

Daily newspapers (ex. Kautiyla) in chickballapur published news on Bhoochetana program activities in the district during 2010-11 seasons and published recommended dosage of fertilizers for groundnut and ragi crops (Figure 15 and 16).

Awareness Campaigns in villages

The DoA staff ensured wall writings (Figure 17) and exhibition of posters in all villages within short period before the on-set of monsoon, indicating the main objective of the program and areas to be covered by the program. Additionally thousands of brochures and handouts were published in each district on improved management practices, information on nutrients status, nutrients recommended taluk-wise and widely distributed in all selected districts.



ಕೌಶಲ್ಯ 01-06-2010 9

ಕರ್ನಾಟಕ ಸರ್ಕಾರ

ಭೂ ಚೇತನ ಯೋಜನೆ :2010–11

ಖುಷ್ಕಿ ಪ್ರದೇಶದಲ್ಲಿ ಬೇಸಾಯ ತಾಂತ್ರಿಕತೆ ಅಳವಡಿಕೆ ಹಾಗೂ ಉತ್ಪಾದನೆ ವರ್ಧಿಸುವ ಯೋಜನೆ

ಯೋಜನೆಯ ಉದ್ದೇಶಗಳು

ಯೋಜನೆಯ ವ್ಯಾಪ್ತಿ

ತಾಲ್ಲೂಕುವಾರು ಬೆಳೆ, ವಿಸ್ತೀರ್ಣ ಮತ್ತು ಪಾಲ್ಗೊಳ್ಳಲಿರುವ ರೈತರ ವಿವರಗಳು

ಕ್ರ. ಸಂ	ತಾಲ್ಲೂಕು	ಬೆಳೆ (ಹೆ.ಗಳಲ್ಲಿ)	ವಿಸ್ತೀರ್ಣ ಒಳಪಡಿಸಿರುವ ಗ್ರಾಮಗಳು	ಯೋಜನೆಗೆ ಸಂಖ್ಯೆ	ರೈತರ
1	ಬಾಗೇಪಲ್ಲಿ	ನೆಲಗಡಲೆ	8000	54	7300
2	ಚಿಂತಾಮಣಿ	ನೆಲಗಡಲೆ	8000	93	7015
3	ಗೌರಿಬಿದನೂರು	ನೆಲಗಡಲೆ	6000	67	4190
4	ಗುಡಿಬಂಡೆ	ನೆಲಗಡಲೆ	5000	105	6232
5	ಚಿಕ್ಕಬಳ್ಳಾಪುರ	ರಾಗಿ	8000	97	6835
6	ಶಿಡ್ಲಘಟ್ಟ	ರಾಗಿ	10000	113	10656
		ಒಟ್ಟು	45000	529	42234

ಖುಷ್ಕಿ ಬೇಸಾಯದ ತಾಂತ್ರಿಕತೆಗಳು :- ಮಣ್ಣು ಮತ್ತು ನೀರು ಸಂರಕ್ಷಣಾ ಕಾರ್ಯಗಳು

ಪೋಷಕಾಂಶಗಳ ನಿರ್ವಹಣೆ

ಮಣ್ಣುಮಾದರಿ ವಿಶ್ಲೇಷಣೆ ಆಧಾರದ ಮೇಲೆ ಇಕ್ರಿಸ್ಯಾಟ್ ಸಂಸ್ಥೆಯವರು ಶಿಫಾರಸ್ಸು ಮಾಡಿದ ಪೋಷಕಾಂಶಗಳ ವಿವರ (ಕೆಜಿ/ಹೆಕ್ಟೇರ್)

ಕ್ರ.ಸಂ.	ತಾಲ್ಲೂಕು	ಬೆಳೆ	ಯೂರಿಯಾ	ಡಿ.ಎ.ಪಿ	ಎಂ.ಒ.ಪಿ	ಜಿಂಕ್ ಸಲ್ಫೇಟ್	ಬೋರಾನ್	ಟ್ರೈಕೋಡರ್ಮಾ	ಜಿಪ್ಸಂ
1.	ಬಾಗೇಪಲ್ಲಿ	ನೆಲಗಡಲೆ	0	55	20	50	2.5	2.5	200
2.	ಚಿಂತಾಮಣಿ	ನೆಲಗಡಲೆ	20	110	20	50	2.5	2.5	200
3.	ಗೌರಿಬಿದನೂರು	ನೆಲಗಡಲೆ	0	110	20	50	2.5	2.5	200
4.	ಗುಡಿಬಂಡೆ	ನೆಲಗಡಲೆ	0	110	20	50	2.5	2.5	200
5.	ಚಿಕ್ಕಬಳ್ಳಾಪುರ	ರಾಗಿ	90	45	15	50	2.5	2.5	200
6.	ಶಿಡ್ಲಘಟ್ಟ	ರಾಗಿ	90	45	15	25	2.5	2.5	200

ಪ್ರಕಟಣೆ: ಸಹಾಯಕ ಕೃಷಿ ನಿರ್ದೇಶಕರು, ಕೃಷಿ ಇಲಾಖೆ, ಬಾಗೇಪಲ್ಲಿ

ಬಹಳಷ್ಟು ಮಂದಿ ಸಂತೋಷ ಪಟ್ಟಿರುವುದಿಲ್ಲ. ಅವರಿಗದು ಸಿಕ್ಕಿಲ್ಲ ಎಂದಲ್ಲ. ಅವರು ಅದನ್ನು ಅನುಭವಿಸಲು ನಿಲ್ಲಲಿಲ್ಲ-ವಿಲಿಯಂ ಫೆದರ್

Figure 15. Details of major crops and area covered by Bhoochetana in different taluks of chickballapur were published in a Kannada news paperge written in Kannada.

37 ಸಾವಿರ ಹೆಕ್ಟೇರ್‌ನಲ್ಲಿ ಭೂಚೇತನ

ರೈತರಿಂದ ಪ್ರತಿಭಟನೆ

ಪ್ರಜಾವಾಣಿ

ಅಭಿವೃದ್ಧಿಗೆ ಶ್ರಮಿಸಲು ಸೂಚನೆ

ಮುಂದಿನ ವರ್ಷ 'ಭೂಚೇತನ'

ದೇಶೀಯ ತಳಿಗಳಿಗೆ ಆದ್ಯತೆ ನೀಡಿ

05-02-2011

ದೂರದರ್ಶನದಲ್ಲಿ 'ಕೃಷಿ ದರ್ಶನ'

Figure 16. Daily News coverage in the print media about Bhoochetana activities in Kolar, Chickballapur, Chamarajanagar and Davangere.

Print Media News coverage was extensive to introduce Bhoochetana program to farmers and also on activities during the season in all districts (Figure 16), besides field facilitators and lead farmers contacts with individual farmers in selected village.

Figure 17a. Wall writings on Bhoochetana activities and its spread in Bidar district during 2010-11 written in Kannada,

Figure 17b. On looker of Wall writing in Kannada on appropriate technologies to implement in farmers' fields in Chamarajanagar.

Capacity-Building of Stakeholders

Review and Team building workshop at ICRISAT in November

A team building workshop was organized on in Bengaluru, to familiarize all stake holders of Bhoochetana project include nodal officers in the Commissionrates of Agriculture and Watershed Development Department, all Joint Directors of Agriculture (JDA), Assistant Directors of Agriculture (ADAs) and District Watershed Development Officers (DWDOs) from the districts along with ICRISAT Scientists and Scientific officers and Resident Research Technicians of the respective districts who participated in the workshop. Presentations were made by Dr. Sarvesh the Director of Agriculture, Karnataka State Department of Agriculture and Dr. S P Wani, Prinicipal Scientist (Watersheds) and Project Coordinator (IWMP), Global Theme on Agroecosystems of ICRISAT, India. (Figure 18), set the perfect scenario for the team building of personnel from different institutions to come together.

Figure18. Dr. K V Raju, Economic Advisor to Chief Minister, GoK motivating the officials to accept higher responsibilities to make Bhoochetana program successful in enhancing farmer' crop yields and income.

In the Team building workshop, the mission staffs especially from new 10 districts were exposed to goal of the mission-mode project and objectives of the project; planning, co-ordination and implementation arrangements among stake holders were discussed and mechanism for monitoring the progress of implementation was decided. Schedules for cluster-wise detailed work plans preparation responsibilities were assigned to project staff. Modalities for ensuring availability of required inputs before the on-set of the season and strategy for their timely distribution to the farmers in each district were discussed. Dr K V Raju addresses the gathering at the end of the one day workshop which was inspiring for all the team members.

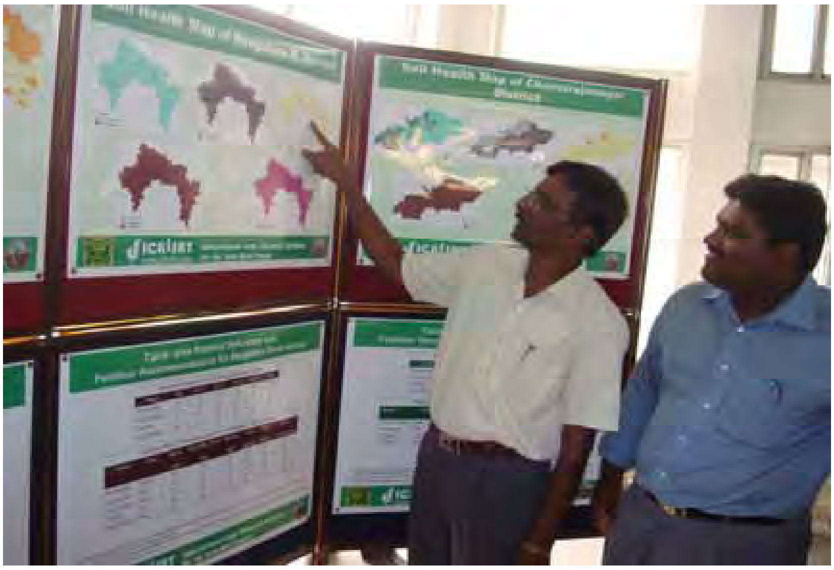


Figure 19. ICRISAT –DoA organized poster session at the review meeting

Trainings

Trainings were organized in three stages considering area of operation as 1. District level training; 2. Taluk-level training; and 3. Cluster-Village level training. Based on the levels of training, the course content was designed keeping in view the participants.

District level trainings were organized in the months of May-June in all the sixteen districts for ADAs, AOs on aspects of soil sampling, soil nutrient status in their respective taluks of each district, nutrients recommendations based on soil nutrient deficiencies for major crops, suitable high-yielding varieties and integrated disease and pest management for different crops, livelihood options for rural landless poor and on best-bet management options for enhancing the productivity of agricultural crops (Figure 20 a,b). Details of number of meeting in each district for these trainings are provided. Faculties were drawn from ICRISAT, UAS Bengaluru and its associated Krishi Vigyan Kendras. In each district, one to six district level trainings were arranged based on need and convenience of participants. The trainings comprise of lectures and extensive discussions to decide upon locally suitable technologies to be recommended for farmers in their respective districts.

Figure 20a. District level training of stakeholders in Gulbarga

Figure 20b.District level meeting with officials in Raichur

Taluk level trainings were organized in the months of June and July in all the districts for Agricultural Officers, Assistant Agricultural Officers, Agricultural Assistants, Field Facilitators and Lead farmers at their respective taluks. Training topics encompassed soil nutrient status in their respective taluks of each district; nutrients recommendations based on soil nutrient deficiencies for major crops, integrated disease and pest management for different crops, livelihood options for rural landless poor and on best-bet management options for enhancing the productivity of agricultural crops (Figure 21 a, b). A minimum of 3 taluk-level trainings in Kolar to a maximum of 23 taluk-level trainings were arranged in Haveri district. Faculty for these training comprised of scientists from KVKs of UAS, Bengaluru and Dharwad, Scientific officers from ICRISAT and JDAs or DWDOs in their respective districts.

Figure 21a.Taluk level training of stakeholders (AAOs, AAs, Field Facilitators and lead farmers) in Sindhaner, Raichur Dist

Figure 21b. Taluk level training of stakeholders field facilitatros training in Davangere

Cluster/Village level trainings were held for farmers in the village to create awareness about Bhoochetana project (Figure 22a) and its goal to achieve 20% yield increase in farmers' fields and information on best-bet management options for enhancing the productivity of agricultural crops. Village level trainings were arranged in all the districts extensive covering more than a thousand farmers in different districts. They were also informed about input subsidies on total package of inputs and information on nutrient deficiencies in their village soils and required micronutrient availability for their use. These trainings were held in almost all selected villages providing hands-on trainings on techniques (Figure 22b) and well attended by farmers.

Figure 22a. Village farmers' meeting in Bidar district

Figure 22b. Hands-on training for farmers in micronutrients mixing in Arsekeri taluk of Hasan

Facilitation of Project Activities in the Mission Mode

- To provide good beginning for the second year activities by including the senior staff working in the new added 10 districts to the project, team building exercise at Bengaluru was organized by ICRISAT and DoA to facilitate all stake holders from sixteen districts to come together for understanding of the mission mode approach to the project. Planning of activities, execution of trainings schedules, awareness campaigns and field publicity was organized in quick succession with active participation of DoA and ICRISAT staff.
- Coordination with DoA staff for inputs mobilization, especially expediting the procurements or placing inputs at the disposal of field staff for easy distribution to farmers timely was harmonized. ICRISAT facilitated timely procurement of groundnut (ICGV 91114), Pigeonpea cultivars, Bajra hybrids and soybean cultivars by DoA.

- ICRISAT arranged seeds of improved cultivars of sorghum, safflower, chickpea for *rabi* sowings to farmers of Haveri and Dharwad through DoA, as these districts were flood affected and farmers have lost their stored seeds.
- ICRISAT staff participated and facilitated weekly review meetings in each district to provide update of field activities and any assistance required for farmers' problems.
- ICRISAT developed format for weekly progress reporting and ICRISAT staff facilitated regular feedback weekly from districts to ICRISAT and SCC through comprehensive checklist format.
- Intense monitoring of field trials by DoA and ICRISAT SCC members through direct contact of ICRISAT staff, farmers and field facilitators, DoA officials in districts using pocket telephone directory published by DoA in Bengaluru.
- Besides participation of project coordinator from ICRISAT and visiting scientist in regular SCC review meetings, their field visits in Kolar district as well as meeting with UAS scientists in Bengaluru and Dharwad had helped to invigorate ICRISAT staff morale and commitment for project activities.

Monitoring and Evaluation by State Coordination Committee (SCC)

State level coordination committee is a high power committee constituted with state level senior administrators of government of Karnataka, directors of department of agriculture and watershed development department, vice-chancellors of the three universities of agriculture in Bengaluru, Raichur and Dharwad, Economic advisor to Chief Minister, Karnataka and project coordinator from ICRISAT.

The committee met frequently during the beginning of the season to take stock of inputs procurement and distribution arrangements, monsoon progression and crop sown statistics. To fetch complete information from cluster villages, taluks to district, a checklist of activity progress weekly-report was prepared by ICRISAT and ensured follow-up weekly reporting synchronized from JDA office and ICRISAT staff.

State level committee reviews the progress of project activities and interacts with district level officials instantaneously through vido-conferencing and take stock of solutions to address problems arising in the field and issue directives for each district (Figure 23). Minister of Agriculture, Mr. S A Ravindranath, attended a district level committee meeting and found out the progress of implementation and success achieved in enhancing the crop yields of ragi and groundnut during kharif season.

Figure 23. State level coordination committee (SCC) reviews the progress in the districts through video conferencing from Bengaluru

State level coordination committee members attended district coordination committee meetings, conducted field visits along with JDA of the district (Figure 24) to monitor and on-board guidance to problems in the district.

Figure 24. Nodal officers and SCC members visits to Bhoochetana districts during the crop season.

Rainy Season Crops

Major Crops and Area Sown

Scaling-up soil, crop and water management technologies for boosting Productivity of Selected Crops.

In the first year of implementation, department of Agriculture (DoA), University of Agricultural science, Bengaluru, Dharwad, Raichur and ICRISAT arrived at a consensus on identified major crops in the selected 25 target districts of Karnataka after several deliberations, considering the historical annual crop statistics published by Directorate of Economics and statistics, Government of Karnataka, for enhancing productivity of major dryland crops in each selected district. The process adopted in the first year was 25% of the cultivated area under two selected major crops in each of the six districts mostly identified from clusters of Sujala watershed villages according to planned strategy for the first year.

In the second year, besides increase in area coverage in six districts under Bhoochetana activities from 25%in the first year to 50% during 2010-11, farmers in the newly added 10 districts were motivated about the project and possible benefits for participating in the technology uptake of the project. The target area coverage in 10 newly introduced districts was upto 33% of the area covered by major crops in the district.

Accordingly in rainy season 2010, Bhoochetana activities were targeted to cover an area of 13.16 lakh hectares with improved management to enhance rainfed crop productivity in 16 districts, and achieved a coverage of 12.02 lakh hectares, which was 91.3% of the target area with four major food grain cereals (finger millet, maize, sorghum and pearl millet), four major grain legumes (pigeonpea, green gram, black gram, and cowpea) and four major oilseed crops (soybean, sunflower, cotton and groundnut) of Karnataka. Input package kits were provided to the farmers with 50% incentive to encourage farmers' participation to adopt sustainable agricultural practices in all the districts including 1st year covered districts.

Initial monsoon rains were good, followed it up by rainfall in June and July helped farmers in all 25 districts to take up sowings of target area (Table 8) under major crops in the districts. Gulburga district, even after bifurcation retained the status of the largest cropped area with 1.94 lakh hectares sown to different crops under Bhoochetanan activities achieving more than 95%of the cropping targets. Chitradurga district was the second largest cropped district with 1.25 lakh hectares sown to major crops, achieved the cropping target up to 99% during the rainy season. Tumkur with 1.25 lakh hectare sown to two major crops and Bijapur with 1.07 lakh hectares sown to six major crops occupied third and fourth ranks respectively in terms of cropped area under Bhoochetana project during 2010-11 crop season. There were eleven districts with more than 50,000 hectares covered with Bhoochetana activities.

Table 8. District-wise target cropping area sown to major crops during kharif 2010-11 crop season.

S. No.	District	Major rainfed crop	Target area	Area sown	% Achieved
1.	Bengaluru Rural	Finger Millet (Ragi)	16676	16532	99
		Maize	19672	19528	99
2.	Bidar	Soybean	12600	10080	80
		Green gram	14175	14175	100
		Black gram	16275	16275	100
		Pigeonpea	23450	21105	90
		Sorghum	21322	19189	90
3.	Bijapur	Maize	15841	13433	87
		Pearl millet	40729	17314	43
		Mung bean	15647	8642	55
		Pigeonpea	27487	47809	174
		Sunflower	20468	4325	21
		Groundnut	22583	10321	46
4.	Chamarajanagar	Sorghum	4801	3908	81
		Maize	12533	11328	90
		Finger millet	4433	4877	110
		Sunflower	3120	3281	105
		Groundnut	2305	2440	105
5.	Chikkaballpur	Groundnut	27000	26833	99
		Finger Millet (Ragi)	45000	44833	100
6.	Chitradurga	Groundnut	66000	65510	99
		Maize	40000	39860	100
		Finger Millet (Ragi)	20000	19650	98
7.	Dharwad	Soybean	24000	21700	90
		Groundnut	20000	15200	76
8.	Davangere	Sorghum	12148	8182	67
		Finger Millet (Ragi)	8773	6446	74
		Maize	52606	53778	102
		Groundnut	500	5153	1031
9.	Gadag	Sorghum	6500	4676	72
		Maize	4000	4005	100
		Green gram	42500	33582	79
		Groundnut	24000	18791	78
		Sunflower	6500	2513	39
10.	Gulburga	Mung Bean	22823	20611	90
		Black Gram	25978	25196	97
		Bajra	10613	10263	97
		Sunflower	16625	14245	86
		Pigeonpea	130261	123749	95
11.	Hassan	Maize	14000	14000	100
		Sunflower	5000	3580	72
		Cowpea	3000	2635	88
		Ragi	20000	15250	76
12.	Haveri	Maize	79000	79000	100
		Groundnut	10000	10000	100
		Soybean	5000	5000	100

Table 8. District-wise target cropping area sown to major crops during kharif 2010-11 crop season.

S. No.	District	Major rainfed crop	Target area	Area sown	% Achieved
13.	Kolar	Ragi	28000	20646	74
		Groundnut	9000	8250	92
14.	Raichur	Millet	28354	27664	98
		pigeonpea	14500	14058	97
		Groundnut	5200	5018	97
		Cotton	12955	11609	90
		Sunflower	12360	11885	96
15.	Tumkur	Groundnut	70628	70150	98
		Ragi	40065	37900	94
16.	Yadgiri	Mung Bean	17785	17470	98
		Black Gram	944	150	16
		Pearl Millet	11039	10871	98
		Sunflower	9095	3477	38
		Pigeonpea	20097	24236	122
Total	All districts	All crops	1315966	1202187	91.3

Inputs Distribution in the Districts

Farmers were supplied with fertilizer, micronutrients, biofertilizer and pesticides as a package supplied at 50% incentive through Rythu Samparka Kendras in respective taluks. Rainy season started intime with early rains in Chamarajanagar. In all the districts, farmers were hurried by the advancement of monsoon rains in the districts. DoA officials did not indent for the total projected requirement of fertilizers and micronutrients anticipating low option rate as well as shortage of storage godowns in the rural areas. In some districts, identified suppliers were later barred after accepting indent for supply of ZnSO4, as the quality of the material was not at required standard. Hence ZnSO4 supplies to farmers were affected in some districts like Bengaluru rural and Chickballapur. Borox was not indented for supply in some districts like Raichur and Bijapur initially (Table 9) affecting overall consumption of these micronutrient in these districts.

Distribution of fertilizers and micronutrients to farmers were low in newly initiated 10 districts of Bhoochetana project during 2010, owing to less familiarity of technologies and their advantage to farmers. In the older districts like Chickballapur, Chitradurga, Haveri, Kolar and Tumkur where Bhoochetana was operationalized in the previous year, farmers purchased inputs knowing the advantage of inputs for enhancing their crop productivity and income. In these districts the total quantities and per cent of fertilizers distributed to the target requirement was higher than in the new districts.

Table 9. Target quantities of Fertilizers and micronutrient inputs those were actually distributed to farmers at their doorstep in the selected Bhoochetana villages in the districts.

S No	District	Crops	Target quantity (tons)			Quantity distributed (% target)		
			Gypsum	$ZnSO_4$	Borax	Gypsum	$ZnSO_4$	Borax
1	Bengaluru Rural-Kharif	Maize, Ragi	3934.4	491.8	18.4	519 (13.1%)	51.7 (10.5%)	9.5 (51.6%)
2	Bidar-Kharif	Green gram, Pigeonpea,	17563	3702	403	1767.5 (10%)	195.3 (5%)	17.4 (4.3%)
3	Bijapur -Kharif	Green gram, black gram, pearl millet, sunflower, pigeonpea	28551	7137.8	427.4	895 (3%)	135.2 (2%)	8.3 (2%)
4	Chamaraja nagar-Kharif		5679.1	271.9	33.9	1793 (31.6%)	81.4 (23.7%)	20.1 (59.3%)
5	Chikkaballpur-Kharif		3600	650	45	1415 (39.3%)	49.5 (7.6%)	28.0 (62.2%)
6	Chitradurga-Kharif	Groundnut, Maize, Ragi	7560	1395	140	4112 (54.3%)	323.9 (23.2%)	50.7 (36.2%)
7	Dharwad-Kharif							
8	Davangere-Kharif							
9	Gadag-Kharif							
10	Gulburga-Kharif							
11	Hassan-Kharif							
12	Haveri-Kharif	Maize, Groundnut, soybean	18800	3875	320	3935 (20.9%)	404 (10.4%)	80.8 (25.3%)
13	Kolar-Kharif	G'nut/pigeon pea, Ragi	7400	925	185	1957.5 (26.5%)	77.36 (8.4%)	35.85 (19.4%)
14	Raichur-Kharif		12718	1100	-	1404 (11%)	219 (19.9%)	-
15	Tumkur-kharif	Groundnut, Ragi	16426	4610	274	3690 (22.4%)	430.5 (9.3%)	67.2 (24.5%)
16	Yadgiri-Kharif	Green gram, black gram, pearl millet, sunflower, pigeonpea	1792	2948	294.8	521 (4.4%)	60 (2.0%)	21.02 (7.1%)

Seasonal Rainfall Situation in the Districts

Daily rainfall from the beginning of the season (May) was monitored by the close coordination with the staff of DoA, Karnataka in all taluks of sixteen districts. We presented graphics of daily or monthly observed rainfall distribution occurred during 2010-11 rainy season in two taluks of each district in this reports. These selected two taluks are typical larger areas cultivated to a major crop and representing dissimilarity with rainfall variability in the district.

Bengaluru Rural

Doddaballapur and Hoskote taluks are dissimilar in their normal rainfall pattern in Bengaluru Rural district (Figure 25). While maize was prominent crop in Doddaballapur taluk, ragi (finger millet) is prodominent in Hoskote, Devanhalli and Nelamangala hence these two taluk were selected for rainfall reporting relevant for crop yield estimation and assessment by comparing improved management against farmers' management.

Daily rainfall observed during the season from May to November in Doddaballpur taluk had a better distribution of rainfall in all months. Although, monthly rainfall was higher than normal in June (68%) and July (16%), less than normal rainfall in August (12%), September (26%) and October (44%) coincides with critical stages of crop growth based sowing period and duration of crop. However in November rainfall was 163 mm, much higher (150%) than normal rainfall of 65 mm. Farmers indicated that this rainfall affected ragi grain quality and harvesting. Annual total rainfall for the year was 840 mm, more or less near to annual normal rainfall of 851 mm for Doddaballapur taluk.

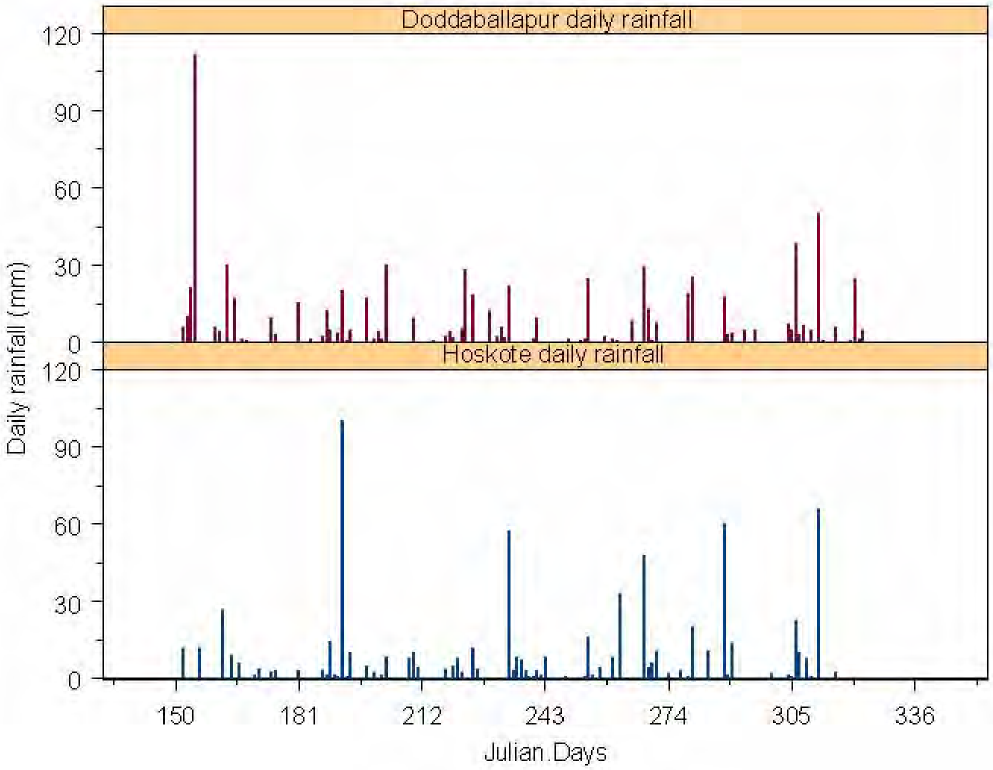


Figure 25. Daily rainfall recorded from June to November 2010 in Doddaballpur and Hoskote taluks of Bengaluru Rural district during crop season 2010

Table 10. Seasonal normal rainfall and actual rainfall observed in Bengaluru rural district during crop season 2010-11

Taluk	Month	May	Jun	Jul	Aug	Sep	Oct	Nov
Doddaballapur	Normal rainfall (mm)	8	75	100	126	159	166	65
	Rainfall 2010 (mm)	**47**	**126**	**116**	**111**	**117**	**93**	**164**
Hoskote	Normal rainfall (mm)	94	67	78	97	136	146	59
	Rainfall 2010 (mm)	**102**	**85**	**115**	**120**	**109**	**110**	**81**

In Hoskote taluk, it was observed that annual total rainfall was 786 mm for 2010 compared to annual normal rainfall of 750 mm for the taluk. Monthly rainfall was higher in May (8%), June (25%), July (47%), August (24%), and was deficit in September (-20%), October (-24%) months compared to normal rainfall in these months. In this taluk also November rainfall was higher (59%) that was a cause of concern to farmers for especially for finger millet crop which was sown late in August.

Bidar

In Bidar district, selected taluks for representing rainfall distribution were Aurand and Bidar. Daily rainfall distribution was more or less similar in both taluks with a long dry spell in October. In the month of August consequetively 7-9 days rainfall skewed distributions, affected pod filling and maturity of short season legumes like green gram and black gram, also affected harvest thereby fodder yields and quality of these crops in all the taluks.

After heavy rainfall in the month of August in all the taluks, a dry spell in late September and October facilitated Rabi season sowing of sorghum and chickpea with good storage of soil water in the profiles. Rainfall in June (-48%) and July (-18%) was below normal in Aurad, but rainfall was lower (-38%) in June and higher than normal in July (79%) and August (73%) in Bidar (Table 11). September rainfall was higher than normal in Aurad, but lower than normal in Bidar.

Table 11. Seasonal normal rainfall and actual rainfall observed in taluks of Bidar district during crop season 2010-11.

Taluk	Month	May	Jun	Jul	Aug	Sep	Oct	Nov
Aurad	Normal rainfall (mm)	26	142	218	201	165	75	20
	Rainfall 2010 (mm)	1.20	74.2	180.5	342.3	185.40	82.4	67.7
Bidar	Normal rainfall (mm)	34	150	224	203	218	86	28
	Rainfall 2010 (mm)	24.2	93.2	402.5	353.4	89.4	85.2	27.4

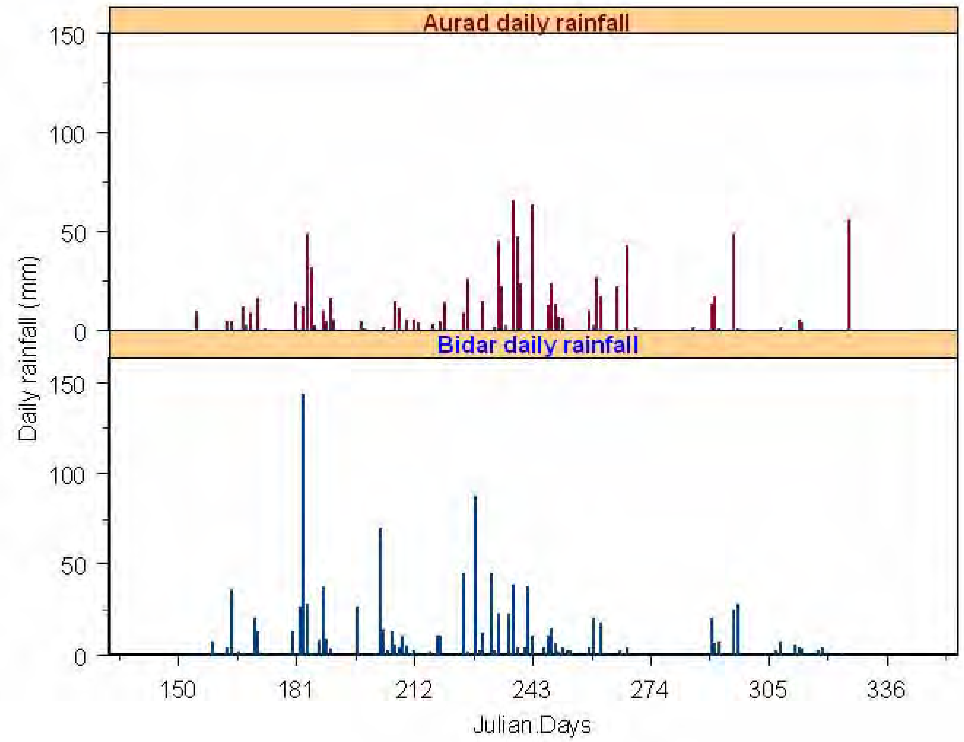


Figure 26. Daily rainfall recorded from June to November 2010 in Bidar and Aurad taluks of Bidar district during crop season 2010

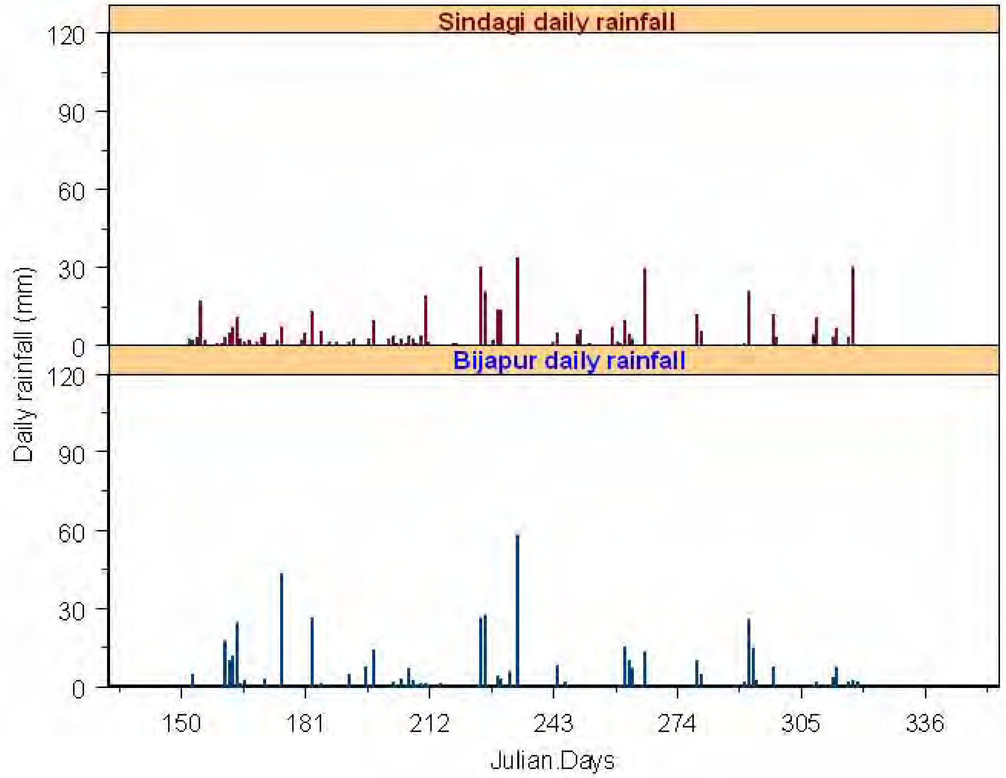


Figure 27. Daily rainfall recorded from June to November 2010 in Bijapur and Sindagi taluks of Bijapur district during crop season 2010

Bijapur

Sindagi and Bijapur taluks in Bijapur district were selected as representatives for all other taluks in the district for rainfall variability. We presented the daily rainfall distribution of both taluks (figure 27). In both the taluks the rainfall in SW monsoon was lower than normal in June, July, September and October however, scanty amounts of rainfall were well distributed during the season (Table 12). During August rainfall was higher than normal rainfall in Sindagi (84%) and Bijapur (64%) in the second fortnight after a longer dry spell in both taluks that affected legume crops.

Table 12. Seasonal normal rainfall and actual rainfall observed in taluks of Bijapur district during crop season 2010-11.

Taluk	Month	May	Jun	Jul	Aug	Sep	Oct	Nov
Sindai	Normal rainfall (mm)	37	95	95	91	168	92	21
	Rainfall 2010 (mm)	**10.4**	**62.3**	**76.8**	**167.7**	**113.9**	**53.9**	**58.1**
Bijapur	Normal rainfall (mm)	48	91	84	83	166	109	25
	Rainfall 2010 (mm)	**24.6**	**118.6**	**68.0**	**136.4**	**68.3**	**65.2**	**80**

Chamarajanagar

Kollegal and Chamarajanagar taluks were considered for seasonal rainfall analysis in Chamarajangar. Although rainfall in May month (Figure 28, Table 13) was less than normal, good enough for sowing and crop establishment. Rainfall was more than normal from June, July and August that helped vegetative phase of the crops. In the months of September and October rainfall was less than but near normal and sufficient for crop growth and November rainfall was much higher than normal.

Table 13. Seasonal normal rainfall and actual rainfall observed in taluks of Chamarajanagar district during crop season 2010-11.

Taluk	Month	May	Jun	Jul	Aug	Sep	Oct	Nov
Kollegal	Normal rainfall (mm)	134.5	39.7	67	72.4	103.0	156.9	83.9
	Rainfall 2010 (mm)	**104**	**42**	**85**	**107**	**83**	**148**	**186**
Chamarajanagar	Normal rainfall (mm)	142.8	32.6	36.4	46	67.3	174.7	58.3
	Rainfall 2010 (mm)	**87**	**68**	**42**	**77**	**83**	**150**	**268**

However, post-rainy season crops sown in September-October must have benefitted from soil moisture availability due to higher rainfall in September, October and November.

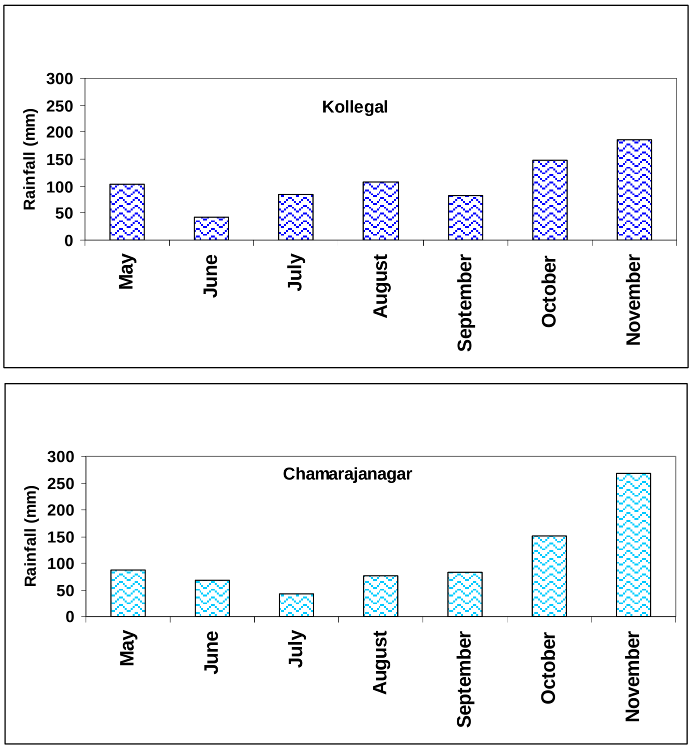


Figure 28. Monthly rainfall recorded from June to November 2010 in Chamarajanagar and Kollegal taluks of Chamarajanagar district during crop season 2010

Chikkaballapur

Bagepally and Chikkaballapur taluks in Chikkaballapur district were considered as representative taluks for rainfall analysis in the district. Bagepally taluk represents groundnut growing areas in the district while Chikkaballapur taluk represents ragi growing areas in the district for estimating crop productivity trends of these crops in response to rainfall and water stress conditions.

In Chikkaballapur, low rainfall during September and October has potential to affect ragi grain yields as this period coincides with flowering and grainfilling stages of finger millet although rainfall was good enough during vegetative phase of this crop. However, crop yield response seems to be good when consider the grain and fodder yield of this crop as it is drought tolerant.

In Bagepally, rainfall during the season from June to September was favourable with higher than normal amounts (Table 14) and good distribution (Fig 29) helped groundnut crop without moisture stress during growing season and the crop yield estimates for the season was also supportive of this hypothesis.

Table 14. Seasonal normal rainfall and actual rainfall observed in taluks of Chikkaballapur district during crop season 2010-11.

Taluk	Month	May	Jun	Jul	Aug	Sep	Oct	Nov
Chickballapur	Normal rainfall (mm)	73.2	77.5	101.6	123	148.9	142.2	63
	Rainfall 2010 (mm)	93.4	131.9	186.4	108	142	79	172
Bagepally	Normal rainfall (mm)	65.3	57.1	85.1	92.9	147	122.2	52.1
	Rainfall 2010 (mm)	63.5	132	186	108	141	77	172

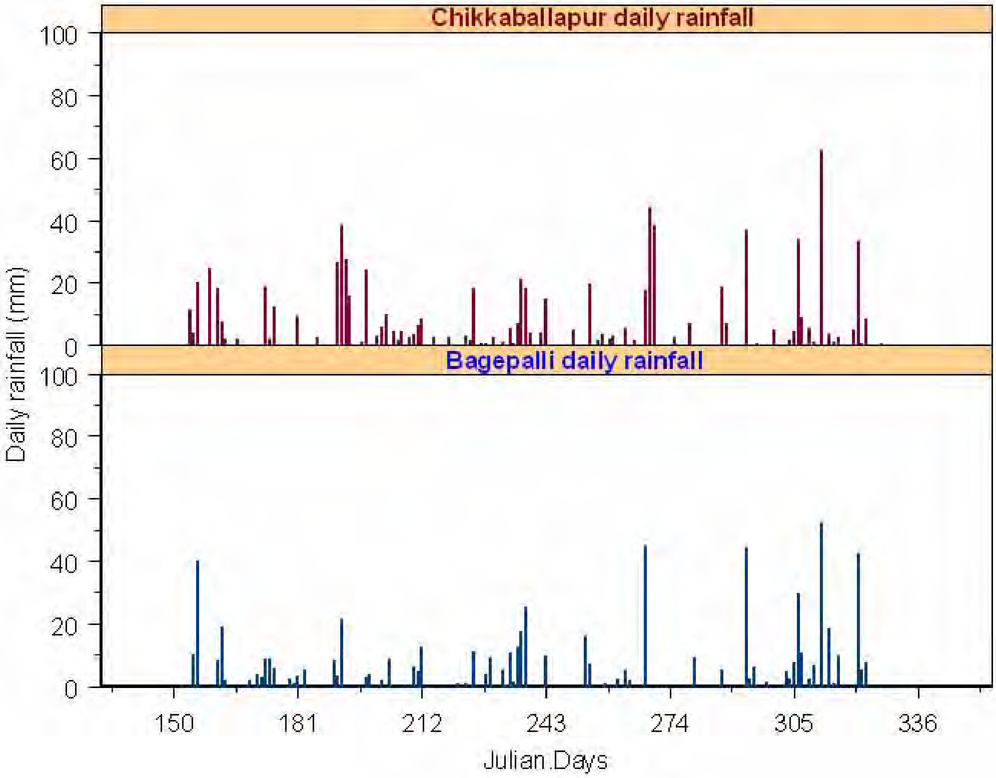


Figure 29. Daily rainfall recorded from June to November 2010 in Bagepalli and Chikkaballpur taluks of Chikkaballapur district during crop season 2010

Chitradurga

In Chitradurga, Hosdurga taluk which is prominently finger millet growing area and Challekere an area known for groundnut prominence were representing for analysis of rainfall in the district. Sowing was done with rainfall in July in all taluks of the district during the season. Although, rainfall distribution was good in Chitradurga, Hosdurga and Holalkere during the season, rainfall was much lower than normal for the September and October months in Challekere (Table 15), Hiryur and Molkalmur taluks has potential to affect crop productivity of maize, finger millet and groundnut sown during late July to August.

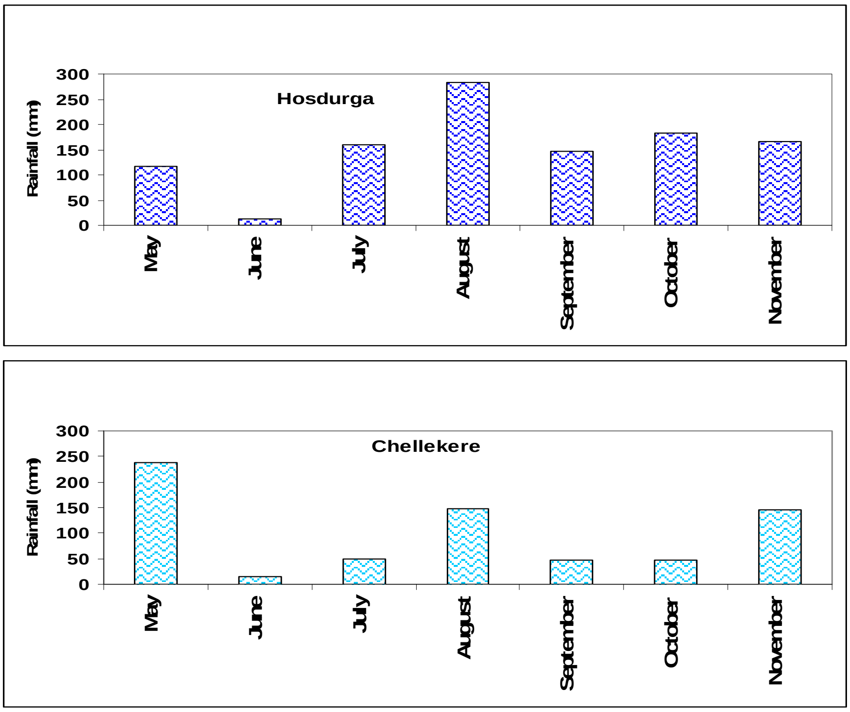


Figure 30. Monthly rainfall recorded from June to November 2010 in Challekere and Hosdurga taluks of Chitradurga district during crop season 2010

Table 15. Seasonal normal rainfall and actual rainfall observed in taluks of Chitradurga district during crop season 2010-11.

Taluk	**Month**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Hosdurga	*Normal rainfall (mm)*	*67*	*31*	*48*	*40*	*73*	*128*	*33*
	Rainfall 2010 (mm)	**117**	**13**	**160**	**284**	**147**	**184**	**165**
Challekere	*Normal rainfall (mm)*	*63*	*29*	*33*	*41*	*84*	*107*	*16*
	Rainfall 2010 (mm)	**237**	**15.6**	**49.6**	**147**	**48**	**48**	**145**

Davangere

In Davangere, we present rainfall distribution and variability analysis for Honahalli and Harapanhalli representing the district. September and October rainfall was lower than normal in Harappanhalli, and the result of longer dry spell in these months had affected crop growth, while rainfall in Honahalli was more than double of the normal rainfall for August, September and October months, presenting significant rainfall variability across taluks in this district.

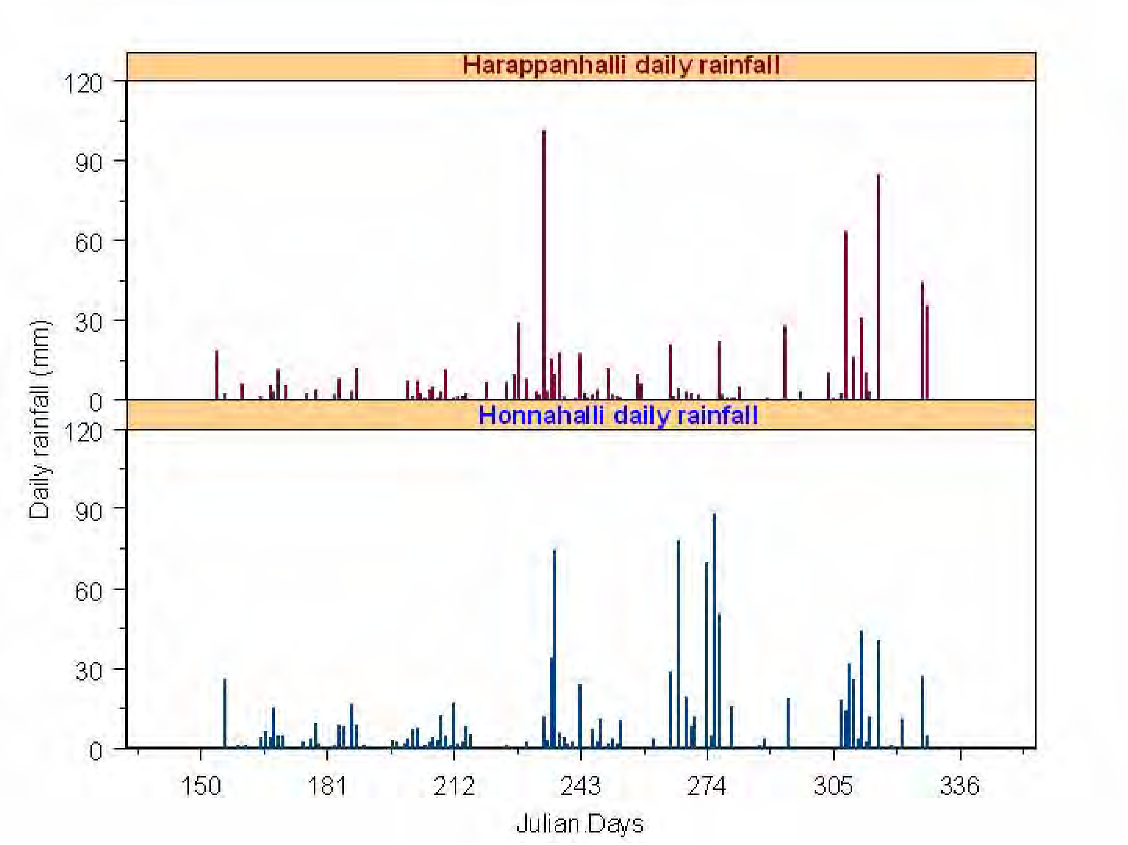


Figure 31. Daily rainfall recorded from June to November 2010 in Honnahalli and Harappanhalli taluks of Davangere district during crop season 2010

Table 16. Seasonal normal rainfall and actual rainfall observed in taluks of Davangere district during crop season 2010-11.

Taluk	Month	May	Jun	Jul	Aug	Sep	Oct	Nov
Harappanhalli	*Normal rainfall (mm)*	*97.8*	*82.6*	*101.4*	*93.8*	*144.8*	*127.0*	*42.5*
	Rainfall 2010 (mm)	**24**	**61**	**69**	**245**	**75**	**74**	**291**
Honnahalli	*Normal rainfall (mm)*	*82.9*	*66.4*	*99.0*	64.2	*94.2*	*117.3*	*43.7*
	Rainfall 2010 (mm)	**36**	**80**	**111**	**181**	**186**	**251**	**233**

Dharwad

Kundagol and Dharwad taluks in Dharwad district are selected to provide over all status of rainfall during the season in Dharwad district. June rainfall was higher than normal in all taluks of Dharwad district except Kalghatagi where it was less than normal for the month. August rainfall was less than normal in all taluks this season except Kalghatagi where the rainfall was more than long-term average. August rainfall was critical for the crops sown at the end of June upto July end.

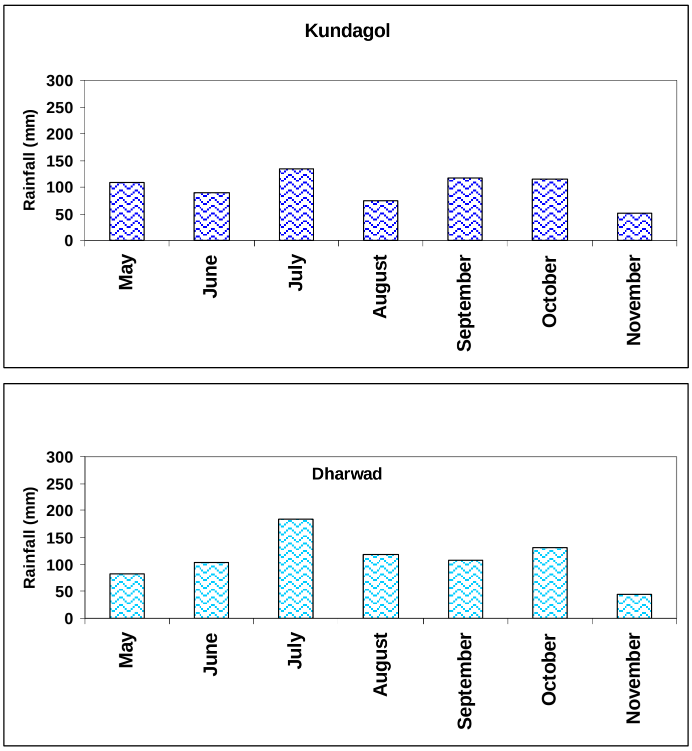


Figure 32. Monthly rainfall recorded from June to November 2010 in Kundagol and Dharwad taluks of Dharwad district during crop season 2010

Table 17. Seasonal normal rainfall and actual rainfall observed in taluks of Dharwad district during crop season 2010-11.

Taluk	**Month**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Kundagol	*Normal rainfall (mm)*	*82*	*69*	*92*	*165*	*71*	*96*	*138*
	Rainfall 2010 (mm)	**108**	**89**	**135**	**75**	**118**	**114**	**52**
Dharwad	*Normal rainfall (mm)*	*93*	*75*	*192*	*189*	*163*	*140*	*106*
	Rainfall 2010 (mm)	**82**	**103**	**184**	**119**	**108**	**130**	**45**

Gadag

In Gadag district, Nargunda and Gadag taluks rainfall data was presented considering them as representative taluks to provide general picture of rainfall situation during the season 2010-11.

Dry spells in September and October in Nargunda must have affected crop growth for want of moisture availability. In Nargund even October rainfall was much lower than normal that affected crops especially for Nargunda.

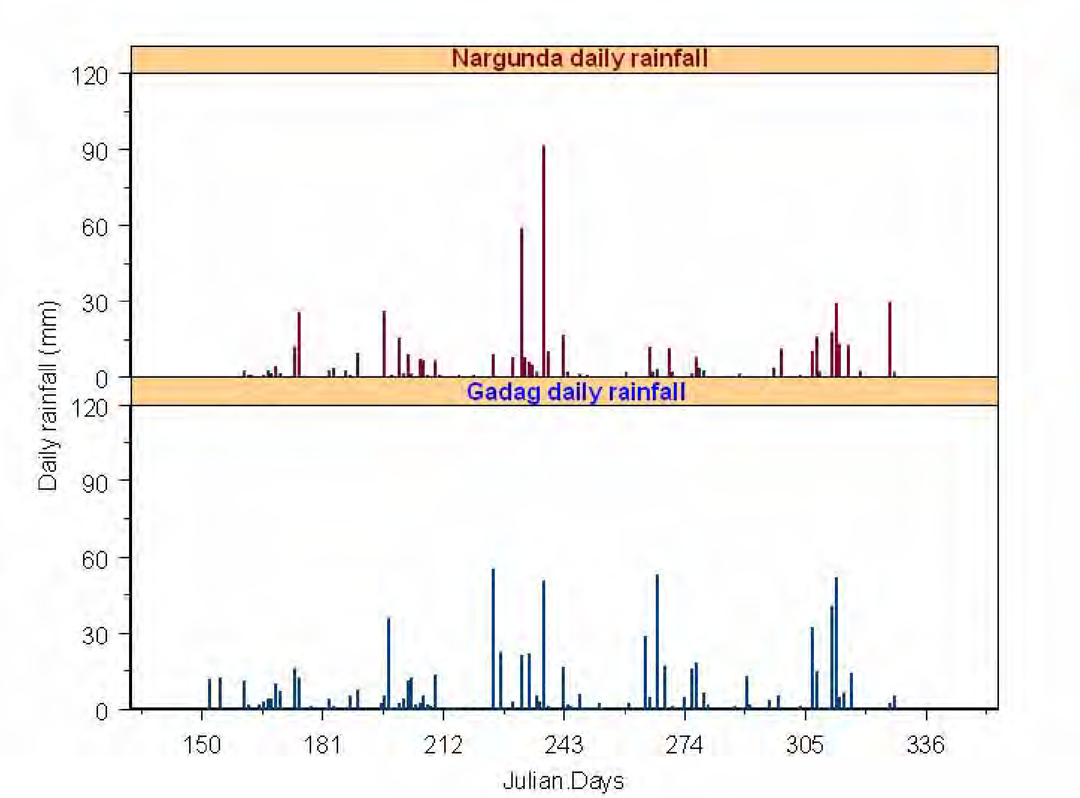


Figure 33. Daily rainfall recorded from June to November 2010 in Gadag and Nargunda taluks of Gadag district during crop season 2010

Table 18. Seasonal normal rainfall and actual rainfall observed in taluks of Gadag district during crop season 2010-11.

Taluk	**Month**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Nargunda	*Normal rainfall (mm)*	*71*	*75*	*75*	*54*	*129*	*129*	*28*
	Rainfall 2010 (mm)	**105.1**	**47.8**	**97**	**217.6**	**37.6**	**33**	**133.8**
Gadag	*Normal rainfall (mm)*	*83*	*79*	*74*	*88*	*136*	*136*	*33*
	Rainfall 2010 (mm)	**69.9**	**94.3**	**114.5**	**199.3**	**118**	**71.4**	**171.4**

Gulburga

In Guburga district, we presented rainfall situation for Jevargi and Gulburga taluks from May to November during 2010. In Jevargi, June rainfall was less than (57%) normal potential to affect early sown legumes.

In Jevargi and Gulburga taluks less than normal rainfall in September, October and November months has potential to affect pigeonpea and Rabi season crops with moisture stress resultant of less rainfall for consequitive 3 months. Heavy rainfall at the end of October has affected fodder quality of short season legumes in the district.

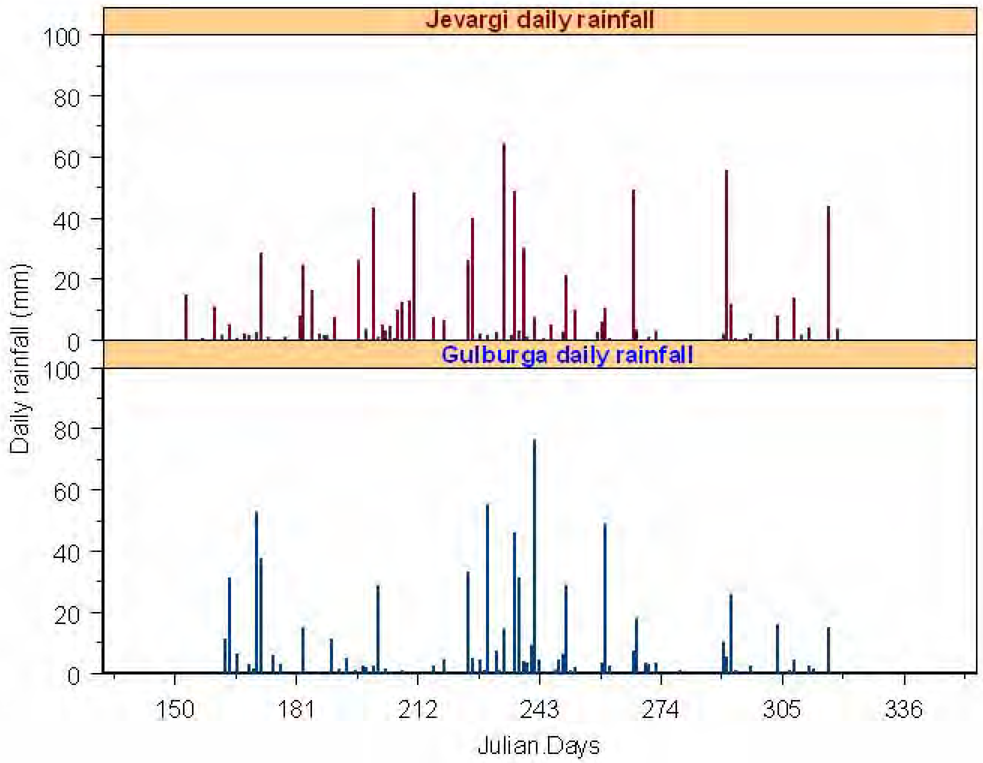


Figure 34. Daily rainfall recorded from June to November 2010 in Gulburga and Jevargi taluks of Gulburga district during crop season 2010

Table 19. Seasonal normal rainfall and actual rainfall observed in taluks of Gulburga district during crop season 2010-11.

Taluk	**Month**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Javargi	*Normal rainfall (mm)*	*40*	*125*	*142*	*163*	*203*	*108*	*31*
	Rainfall 2010 (mm)	**45.3**	**71.3**	**232.2**	**243.5**	**121.6**	**88.6**	**67.4**
Gulburga	*Normal rainfall (mm)*	*45*	*116*	*143*	*147*	*226*	*82*	*22*
	Rainfall 2010 (mm)	**48.2**	**151**	**221.1**	**299.3**	**130.8**	**55.8**	**23.5**

Haveri

In Haveri, Savanur and Ranebannur taluks were selected to present the rainfall situation for the entire district.

Savanur represents groundnut growing areas and Ranebennur represent maize growing areas of the district. Rainfall in both taluks was fairly well distributed with large number of rainy days with smaller amounts of rainfall events. Rainfall from June to September in both taluks was slightly more than normal with good distribution. In Savanur however, there was lower rainfall in October month fairly compensated by higher than normal rainfall in November.

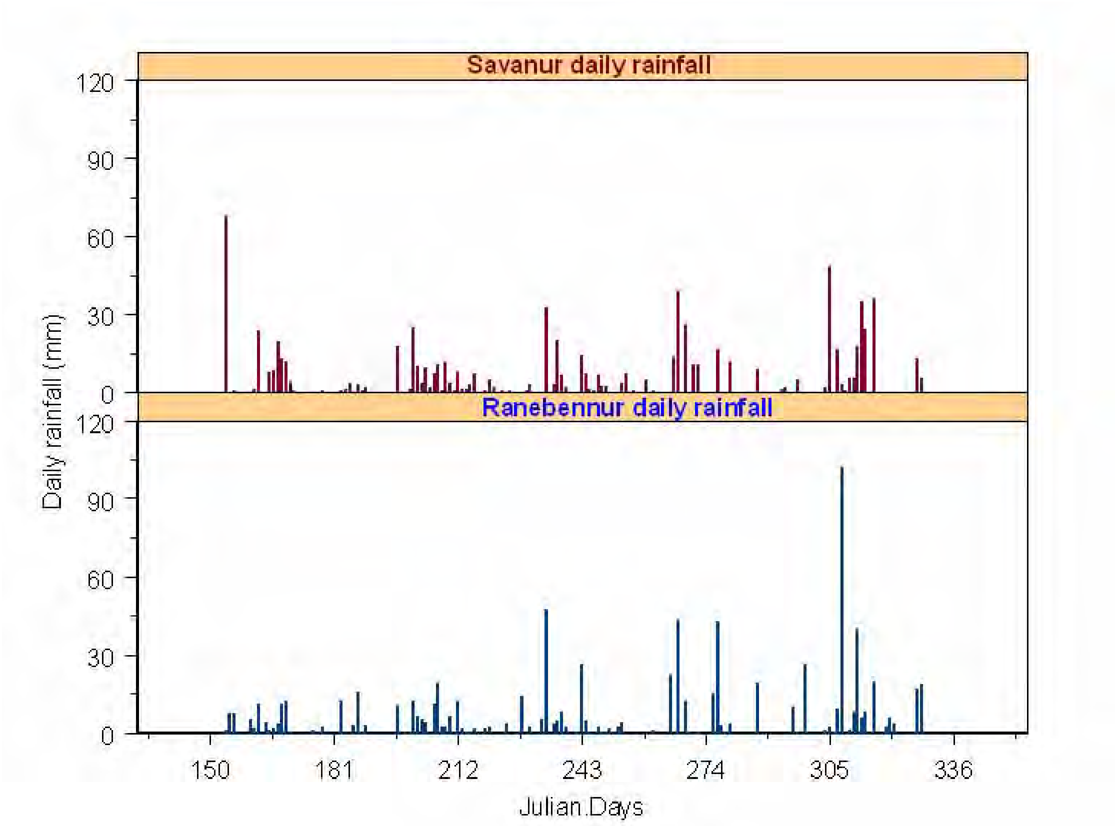


Figure 35. Daily rainfall recorded from June to November 2010 in Ranebennur and Savanur taluks of Haveri district during crop season 2010

Table 20. Seasonal normal rainfall and actual rainfall observed in taluks of Haveri district during crop season 2010-11.

Taluk	Month	May	Jun	Jul	Aug	Sep	Oct	Nov
Savanur	*Normal rainfall (mm)*	*98*	*85*	*128*	*88*	*100*	*115*	*36*
	Rainfall 2010 (mm)	**79**	**161**	**124**	**105**	**139**	**48**	**210**
Ranebennur	*Normal rainfall (mm)*	*88*	*69*	*97*	*62*	*86*	*117*	*36*
	Rainfall 2010 (mm)	**78**	**70**	**125**	**124**	**94**	**121**	**242**

As a result even Rabi season crops were safe guarded from moisture stress. In Ranebennur during October month there was no rainfall anamoly. As a result productivity in Haveri district was good with maize, groundnut and soybean.

Hasssan

In Hassan, Arkalguda and Hassan taluks were considered for presentation of rainfall situation for crop growth during 2010. In Arkalguda rainfall was near normal in June but was less than normal in August, October and November while September was the only month exceeding normal rainfall (200%).

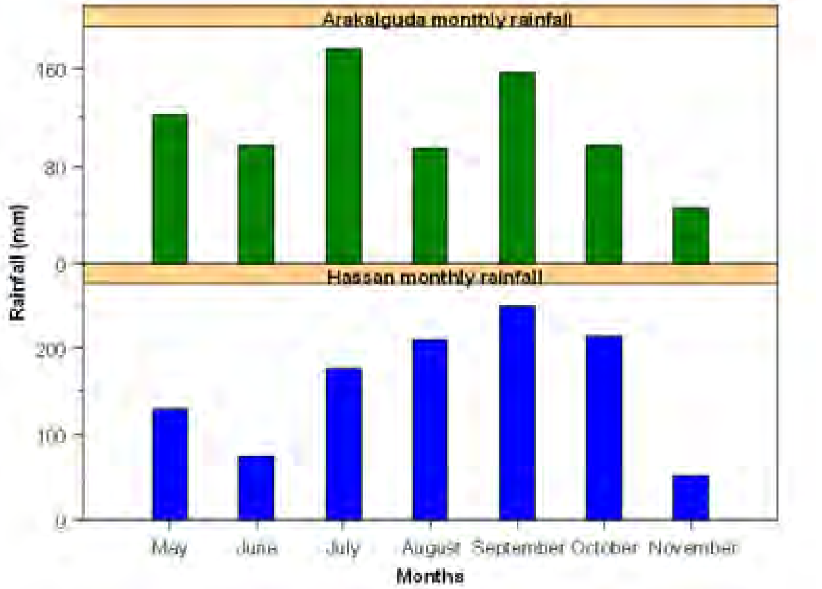


Figure 36. Monthly rainfall recorded from June to November 2010 in Arkalguda and Hassan taluks of Hassan district during crop season 2010

Table 21. Seasonal normal rainfall and actual rainfall observed in taluks of Hassan district during crop season 2010-11.

Taluk	Month	May	Jun	Jul	Aug	Sep	Oct	Nov
Arkalguda	*Normal rainfall (mm)*	*109*	*92*	*222*	*122*	*75*	*143*	*65*
	Rainfall 2010 (mm)	**122**	**97**	**177**	**95**	**156**	**97**	**45**
Hassan	*Normal rainfall (mm)*	*94.8*	*74.7*	*181.3*	*77.2*	*87*	*188.6*	*53.3*
	Rainfall 2010 (mm)	**130**	**74**	**176**	**210**	**249**	**215**	**52**

While a contrasting situation persisted in Hassan with near normal rainfall in June and July, while in August, September and October rainfall was more than 200% of the normal rainfall for the taluk resulting in robust growth of maize with higher maize fodder productivity in the season.

Raichur

Raichur and Lingsugur taluks were considered to present rainfall situation for Raichur district (Figure 37) and its effects on crop productivity across taluks.

During the months of June, July and August, rainfall was near or more than normal for these taluks, however, rainfall receded during September and October and was particularly low (Table 22) to affect crops at maturity of crops sown during July and August. There was high probability of less stored water in the profile for Rabi crops like chickpea and sorghum.

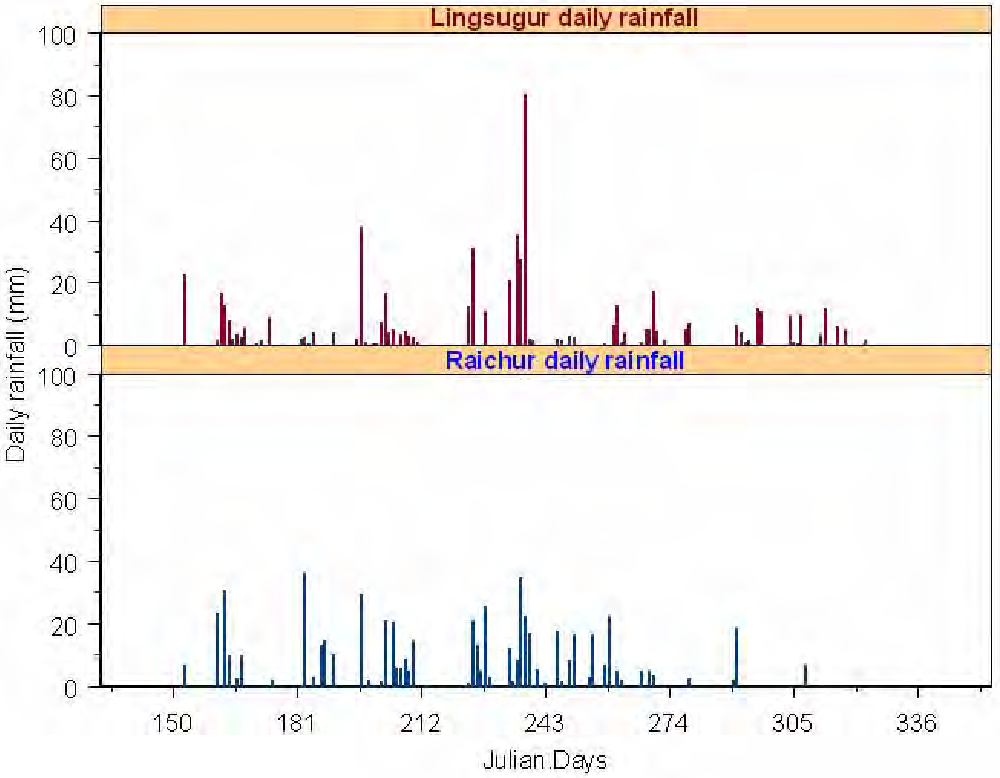


Figure 37. Daily rainfall recorded from June to November 2010 in Raichur and Lingsugur taluks of Raichur district during crop season 2010

Table 22. Seasonal normal rainfall and actual rainfall observed in taluks of Raichur district during crop season 2010-11.

Taluk	**Month**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Lingsugur	*Normal rainfall (mm)*	*28.8*	*93.4*	*128.9*	*125.6*	*165.8*	*80.9*	*22.8*
	Rainfall 2010 (mm)	**27.6**	**84.2**	**189.2**	**169.4**	**111.2**	**22.5**	**6.8**
Raichur	*Normal rainfall (mm)*	*39.9*	*62.5*	*80.2*	*30.3*	*141.4*	*77.6*	*30.3*
	Rainfall 2010 (mm)	**33**	**86.6**	**104.8**	**221.6**	**69.2**	**57.8**	**39.9**

Kolar

Kolar rainfall was reported for representative taluks of Mulbagula which is predominantly groundnut growing taluk and Kolar taluk which is predominantly ragi growing taluk surrounded by Srinivaspura, Malur and Bangarpet, which grow ragi as major crop.

Rainfall was 200% more than normal during June and 35% more than normal during July for these taluks helping farmers with a secure sowing season in June and July. But rainfall was drastically lower at 33% to 50% of normal rainfall in August.

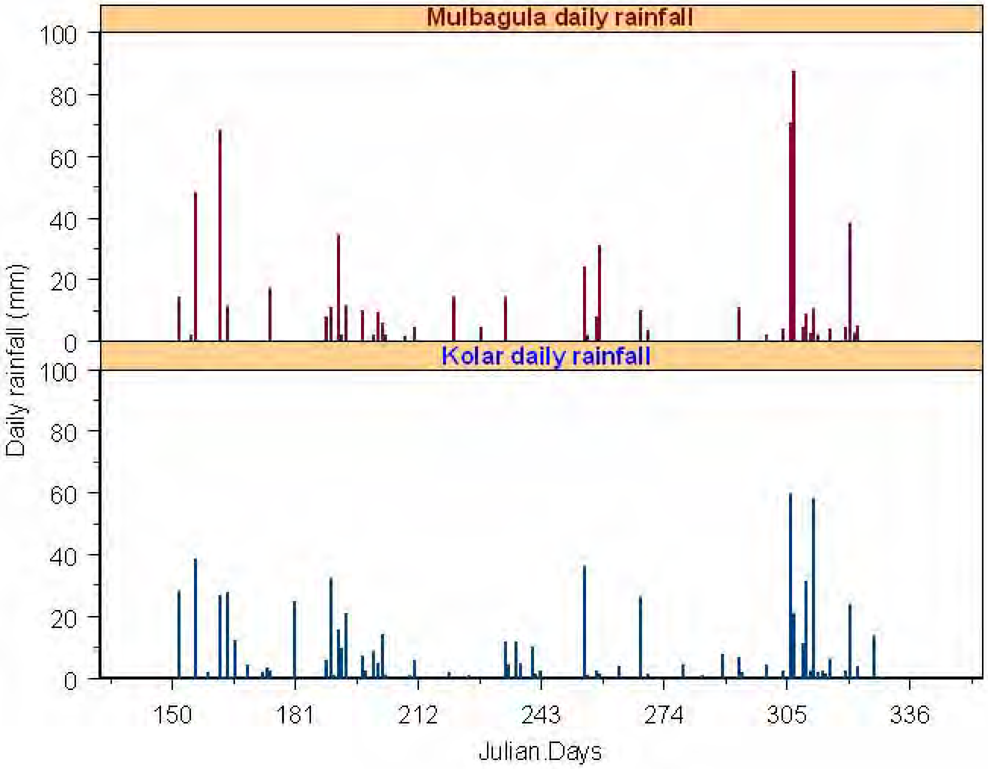


Figure 38. Daily rainfall recorded from June to November 2010 in Kolar and Mulbagula taluks of Kolar district during crop season 2010

Table 23. Seasonal normal rainfall and actual rainfall observed in taluks of Kolar district during crop season 2010-11.

Taluk	**Month**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Mulbagula	*Normal rainfall (mm)*	*75*	*54*	*76*	*99*	*137*	*146*	*70*
	Rainfall 2010 (mm)	**65.4**	**161.6**	**101.8**	**33.2**	**78.3**	**77.1**	**241**
Kolar	*Normal rainfall (mm)*	*84*	*52*	*76*	*95*	*151*	*139*	*64*
	Rainfall 2010 (mm)	**17.6**	171.8	128.8	48.6	71.8	27.0	**237.6**

During September and October rainfall was particularly lower than 50% of the normal in these months (Table 23) to affect groundnut development and maturity for the crop sown during June and July as well as crop establishment and vegetative phase of ragi crop that was sown during late July and first week of August in Kolar district

Tumkur

Tumkur and Madgiri taluks were considered to present rainfall situation in the district during 2010, as ragi was the major crop in Chikkanayanahalli, Gubbi and Tumkur and adjoining taluks while groundnut was a prominent crop in Madgiri, Koratagere, Sira and Pavagada taluks of Tumkur district.

Table 24. Seasonal normal rainfall and actual rainfall observed in taluks of Tumkur district during crop season 2010-11

Taluk	Month	May	Jun	Jul	Aug	Sep	Oct	Nov
Madgiri	*Normal rainfall (mm)*	*60.2*	*44*	*52.6*	*61.2*	*134.8*	*120.4*	*40.8*
	Rainfall 2010 (mm)	**89.4**	**48**	**95.2**	**89**	**95.2**	**68.5**	**34.5**
Tumkur	*Normal rainfall (mm)*	*79.4*	*49.6*	*79*	*77.2*	*143*	*122*	*39*
	Rainfall 2010 (mm)	**69.9**	**83.1**	**164**	**123**	**182.9**	**138.6**	**74.4**

Although rainfall in June was near normal, only during July when rainfall was 80% higher than normal and sufficient for groundnut sowings, farmers commenced sowing during second fortnight of July. During September, October and November rainfall receded in groundnut growing areas affecting critical stages of crop and its productivity. Even after 100% more than normal rainfall in June and July farmers took up sowing of ragi only in the month of August and rainfall was more than normal in August, September, October and November in ragi growing areas including Tumkur.

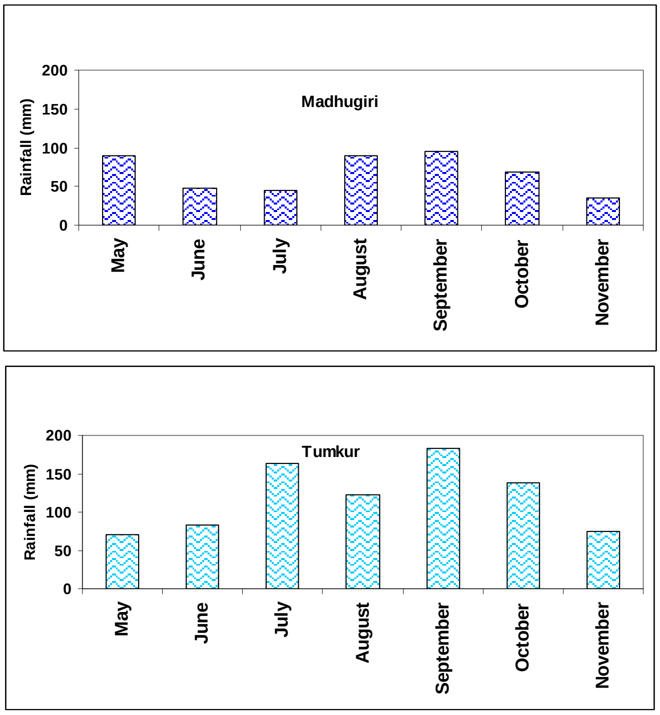


Figure 39. Monthly rainfall recorded from June to November2010 in Madgiri and Tumkur taluks of Tumkur district during crop season 2010

Yadgir

Rainfall of Shorapur and Yadgir taluks were presented for analysis to represent the entire district (Figure 40) and its effects on different crops grown in taluks of newly formed district of Yadgir. Rainfall from June to October was higher than normal (up to 135%) in Yadgir taluk, with good distribution. In Shorapur taluk rainfall was low and poorly distributed in

June and July, rainfall in August was 80% higher than normal, however receded in September, October and November recorded lower than normal.

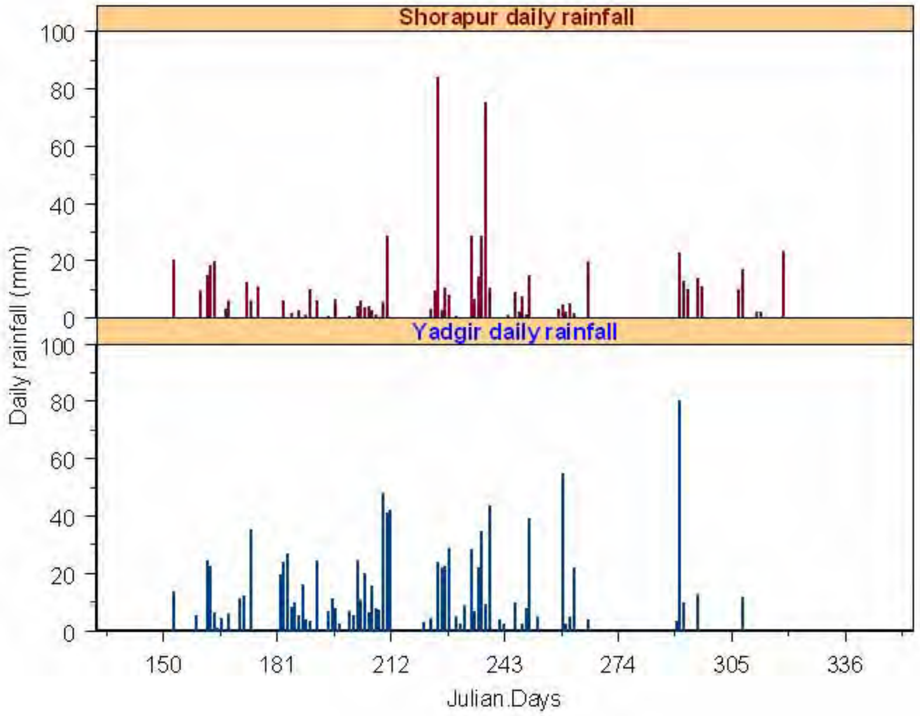


Figure 40. Daily rainfall recorded from June to November 2010 in Yadgir and Shorapur taluks of Yadgir district during crop season 2010

Table 25. Seasonal normal rainfall and actual rainfall observed in taluks of Yadgir district during crop season 2010-11.

Taluk	Month	May	Jun	Jul	Aug	Sep	Oct	Nov
Shorapur	*Normal rainfall (mm)*	*42*	*123*	*167*	*156*	*199*	*119*	*25*
	Rainfall 2010 (mm)	**26.6**	**120.2**	**91.6**	**281.4**	**71.2**	**70.7**	**54.2**
Yadgir	*Normal rainfall (mm)*	*35*	*120*	*174*	*175*	*193*	*103*	*20*
	Rainfall 2010 (mm)	**29.4**	**140.9**	**402.3**	**268.8**	**149.8**	**105.8**	**11.5**

Window of Sowing Opportunity in the Districts for Kharif Crops

Good monsoon rains in the months of June and July 2010 in most of the districts helped farmers to sow crops in time mostly from the 2nd week of June in Northern Karnataka districts. In Chamarajanagar, the sowing started as early as April continued up to early May with better rainfall in April and May months in that district. In Hassan also sowing of crops commensed as early as 2nd week of May and continued up to 4th week of June.

Table 26. Window of sowing opportunities during Kharif 2010-11 for crops in different districts of Karnataka under Bhoochetana project

S. No.	District	Major rainfed crop	Sowing window of opportunity
1.	Bengaluru Rural	Finger Millet (Ragi)	4th week, June to 2nd week, August
		Maize	2nd week, June to 2nd week, July
2.	Bidar	Soybean	3rd week, June to 1st week, July.
		Green gram	2nd week, June to 4th week, June.
		Black gram	2nd week, June to 4th week, June
		Pigeonpea	2nd week, June to 4th week, June
		Sorghum	4th week, June to 2nd week, July.
3.	Bijapur	Maize	30th May to 30th June
		Pearl millet	25th May to 30th June
		Mung bean	23rd May to 15th June
		Pigeonpea	24th May to 7th July
		Sunflower	25th May to 7th August
		Groundnut	7th June to 15th July
4.	Chamarajanagar	Sorghum	1st week, April to 2nd week, May
		Maize	1st week, May to end May (Gundalpet, Chamaraj Nagar Taluks), 1st week, June to end July (Kollegal and Yalandur taluks)
		Finger millet	2nd week, June
		Sunflower	2nd week , April to 2nd week, May
		Groundnut	3rd week, April to 2nd week, May
5.	Chikkaballpur	Groundnut	4th week, June to 4th week, July
		Finger Millet (Ragi)	4th week, July to 4th week, August
6.	Chitradurga	Groundnut	1st week, July to 4th week, August
		Maize	1st week, July to 2nd week, August
		Finger Millet (Ragi)	3rd week, August to 4th week, September.
7.	Dharwad	Soybean	
		Groundnut	
8.	Davangere	Sorghum	2nd week, June to 1st week, July
		Finger Millet (Ragi)	1st week, July to 2nd Week, August
		Maize	2nd week, June to 1st week, July
		Groundnut	1st week, July to 3rd week, July
9.	Gadag	Sorghum	4th Week of May to 2nd Week of June
		Maize	1st Week of June to 3rd Week of August
		Green gram	4th Week of May to 4th Week of June
		Groundnut	1st Week of June to 4th Week of July
		Sunflower	1st Week of June to 3rd Week of August
10.	Gulburga	Mung Bean	1st week, June to 4th week, June
		Black Gram	2nd week, June to 3rd week, July
		Pearl Millet	3rd week, June to 4th week, July
		Sunflower	3rd week, June to 1st week, August
		Pigeonpea	1st week, June to 4th week, July

11.	Hassan	Maize Sunflower Cowpea Finger Millet (Ragi)	Last week, May to end June Last week, May to end June 2nd week to 4th week, May 1st week to 4th week, June
12.	Haveri	Maize Groundnut Soybean	3rd week, May to 1st week, July 1st week to 4th week, June 1st week to 4th week, June
13.	Kolar	Ragi Groundnut	2nd week, July to 3rd week, August 1st week, June to 1st week, July
14.	Raichur	Pearl Millet pigeonpea Groundnut Cotton Sunflower	5th July to 25th July 1st June to 15th July 15th June to 15th July 15th June to 25th July 15th June to 5th July, 15th September to 31st October
15.	Tumkur	Groundnut Ragi	2nd week, July to 4th week, July 25th July to 15th August
16.	Yadgiri	Mung Bean Black Gram Pearl Millet Sunflower Pigeonpea	1st week, June to 4th week June 2nd week, June to 3rd week July 3rd week, June to 4th week July 3rd week June to 1st week August 2nd week June to 4th week July

In all other districts except Chitradurga, sowings of major rainfed crops like maize, groundnut, pearl millet, soybean were completed by July. In Kolar, Tumkur and other districts, ragi was sown late in the season from late July to mid-late August even when the monsoon rainfall was good this year. Sunflower was another crop late sown in Kharif in the months of August and September especially in Chitradurga, Raichur, Bidar, Yadgir and Gulburga while the crop was sown in southern Karnataka districts namely Hassan and Chamarajanagar in the month of June.

Farmers' ParticipatoryVarietal Evaluations

During the crop season, ICRISAT requested JDA of each district to provide support for planned varietal demonstration with farmers' participation, by encouraging them with supply of fertilizer inputs at subsidized costs. ICRISAT provided guidance with the involvement of ICRISAT technician to followup the layout of demonstration in accepted farmers' fields. ICRISAT provided seed material for 83 trials with different crops in fifteen districts (Table 27) where farmers volunteered for trials. ICRISAT provided guidance on suitability of cultivars of each major crop of the district to evaluate in the farmers' fields

Table 27. Details of varietal trials during rainy season 2010-11 in 15 districts of Bhoochetana in Karnataka

S. No.	Districts	No. Taluks	crop	varieties	No. of trials
1	Kolar	2	Groundnut	ICGV91114, K1375, TMV13	6
		4	Ragi	L-5, MR-1	8
2	Chikkaballapur	4	Groundnut	ICGV91114, K1375, TMV13	12
		2	Ragi	L-5, MR-1	4
3	Tumkur	4	Groundnut	ICGV91114, K1375, TMV13	12
		6	Ragi	L-5, MR-1	12
4	Chitradurga	3	Groundnut	ICGV91114, TMV13	9
		1	ragi	L-5, MR-1	6
		2	Maize (Chitradurga)		
5	Davangeri	4	ragi	L-5, MR-1	8
			maize		
			jowar		
		2	groundnut	ICGV91114, K1375, GPBD4	6
6	Haveri		groundnut	ICGV91114, K1375, GPBD4	
			soybean	KHSb2, MAUS-2, JS 9305	
			maize		
7	Dharwad		groundnut	ICGV91114, K1375, GPBD4	
			soybean	KHSb2, MAUS-2, JS 9305	
8	Gadag		maize		
			green gram	PDM54, S4, ML267, LGG 460	
			groundnut	ICGV91114, K1375, GPBD4	
9	Chamarajanagar		ragi	L-5, MR-1	
			soybean	KHSb2, MAUS-2, JS 9305	
			maize		
			sunflower		
10	Bengaluru Rural	4	ragi	L-5, MR-1	8
			maize		
11	Hassan		ragi	L-5, MR-1	
			maize		
			sunflower		
			cowpea		
12	Gulburga	10	red gram	ICPL87119, ICP 85063, ICP 7035, ICP 96053, ICP 96058, BSMR736	
		1	black gram	TAU1, DU1	
			green gram	PDM54, S4, ML267, LGG 460	
			bajra	ICTP8203, ICMV 221	
			sunflower		
13	Bijapur		red gram	ICPL87119, ICP 85063, ICP 7035, BSMR736	
			groundnut	ICGV91114, K1375, TMV13	
			green gram	PDM54, S4, ML267, LGG 460	
			bajra	ICTP8203, ICMV 221	
			sunflower		

			maize		
14	Bidar	1	red gram	ICPL87119,ICP 85063, ICP 7035, ICP 96053, ICP 96058, BSMR736	
		1	Black gram	TAU1, DU1	
		1	Green gram	PDM54, S4, ML267, LGG 460	
		1	Soybean	KHSb2, MAUS-2, JS 9305	
		1	Sorghum		
15	Raichur		Groundnut	ICGV91114, K1375, TMV13	15
			Bajra	ICTP8203, ICMV 221	15
			Sunflower		15
			Cotton		
			Red gram	ICPL87119, ICP 85063, ICP 7035, BSMR736	45

Crop Cutting Experiments for Crop yield Estimation: A Joint Evaluation

Joint team of official from DoA, DES, UAS Scientists along with ICRISAT Technicians adopted a uniform crop sampling procedure across all districts for crop cutting experients and yield estimations. The uniform guidelines were as follows.

- Identify all farmers who were registered/took the inputs from RSKs and applied in their designated fields and sown a selected major crop. This was ascertained through RSK bills and Field Facilitators who facilitated farmers in the village for registration /and inputs procurement from DoA.
- At taluk level, ADA/AO ensured preparation of the total list of those identified farmers along with ICRISAT scientific associate and Field Facilitatros and Lead Farmers in the villages.
- Pool up the list of farmers at district level to facilitate further monitoring and evaluations.
- At taluk level, ICRISAT staff/AO/ADA made at least two field visits in the cropping season to randomly selected farmers fields those coincide with the end of vegetative phase and flower or maturity phase.
- In these phases, field photos showing crop growth differences in individual farmer’s fields were obtained as a record for verification.
- At the time of crop harvest, JDA office prepared farmers’ list for crop sampling randomly selecting farmers’ fields which also had farmers’ management treatment in the same farmer’s field.
- Crop sampling was done in the randomly selected farmers’ fields in each village.

Procedure for field selection for sampling:

- 10% of villages in each taluk were considered for crop sampling in the farmers' fields.
- In each village three farmers' fields were sampled in both farmers' management and improved management as advised in Bhoochetana guidelines.
- A minimum of three randomly selected samples in each treatment from a farmer's field with a minimum sample size of 9 m^2 or even more crop area based on crop row orientation, aggregating to a minimum of 27 m^2 or more crop area was sampled in each treatment.
- Enough precautions were taken to select unbiased representative crop samples from farmers' field.
- Total fresh weight of each sample (9 m^2 or more) was measured for three samples, and a sub-sample of 10-15 whole plants weighing up to 2 to 3 kg fresh weight was collected, weighed for recording fresh weight of sub-sample.
- In this process, we collected one sub-sample each from farmers' management and improved BC management of a farmers' field for moisture estimation and yield components estimation.
- The whole plant sub-samples were processed to separate pods and ear-heads from haulms and stalk.
- Thus collected two plant parts were properly labeled and bagged in Kora cloth bags (pod or ear head) and muslin cloth bags (stalk) by ICRISAT Technicians for air /sun-drying for two to three days, and were sent to ICRISAT Patancheru Campus for further processing and yield estimations.
- At ICRISAT, these plant samples were dried at constant temperature of 65-70º C for 48 hrs in stabilized dryer temperature and dry weights were recorded.
- Grain/pod attributes were measured to understand quality and marketability of the produce.
- Although mean crop yields are provided for the purpose of summaries, individual farmers-wise crop yield are also provided as annexure to the report.

Supervisor Responsibility for crop sampling

All the following steps were thoroughl discussed and planned under the guidance, support and supervision of the respective JDAs by scheduling the entire process in the district well in advance:

- A Joint team of officials constituted by JDA in each district supervised the crop sampling at their designated villages.
- All the representatives of KSDA, DEs, UAS, WDD, ICRISAT, FFs, LFs, participating farmers and those suggested by JDAs were included in the Team.
- Name of the farmer with date and location of sampling were recorded for each sample from farmers' fields.
- At the time of crop sample harvest, some fields were photographed along with the farmer in his field to provide authenticity to the sampling.
- Farmers opinions were also recorded in a sheet when the crop data is recorded at harvest sampling, and all other representatives attending the crop sampling also signed on record of sample weights for each farmers' field.
- A copy of the duly signed fresh weights data sheet was available with DoA officer or their representatives
- Some subsamples of whole plant randomly collected were retained for processing by DoA staff which might serve as a counter check for yield estimations provided by ICRISAT.

Figure 41. Sorghum crop sampling in Bidar and Ragi crop sampling in Kolarr districst.

Rainy Season Crop Yield Estimation in Farmers' Fields

Bengaluru Rural

Maize

Maize is a major crop found preference of farmers, cropped area increasing year after year, grown on nearly 19500 ha during kharif 2010-11 achieved area target (99%) under Bhoochetana project in Bengaluru Rural district. In Doddaballapur taluk mean grain yield of maize was estimated at 4.6 t ha^{-1} in farmers' management (FM) as compared to 6.5 t ha^{-1} in improved management (IM) in number of farmers' fields (Table 28). Maize grain yield increase with IM was 42% higher compared to farmers' management for the same taluk. Similarly maize mean fodder yield was estimated at 3.46 t ha^{-1} with farmers' management compared to maize higher fodder yield of 4.45 t ha^{-1} with improved management in farmers' fields. Fodder yield increase with IM was on average higher at 29% over farmers' management.

Table 28. Maize crop yields in farmers' fields with improved management compared to farmers' management durin Kharif 2010-11 in Bengaluru Rural district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Doddaballapur	Maize	8720	3460	4600	12560	4450	6530	29	42

The response of maize to improved management would have been more conspecious in terms of fodder and grain yield with improved management by efficient utilization of resources, but for the deficit rainfall during the months of August, September and October in this district which synchronized with silking and grain filling critical stages of maize crop which was mostly sown in the months of June and July in this district. However, farmers realized the advantage of an increase of almost 2 t ha^{-1} grain yield, and one ton of additional fodder yield per hectare with improved management which was significant for farmers in this district.

Ragi (finger millet)

Ragi is one of the major crops in the district grown on 16532 ha during the kharif season 2010-11 in Devanhalli, Doddaballapur, Hoskote and Nelamangala taluks almost achieved area target (99%) set under Bhoochetana project (Table 29).

Ragi grain and stalk yield response with FM and IM were consist with rainfall during the season and considerable grain yield increases were observed from 31%in Nelmangala and Dodballapur to 55% in Devanhalli taluks in the district with improved management over farmers' management, averaged upto 35% grain yield increase across the district.

Table 29. Finger millet (ragi) crop yields in farmers' fields with improved management and farmers' management during Kharif 2010-11 in various taluks of Bengaluru Rural district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Devanahalli	Ragi	5640	3550	1410	8320	5120	2190	44	55
Doddaballapur	Ragi	5760	3580	1660	7530	4640	2170	30	31
Hoskote	Ragi	8740	5650	2250	11720	7460	3060	32	36
Nelamangala	Ragi	7820	4560	2180	10080	5890	2860	29	31
Bengaluru Rural Mean	Ragi	7640	4730	2040	10170	6240	2760	32	35

Ragi fodder yield increase was also observed in range of 29% to 44% among different taluks, on an average of 32% increase in fodder yield with improved management. Mean grain yield increase of ragi was almost 720 kg ha^{-1}, and mean fodder yield increase was nearly 1500 kg ha^{-1} with improved management in the district. Ragi fodder is valued by the farmers to feed large population of milch cattle in the district.

Bidar

Black gram

Black gram and green gram are two important legumes popularly grown as base crops for a pigeonpea intercrop in the district. Black was grown on 16275 ha, achieved 100% of the target area coverage under Bhoochetana for the crop in five taluks of the district.

Table 30. Black gram yields in farmers' fields with improved management and farmers' management during Kharif 2010-11 in various taluks of Bidar district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Aurad	Black gram	3490	2240	910	5050	3310	1310	48	44
Basvkalyan	Black gram	4070	2160	1530	5720	2850	2120	32	39
Bhalki	Black gram	1100	510	380	1580	730	550	43	45
Bidar	Black gram	2270	1220	530	3090	1910	710	57	34
Humnabad	Black gram	4060	2310	1290	5350	3510	1630	52	26
Bidar Mean	Black gram	3000	1690	930	4160	2460	1260	46	35

Response of black gram in terms of grain and stalk yield to management practices were consistant within each taluk during 2010-11. With improved management, black gram grain yield increase was between 26% and 45% in different taluks, and a similar trend was observed in stalk yield with an increase between 23% and 57% from different taluks with improved management. In Aurad, Bhalki and Bidar taluks black gram yield response was lower and similar among these taluks but a higher response of grain and fodder yields were observed in Basavakalyan and Humnabad. A critical observation reveals that sufficient rainfall in June which helped short season legumes like black gram and green gram to grow faster in the vegetative phase in Basavakalyan and Humnabad produced more grain yield with sufficient rains in later months. However, farmers expressed that heavy rains especially in August spoiled good crops at harvest as fodder and grain quality was affected in this district.

Green gram

Green gram was grown on 14175 ha covering 100% of the target area for the crop in five taluks of the district under Bhoochetana project durng 2010-11. Mung bean grain and fodder yields in response to management practices were consistant, as grain yield increase varied between 31% and 45% and fodder yield increase varied between 26% and 60%with improved management compared to farmers' management in same taluks. Mean grain yield increase of 330 kg ha^{-1} was almost 38%, and mean fodder yield increase was 480 kg ha^{-1} was almost 37% increase within the district (Table 31). Mung bean yield response was also affected by low rainfall in the month of June in Aurad, Bhalki and Bidar taluks.

Table 31. Green gram yields in farmers' fields with improved management compared to farmers' management during Kharif 2010-11 in various taluks of Bidar district.

Taluks	**Crop**	**Farmers' management (FM) (kg ha^{-1})**			**Improved management (IM) (kg ha^{-1})**			**% Yield increase with IM**	
		TDM	**Stalk**	**Grain**	**TDM**	**Stalk**	**Grain**	**Stalk**	**Grain**
Aurad	Green gram	2170	970	750	2860	1400	1010	44	35
Basvkalyan	Green gram	3820	1700	1380	4860	2280	1810	34	31
Bhalki	Green gram	1220	550	440	1840	860	640	56	45
Bidar	Green gram	1630	650	700	2570	1040	1000	60	43
Humnabad	Green gram	4080	2690	1090	5560	3390	1530	26	40
Bidar Mean	Green gram	2580	1310	870	3540	1790	1200	37	38

Sorghum

Sorghum was grown on 19189 ha during 2010-11 kharif achieving crop targets by 90%under Bhoochetana for the district. Rainy season sorghum was sown during end of June to first fortnight of July. Sorghum is a hardy crop and was less affected by rainfall variability as seen from almost uniform crop yield estimates across taluks although there were differences in rainfall across taluks. Sorghum grain yield across taluks varied in a narrow range between 1520 and 1730 kg ha^{-1} and fodder yield varied between 3880 and 4280 kg ha^{-1} with farmers' management (Table 32). Mean grain yield of sorghum across taluks varied between 2050 and 2480 kg ha^{-1} and fodder yield varied between 5230 and 5850 kg ha^{-1} with improved management. Grain yield advantage with improved management to farmers was upto 46% (mean 40%) compared to farmers' management in Bidar district.

Table 32. Rainy season sorghum yields in farmers' fields with improved management compared to farmers' management during Kharif 2010-11 in various taluks of Bidar district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Aurad	Sorghum	4320	1930	1730	5850	2440	2480	26	43
Basvkalyan	Sorghum	3870	1780	1570	5230	2440	2160	37	38
Bhalki	Sorghum	4140	1740	1670	5630	2340	2440	34	46
Bidar	Sorghum	4280	2240	1520	5470	3050	2050	36	35
Humnabad	Sorghum	3880	1540	1650	5430	2250	2320	46	41
District Mean	Sorghum	4100	1840	1630	5520	2500	2290	36	40

Fodder yield advantage to farmers with improved management in this district was up to 46% (mean 36%) compared to farmers' management.

Soybean

Soybean sowing commenced during 3rd week of June and completed by 1st week of July covering an area of 10080 ha that was 80% of the target area of 12600 ha in five taluks under Bhoochetana. Soybean is known to be tolerant for waterlogging and minimize the affects of high rainfall. During July and August months Aurad, Bhalki and Bidar taluks received high rainfall. However, the lower grain yield of soybean in these taluks can be attributed to lower rainfall in the month of June and moisture stress which affected its vegetative phase early in the season uniformly under both managements.

Table 33. Soybean yields in farmers' fields with improved management compared to farmers' management during Kharif 2010-11 in various taluks of Bidar district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Aurad	Soybean	3760	660	2050	5220	840	3030	27	48
Basvkalyan	Soybean	4310	700	2430	5540	970	3260	39	34
Bhalki	Soybean	3440	810	1790	4990	1480	2540	83	42
Bidar	Soybean	4290	1350	1860	5640	1790	2720	33	46
Humnabad	Soybean	4280	920	2360	5490	1210	2990	32	27
Bidar Mean	Soybean	4020	890	2100	5380	1260	2910	42	39

Higher grain yield in Basavkalyan and Humnabad taluks in both treatments are attributed to better rainfall in June for initial crop growth. Mean grain yield of soybean varied between a minimum of 1790 kg ha^{-1} and a maximum of 2430 kg ha^{-1} with farmers' management, while mean grain yields varied between a minimum of 2540 kg ha^{-1} and a maximum of 3260 kg ha^{-1} with improved management across taluks. Grain yield increase with improved management compared to farmers' management was between 27% and 48% with mean grain yield increase of 39% for the entire district. Similarly, soybean stalk which is generally not used for fodder, yield increase varied between a minimum of 27% and a maximum of 83%, with the district average of 42% was observed during the kharif season 2010-11. Soybean stalk yield estimated was disproportionately lower due to end season rainfall affected leaf fall and stalk/twigs deterioration.

Pigeonpea

In Bidar district, pigeonpea was sown mostly as sole crop with supplemental irrigation, or was grown as an intercrop in soybean, green gram, black gram or rainy season sorghum. Pigeonpea was sown from 2nd week of June to end of June covering an area of 21105 ha (90%) of the target area of 23450 ha in five taluks of the district.

Pigeonpea grain yields varied from a minimum of 910 kg ha^{-1} in Bidar taluk to a maximum of 1290 in Humnabad taluk with a mean grain yield across all districts was at 1230 kg ha^{-1} with farmers' management (Table 34). With improved management pigeonpea mean grain yield in taluks varied from a minimum of 1290 kg ha^{-1} in Bidar to a maximum of 2000 kg ha^{-1} in Bhalki taluk. Response of pigeompea to farmers' management and improve management in terms of increased yields were consistant across taluks. Grain yield increase in pigeonpea with improved management varied in a narrow range from 34% to 42% over grain yield with farmers' management. Pigeonpea stalk yield of almost 6 t ha^{-1} was recorded with farmers' management while it was almost 8 t ha^{-1} with improved managemet with an overall increase of 33% in stalk yields. Pigeonpea stalks are mainly valued for thatching as well as firewood in rural Karnataka. Pigeonpea husk and leaves after threshing is a valuable feed for milch cattle.

Table 34. Pigeonpea yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Bidar district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Aurad	Pigeonpea	7670	5880	1190	9420	6970	1690	19	42
Basvkalyan	Pigeonpea	7870	5970	1260	10540	7960	1730	33	37
Bhalki	Pigeonpea	8900	6690	1490	12750	9820	2000	47	34
Bidar	Pigeonpea	7560	5730	910	9730	7390	1290	29	42
Humnabad	Pigeonpea	7520	5680	1290	10210	7600	1820	34	41
Bidar Mean	Pigeonpea	7900	5990	1230	10530	7950	1700	33	38

Bijapur

Maize, pearl millet, green gram, pigeonpea, sunflower and groundnut were identified and targeted an area of 142,755 ha under Bhoochetan project during 2010, achieved sowing target of 71% with these selected crops in an area of 101844 ha in the district.

Green gram

In Bijapur, green gram was grown on 14175 ha, a cropping target which was achieved 100% with farmers' interest in this crop. Green gram grain yield was generally low in this district in both treatments compared to other adjacent districts owing to poorly distributed low rainfall in June and July that affected the initial crop establishment and vegetative growth. There were longer dry spells in July which caused moisture stress. Mean grain yield of green gram was 330 kg ha^{-1} with farmers' management across taluks while grain yield was observed minimum at 150 kg ha^{-1} in Indi taluk and maximum of 390 kg ha^{-1} was recorded in B. Bagiwadi taluk with farmers' management (Table 35). Minimum grain yield of 200 kg ha^{-1} was recorded in Indi taluk while a maximum grain yield of 590 kg ha^{-1} was recorded in B. Bagiwadi taluk with improved management, and the responses were consistant across taluks for management treatment in farmers' field. Green gram grain yield increase with improved management varied between 20% in Sindagi to 57% in Bijapur with over all mean yield increase of 45% in across taluks of Bijapur districts.

Table 35. Green gram yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Bijapur District.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
B.bagewadi	Green gram	1070	470	390	1740	790	590	68	51
Bijapur	Green gram	1030	480	350	1470	600	550	25	57
Indi	Green gram	570	340	150	710	400	200	18	33
Sindagi	Green gram	1050	510	350	1340	670	420	31	20
Bijapur Mean	Green gram	980	460	330	1380	620	480	35	45

Groundnut

Groundnut crop target area was fixed at 22583 ha, of which 46%area (10321 ha) was sown to groundnut, shows that farmers consideration of risk in Bijapur as it is cost intensive crop for seed and inputs. Groundnut pod yield in Bijapur was lowest amongst all the districts under Bhoochetana project in both treatments as was the case with green gram in this district. As mentioned earlier rainfall after sowing in the months of June and July was low with small amounts of rainfall on many days without having good moisture in the soil profile. Low rainfall early in crop establishment and vegetative growth affected particularly all short season legumes. Groundnut pod yield was at a minimum of 230 kg ha^{-1} in Muddebihal and pod yield maximum of 380 kg ha^{-1}, and mean pod yield of 320 kg ha^{-1} with farmers' management, while minimum pod yield was at 330 kg ha^{-1} in Muddebihal taluk and a maximum pod yield of 630 kg ha^{-1}, and mean pod yield of 470 kg ha^{-1} in Sindagi with improved management. Pod yield response was consistant within a taluk for both management treatments.

Groundnut pod yield increase varied from 24% in Indi taluk to 66% in Sindagi taluk with mean of 47% pod yield increase with improved management in Bijapur. Groundnut stalk yields response was also similar to pod yield response with two managements. Mean stalk yield of 680 kg ha^{-1} was observed with farmers' practice while mean stalk yield of 950 kg ha^{-1} was recorded with improved management, resulting in 40% increase in stalk yields with improved management over farmers' management. Groundnut stalk is valued as fodder to cattle in most of the groundnut growing areas in Karnataka.

Table 36. Groundnut yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Bijapur District.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Pod	TDM	Stalk	Pod	Stalk	Pod
Bijapur	Groundnut	760	450	310	1040	590	450	31	45
Indi	Groundnut	970	600	370	1320	860	460	43	24
Muddebihal	Groundnut	780	550	230	1140	810	330	47	43
Sindagi	Groundnut	1490	1110	380	2180	1540	630	39	66
Bijapur Mean	Groundnut	1000	680	320	1420	950	470	40	47

Maize

During kharif season, target area for maize cropping in Bijapur was 15841 ha of which 87% i. e. 13433 ha was cropped in Bijapur and Muddebihal taluks. Maize sowing was done during June in all the maize growing areas in the district. Although rainfall was scanty during June and July in Bijapur, maize was not affected in terms of fodder and grain yield in both the management treatments as it is a slow growing crop initially, low rainfall did not effect as much it affected legumes productivity in this district. Maize mean grain yields were less at 4960 kg ha^{-1} in Muddebihal taluk and mean grain yields were higher at 6220 kg ha-1in Bijapur taluk with a district mean of 5560 kg ha^{-1} with farmers' management, while mean grain yields were higher at 7990 kg ha^{-1} in Bijapur and were much less at 6510 kg ha^{-1}in Muddebihal taluk, and district mean grain yield of 7250 kg ha-1 was recorded with improved management in Bijapur. Grain yields were 30% higher and fodder yields were 31% higher with improved management in Bijapur compared to farmers' management.

Table 37. Maize yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Bijapur District.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Bijapur	Maize	11890	3600	6220	15080	4430	7990	23	28
Muddebehal	Maize	8800	2730	4960	12110	3830	6510	40	31
Bijapur Mean	Maize	10340	3160	5590	13590	4130	7250	31	30

Pearl millet

Pearl millet targeted crop area under Bhoochetana project was in an area of 40729 ha but interest was lessend with this crop hence the crop target achieved was only 43% at 17314 ha sown to this crop during the kharif season. Pearl millet sowings were completed between 25th May and 30th June in the district.

Pearl grain yields and fodder yield were lower affected by moisture stress in Indi and Muddibihal taluks in both the managements. Pearl millet mean grain yield was at a minimum of 710 kg ha^{-1} in Indi taluk, and was highest at 2370 kg ha^{-1} Bijapur taluk farmers' field with farmers' management. While similar trend was observed in mean grain yield at a minium 1090 kg ha-1 in Indi taluk, and a mean grain yield at a maximum of 3140 kg ha-1 in Bijapur taluk with improved management during kharif season 2010-11.

Over all mean grain yield increase with improved management for the farmers in the district was 710 kg ha^{-1} which was 35% more than farmers' management, and fodder yield increase with improved management was 710 kg ha^{-1} compared to farmers' management. Millet fodder in these districts is used for cattle which is valuable to the farmers.

Table 38. Pearl millet yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Bijapur District.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
B.bagewad	Pearl Millet	5120	2190	2090	6390	3090	2730	41	31
Bijapur	Pearl Millet	5140	2230	2370	7040	2960	3140	33	32
Indi	Pearl Millet	1950	930	710	2830	1360	1090	46	54
Muddebehal	Pearl Millet	3760	1940	1370	5340	2600	2020	34	47
Sindagi	Pearl Millet	4540	2080	1850	6240	2570	3010	24	63
Bijapur Mean	Pearl Millet	4560	2020	1960	6150	2730	2670	35	36

Pigeonpea

In Bijapur, pigeonpea area increased this cropping season owing to good market price for pigeonpea dal as well as farmers confidence to produce more with high input management either for sole crop or for intercrop. Pigeonpea was grown on 47809 ha against a target area of 27487 ha, and the district achieved almost 174% coverage of the target area for pigeonpea with additional area brought under pigeonpea this season.

Pigeonpea in this district across all taluks was affected by scanty rainfall since August until November, when the crops vegetative face and flowering also exposed to limited moisture, hence lower biomas production and grain yields compared to neighbouring Bidar district where pigeonpea biomass production was almost double. A critical view of the yield estimates indicate that biomass to grain conversion was high in Bijapur affected by inherent moisture stress. In Bijapur and Muddebihal pigeonpea growth and yields were higher compared to other taluks as farmers in this taluks preferred sole pigeonpea in stead of intercrop pigeonpea in other taluks. In Bijapur taluk farmers harvested additional grain yield of 400 kg ha^{-1}, in Indi taluk it was 140 kg ha^{-1} and in Sindagi taluks addition yield obtained was 200 kg ha^{-1} with improved management under Bhoochetana project. Over all grain yield increase across all taluks was 26%, however varied among taluks between 22%and 32% for the season 2010-11.

Table 39. Pigeonpea yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Bijapur District.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Bijapur	Pigeonpea	4940	2750	1540	6810	4090	1940	49	26
Indi	Pigeonpea	1930	1100	500	2680	1610	640	46	28
Muddebihal	Pigeonpea	3560	2030	1020	4400	2530	1240	25	22
Sindagi	Pigeonpea	2610	1610	630	3240	1960	830	22	32
Bijapur Mean	Pigeonpea	3260	1870	920	4280	2550	1160	36	26

Chamarajanagar

In all taluks of Chamarajanagar, sorghum sowing started early in the 1st week of April and continued up to May. Maize, sunflower and Groundnut were sown mostly in the month of May, and Finger millet was sown late in June during Kharif 2010-11. Sorghum target area (4801 ha) was sown upto 81% and Maize target area (12533 ha) was sown up to 90%. Major crops like finger millet (110%), sunflower (105%), and groundnut (105%) were sown 5% to 10% above the target area in the season as good sowing conditions and farmers' preference prevailed for these crops.

Groundnut mean pod yield increase across the district was nearly 700 kg ha^{-1} with improved management which was 56% higher than farmers' management. Farmers were benefitted by addition production of 400 kg ha^{-1} groundnut fodder with improved management which is 41% higher compared to farmers' management in the district.

Ragi, a staple cereal food crop produced additionally 760 kg ha^{-1} grain yield (57% increases) and 250 kg ha^{-1} of fodder yield (13%) with improved management over farmers' management in the district. Maize mean grain and fodder yield was low with farmers' management as well as with improved management because less stress tolerance for moisture however made a significant difference with a yield increase of 1300 kg ha-1 with improved management which is 73% yield increase to farmers in the district.

Although sorghum grain yield and biomass production in both managements were lower, there was 55% yield increase with improved management and farmers harvested nearly 800 kg ha^{-1} additional grain yield and nearly equal quantities of additional fodder yield was obtained in the district.

Sunflower crop with low tolerance for moisture stress affected by less amount of rainfall in June and July in different taluks produced less biomass and yields with both managements. In response to improved managemet sunflowere produced nearly 400 kg ha^{-1} additional seed yield with improved management which was almost 51% increase yield compared to farmers' management in the same district.

Table 40. Major crop yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Chamarajanagar District.

Crop	Farmers' management (kg ha$^{-1)}$		Improved Management (kg ha$^{-1)}$		% increase in yield (IM)	
					Stalk	Pod/Grain
	Stalk	Pod /Grain	Stalk	Pod/ Grain	kg ha^{-1}	kg ha^{-1}
Groundnut	1105	1109	1553	1733	41	56
Ragi	1932	1331	2183	2093	13	57
Maize	5333	1776	9194	3078	72	73
Sorghum	2227	1428	3031	2215	36	55
Sunflower	826	746	967	1128	17	51

Chickballapur

Finger millet

In chickballapur, finger millet is an important staple food crop targeted to cover an area of 45000 ha, was sown in 44833 ha almost achieving 100% coverage of the cropped area under Bhoochetana in the district. Finger millet sowing was mostly done between end July and August. Rainfall in Sidlagatta and Chikkaballapur taluks during the crop season was more than normal except in August and there was no moisture during the crop period, hence ragi yield was higher in both treatments, and mean grain yield with improved management around 3.5 t ha^{-1} to 3.9 t ha^{-1} was an exceptionally higher yield of ragi (Table 41). Ragi farmers gained by an additiona grain yield of 1.1 t ha^{-1}, and an additional fodder yield of 1.2 t ha^{-1} in chickballapur district, which reflects enhancement in grain yield by 42%, and enhancement in fodder yield by 57%traditionally considered a poor farmers'crop with low yield. Farmers in this district and neighbouring Kolar agreed that the crop yields with improved management were exceptionally higher, but incessant rains.in November affected grain quality of ragi in some taluks.

Table 41. Ragi yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Chickballapur district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Chickballapur	Ragi	5900	2430	2820	8610	3560	3960	47	40
Sidlagatta	Ragi	5050	1800	2440	7850	3070	3500	71	43
Chickballapur Mean	Ragi	5440	2090	2610	8200	3290	3710	57	42

Groundnut

Groundnut crop was targeted to grow in 27000 ha of four taluks, actually sown area was 26833 ha, an achievement up to 99% of the target in chickballapur. Groundnut was sown in four taluks between 4th week of June to 4th week of July 2010. Bagepalli, Chintamani, Gowribidnur and Gudebanda taluks have been traditionally groundnut growing areas, and with farmers' practice groundnut pod yields hover around 1 ton ha^{-1} in good rainfall years, and much less in deficit rainfall years. As this year happened to be a good rainfall year, groundnut mean pod yields across taluks was 1350 kg ha^{-1} under farmers' management while mean grain yield under improved management was significantly higher at 2010 kg ha^{-1}, an additional pod yield of 660 kg ha^{-1} was harvested by farmers in the district. Pod mean yield increase was 49%, varied in a narrow range between 47% and 52% among taluks. Pod and fodder yield differences either for farmers' management or for improved management were consistant and very small difference exists across taluks. Fodder mean yield increase obtained by farmers in the district was almost 700 kg ha^{-1}, which must have been affected by late leaf spot with end season rainfall in November.

Table 42. Groundnut yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Chickballapur district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Pod	TDM	Stalk	Pod	Stalk	Pod
Bagepalli	Groundnut	2310	1080	1230	3770	1950	1820	81	48
Chintamani	Groundnut	2350	1030	1320	3760	1750	2000	70	52
Gowribidanur	Groundnut	2550	1010	1540	3910	1640	2270	62	47
Gudebande	Groundnut	2510	1180	1330	3690	1720	1960	46	47
Chikkballapur Mean	Groundnut	2440	1090	1350	3770	1760	2010	61	49

Chitradurga

Maize

In Chitradurga, maize was sown from 1st week of June to end of July as the rainfall in June was scanty.Area targeted to be sown with maize in Chitradurga was 66000 ha of which 65510 ha were sown during the kharif which amounts to 99% of the target area sown in the district.Maize was mainly concentrated in two taluks namely Holalkere and Chitradurga. Mean grain yield estimates in Chitradurga taluks were 4530 kg ha^{-1} and in Holalkere were 2860 kg ha^{-1} with farmers' management, while mean grain yield in Chitradurga taluk was 6180 kg ha^{-1}and in Holalkere was 4160 kg ha^{-1}. Additional yield gained by farmers in Chitradurga was 1650 kg ha^{-1} which was 36% increase over grain yield with farmers' practices, and in Holalkere additional yield gained by farmers was 1300 kg ha^{-1} which was 45% over grain yields with farmers' practice. Farmers' obtained fodder yield also followed the same trend with 700 kg ha^{-1} additional fodder in Chitradurga, and an additional fodder yield of 680 kg ha^{-1} in Holalkere with improved management over farmers' management

Table 43. Maize yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Chitradurga district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	grain	Stalk	Grain
Chitradurga	Maize	7700	2230	4530	10570	2930	6180	31	36
Holalkere	Maize	5390	2070	2860	7840	2750	4160	33	45
Chitradurga Mean	Maize	6740	2160	3840	9430	2850	5340	32	39

Finger millet

In Chitradurga, finger millet was targeted to be grown on 20000 ha, and actual sown on 19650 ha achieved area coverage of 98% of the target during 3rd week of August to 4th week of September. Ragi was grown in Hosdurga taluk of Chitradurga which is generally a scanty rainfall taluk in the district, but received higher amounts of rainfall than normals from July to October during the year 2010.

In this taluk, finger millet grain yield was 2050 kg ha^{-1} with farmers' management while mean grain yield was 2680 kg ha^{-1} with improved management and farmers in this taluk obtained an additional yield of 630 kg ha^{-1} (31%) due to improved management. Additional fodder yield 910 kg ha-1 was obtained by farmers with improved management in the district.

Table 44. Ragi yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Chitradurga district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Hosadurga	Ragi	5570	2820	2050	7250	3730	2680	32	31
Chitradurga Mean	Ragi	5570	2820	2050	7250	3730	2680	32	31

Davangere

Maize

In Davangere, Maize was targeted to sow on 52606 ha during kharif season in the district, but sowing was done on 53778 ha (102%) which indicates farmers' preference to maize in the district. Sowing commenced from 2nd week of June and continued upto 2nd week of July. Maize grain yield was low at 3300 kg ha^{-1} in Jagalur taluk, and grain yields were higher at 6780 kg ha^{-1} in Honahalli taluk (Table 45) with farmers' management. Maize grain yields were lower at 4290 kg ha^{-1} in Jagalur and grain yields were higher at 8630 kg ha^{-1} in Honahalli with improved management. Grain yield increase across taluks with improved management varied between 35% in Harihara to 20% in Harappanahalli with a district mean increase of 26% over the faremrs' management. Farmers in Honahalli taluk harvested higher additional grain yield up to 1870 kg ha^{-1}, and farmers in Jagalur had less additional yield of 990 kg ha-1 with improved management. Maize mean fodder yields increase was 690 kg ha^{-1} which was 32%increase, but varied among districts from 23%to 37% with improved management in the district.

Table 45. Maize yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Davangere district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Channagiri	Maize	6360	1430	4020	7980	1950	5300	36	32
Davanagere	Maize	10940	2190	6650	14620	2810	8180	28	23
Harapanahalli	Maize	10230	3610	5060	13460	4960	6080	37	20
Harihara	Maize	6760	1590	4410	9230	1950	5960	23	35
Honnali	Maize	12130	3100	6760	17510	4120	8630	33	28
Jagalur	Maize	5020	1100	3300	6540	1410	4290	28	30
Davanagere Mean	Maize	8850	2170	5220	11890	2860	6600	32	26

Finger millet

In Davangere ragi is an important crop in four taluks with a target area 8773 ha and the target was achieved up to 74% with sowing on 6446 ha during the crop season. Across four taluk mean grain yield obtained by farmers was 1850 kg ha^{-1} with improved management compared to 1420 kg ha^{-1} with farmers' management, amounting to an additional yield 430 kg ha^{-1} was accrued to the farmers (Table 46). Mean additional fodder yield increase of one ton was observed with farmers who adopted improved management, it is almost 34% increase of fodder yield over fodder yield in the farmers' management.

Table 46. Ragi yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Davangere district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Channagiri	Ragi	5450	4110	1030	8260	6050	1490	47	45
Davanagere	Ragi	6310	3490	1450	8290	4660	1830	34	26
Harapanahalli	Ragi	6840	4120	2150	9600	5240	2810	27	31
Jagalur	Ragi	2790	1470	960	3610	1990	1230	35	28
Davanagere Mean	Ragi	4980	2970	1420	6850	3970	1850	34	30

Sorghum

Sorghum is second most important crop after maize in terms of target area of 12148 ha and 8182 ha area was sown to sorghum which is 67% of the target. That indicates reduced farmers interest in sorghum during this kharif season in the district. Sorghum was sown from 2nd week of June to first week of July.

Table 47. Sorghum yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Davangere district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Channagiri	Sorghum	6850	3860	2010	8710	4940	2630	28	31
Honnali	Sorghum	7610	3680	2960	9860	4460	3720	21	26
Jagalur	Sorghum	4420	3000	1100	5690	3660	1490	22	35
Davanagere Mean	Sorghum	5860	3420	1780	7520	4230	2320	24	30

Sorghum grain yield estimates across four taluks of Davangere indicate a mean yield grain of 1780 kg ha^{-1} was recorded with farmers' management, and a mean grain yield of 2320 kg ha^{-1} was recorded with improved management which is almost 30% increase in grain yield obtained by farmers in the district. Sorghum fodder yield of 3420 kg ha^{-1} was estimated with farmers management, and an increase in fodder yield up to 4230 kg ha^{-1} was recorded which amounts to over all increase of fodder by 24% with improved management.

Gadag

Green gram

Green gram is one of the major crops targeted in area of 42,500 ha, and was sown in an area of 33,582 ha which was 79% of the target area in three taluks of Gadag. Green gram was shown from 2nd week of June to 4th of June during the season. Green gram mean grain yield varied from 260 kg ha-1 to 310 kg ha-1 with farmers' management. Green gram mean grain yield varied from 420 kg ha^{-1} to 460 kg ha^{-1} across taluks with improved management. Mean grain yield increase was 160 kg ha^{-1}, which was 57% higher with improved management compared to grain yield with farmers' management. Across all taluks green gram grain yield in both treatment were lower as the crop was initially affected by dryspell during it vegetative growth in June soon after germination which affected green gram plant growth and development.

Table 48. Green gram yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Gadag district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stover	Grain	TDM	Stover	Grain	Stover	Grain
Gadag	Greengram	920	630	290	1330	880	460	40	59
Ron	Greengram	850	540	310	1280	820	460	52	48
Shirahatti	Greengram	860	610	260	1210	780	420	28	62
Gadag Mean	Greengram	870	590	280	1260	820	440	39	57

Groundnut

Groundnut in Gadag is second most important crop in terms of target area of 24000 ha and farmers preference. Groundnut was grown in an area of 18791 ha, achieved cropping target up to 78% for the season. In Gadag and Shirahatti rainfall was more than normal during September, October and November at pod formation and pod filling for the July sown crop, while lower than normal (scanty) rainfall was recorded in Ron and Mundagi taluks during these months, and the affect on pod yield was visible for both the treatments in these taluks.

Table 49. Groundnut yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Gadag district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})				Improved management (IM) (kg ha^{-1})				%Yield increase with IM	
		TDM	Stalk	Pod	kernel	TDM	Stalk	Pod	kernel	Stalk	Grain
Gadag	Groundnut	3350	1590	1760	1130	5210	2770	2440	1600	61	39
Ron	Groundnut	1510		1510	990	2020		2020	1290	38	34
Shirahatti	Groundnut	3280	1870	1410	920	4450	2280	2170	1470	26	54
Mundargi	Groundnut	1700		1700	1120	2330		2330	1590	28	37
Gadag mean		2610	1750	1590	1030	3640	2580	2280	1520	34	43

Groundnut mean pod yield of 1590 kg ha^{-1} and mean fodder yield of 1750 kg ha^{-1} was estimated with farmers' practice while farmers harvested mean pod yield of 2280 kg ha^{-1} and mean fodder yield of 2580 kg ha^{-1}with improved management in the farmers' fields. Farmers' harvested additionally 700 kg ha^{-1} of fodder yield and another 700 kg pod ha^{-1} with improved management, tantamounts to 34% increase in fodder and 4% increase in groundnut pod yield across all taluks.

Maize

In Gadag, maize was not a major crop which had come up on 4000 ha achieving 100% area sown, shows growing farmers' interest in its cultivation.

Table 50. Maize yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Gadag district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Gadag	Maize	10720	2570	6420	15430	3980	8800	55	37
Ron	Maize	10420	3070	5540	14280	5200	6960	69	26
Shirahatti	Maize	11230	3510	6060	14970	4560	7950	30	31
Mundargi	Maize	12190	3610	6940	17990	5770	9580	60	38
Naragund	Maize	10670	3240	5840	14370	5050	7120	56	22
Gadag Mean	Maize	11190	3210	6300	15720	4920	8340	53	32

Maize yields were slightly affected by lower than normal rainfall in September and October months in Ron, Nargunda taluks uniformly for both managements as stress during these months affect grain filling stage of the crop. Mean grain yield was 6300 kg ha-1 with farmers' management and it was 8340 kg ha-1 with improved management resulting in an additional grain yield of nearly 2000 kg ha^{-1} with improved management for the farmers which is 32% increase in grain yield. A similar gain with increase (53%) in fodder quantity by 1700 kg ha-1 due to improved management was observed compared to farmers' management in the district.

Gulburga

Green gram

Green gram was one of the major crops selected to be grown in 22823 ha area under Bhoochetana project, which was actual sown in an area of 20611 ha which was almost 90% of target achievement. Green gram sowing was done mostly during the second fortnight of June.

In Chincholi taluk, green gram performance in both treatments were affected by unusually higher rainfalls of 439 mm in June, 368 mm in July and 218 mm in August during its growth, flowering and pod filling stages of crop, hence grain yield was affected although 2 to 3 ton ha^{-1} of biomas was produced, grain yield was much less at 460 kg ha^{-1} with farmers' management as well as at 590 kg ha^{-1} with improved management, however recorded a gain of 28% additional grain yield (Table 51). Fodder quality was very much affected with cloudy and rainfall conditions during the season.

Pearl millet was also taken up in Chincholi taluk under Bhoochetana project during kharif season 2010. Due to high rainfall during its growth period pearl millet mean grain yield in farmers' field was 1590 kg ha^{-1} and fodder yield of 1600 kg ha^{-1} with farmers' practices and 2080 kg ha^{-1} of mean grain yield, and 2060 kg ha^{-1} of mean fodder yield was recorded with improved management which was in 31% increase in grain yield and 29% increase in fodder for farmers adopted improved management under Bhoochetana project.

Table 51. Green gram yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Gulburga district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stover	Grain	TDM	Stover	Grain	Stover	Grain
Chincholi	Greengram	2110	1520	460	3040	2180	590	43	28
Chincholi	Pearl Millet	3850	1600	1590	4860	2060	2080	29	31

Pigeonpea

Pigeonpea is one of the major crops in the district either as a sole crop or as an intercrop with short season legumes. It was targeted to grow on 130261 ha however achieved almost 95%of the target area (123749 ha) sown to pigeonpea with good rains during sowing period in June 2010.

In all the taluks of Gulburga, rainfall was either much higher than normal or near normal during June to September which promoted higher vegetative growth of pigeonpea, but during September and October months cloudy conditions and severe infestation of insects caused floral drop heavily resulted in lower conversion of biomass to grain yield in this crop. Hence mean grain yield of 1380 kg ha^{-1} in farmers' management and mean grain yield of 1870 kg ha^{-1} with improved management was considered lower response of crop to management. However, with improved management, farmers still stand to gain by an increase in grain yield of 500 kg ha^{-1}, as pigeonpea grain fetches premium value in the market during this season.

Table 52. Pigeonpea yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Gulburga district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Afzalpur	Pigeonpea	6790	5190	1070	9200	7080	1410	36	32
Aland	Pigeonpea	8210	5740	1590	11480	8160	2230	40	40
Chincholi	Pigeonpea	6890	4660	1520	7960	5100	1940	12	28
Jewargi	Pigeonpea	6570	4730	1330	8750	5960	1850	32	39
Gulbarga Mean	Pigeonpea	7140	5090	1380	9420	6620	1870	31	36

Hassan

In Hassan district maize, finger millet, sunflower and cowpea are the major crops nomimated for inclusion under Bhoochetana project during the kharif 2010-11. While maize was grown on 14000 ha achieved 100% sowing target for this crop, Ragi was sown on 15250 ha achieved crop target of 76% only. Ragi sowing was done mostly in the month of June with good rainfall and it was early sowing for ragi traditionally in Hassan compared to other ragi growing districts.

In all taluks of Hassan district, rainfall was near normal during June and July, but higher rainfall was recorded in August and September months in Arakalguda and Hassan taluks compared to other taluks of the district. There were wider deviations of grain and fodder yield in response to either farmers' management or improved management. In Arakalguda and Hassan, higher biomass production may be explained due to congenial moisture conditions; however higher biomass could not be converted to higher grain yields proportionally, although more than one ton ha-1 higher grain yield was recorded with both management in these taluks. Over all mean grain yield increase (35%) with improved management was nearly 650 kg ha^{-1} compared to farmers' management and similarly fodder yield increase (39%) was observed by an additional fodder yield of 1400 kg ha^{-1} with improved management.

Table 53. Maize yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Hassan district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Aluru	Maize	19620	14240	4860	28590	18840	8960	32	84
Beluru	Maize			4200	32740	25340	5520		31
H.N.Pura	Maize			1980	12430	8540	3390		71
Hassan	Maize	18750	14270	3910	28800	21960	6020	54	54
Hassan Mean	Maize	19180	14260	3850	26320	19260	6000	35	56

Table 54. Ragi yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Hassan district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Arakalagodu	Ragi				12280	9320	2280		
Arasikere	Ragi				6110	2820	2560		
Beluru	Ragi	6430	4570	1460	7500	5670	1480	24	1
H.N.Pura	Ragi	5020	3410	1290	5610	3670	1620	8	26
Hassan	Ragi	9750	4480	2250	10640	7010	2880	56	28
Hassan Mean	Ragi	6910	4020	1650	8320	5420	2290	35	39

Haveri

Maize, groundnut and soybean were the selected major crops in Haveri district under Bhoochetana during kharif 2010-11. Target area for maize was 79000 ha, for groundnut it was 10000 ha, and for soybean it was 5000 ha. All the target area was 100% shown with nominated crops.

Groundnut

In all taluks response of groundnut to management treatments were consistant and pod yields among taluks were less variable due uniform distribution of rainfall during the crop season.

Table 55. Groundnut yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Haveri district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})				Improved management (IM) (kg ha^{-1})				% Yield increase with IM		
		TDM	Stalk	Pod	kernel	TDM	Stalk	Pod	kernel	stalk	Pod	kernel
Haveri	Groundnut	5420	2930	2490	1750	6790	3470	3320	2350	18	33	34
Savanur	Groundnut	5730	3020	2710	1740	7630	3800	3830	2550	26	41	47
Shiggaon	Groundnut	6420	3510	2910	2010	8560	4980	3580	2520	42	23	25
Haveri Mean	Groundnut	5780	3100	2680	1800	7550	3950	3610	2480	27	35	38

Farmers obtained pod yield of 2680 kg ha^{-1} with farmers' management and pod yield of 3610 kg ha^{-1} with improved management that amounts to an additional pod yield of 930 kg ha^{-1} to farmers who had adopted improved management including micronutrient application. Additional fodder yield obtained by farmer with improved management was 850 kg ha^{-1}.

Soybean

Soybean was grown on black soils in Savanur and on alfisols in other taluks of Haveri during kharif season. Rainfall was distributed uniformly during kharif season in all taluks. Farmers harvested a good soybean crop in all taluks with mean grain yield of 1790 kg ha^{-1} with farmers management, and mean grain yield of 2230 kg ha^{-1} was harvested with improved management (Table 56).

Table 56. Soybean yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Haveri district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Haveri	Soybean	3160	760	1620	4360	1370	2050	80	27
Savanur	Soybean	4400	1080	2250	5920	1740	2820	61	25
Shiggaon	Soybean	3190	850	1610	4410	1490	1990	75	24
Haveri Mean	Soybean	3520	900	1790	4820	1540	2230	71	25

There was an additional grain yield of 440 kg ha^{-1} obtained by farmers that was an increase of 25% by adoption of improved management. In Savanur taluk, soybean yield was higher compared to other taluks in both treatments although there was not much variation in rainfall. This response of soybean to management was due to black soils whereas soybean response to management in other taluks was due to Alfisols.

Maize

Maize is more popular among farmers in all taluks of Haveri, hence was taken in all taluks under Bhoochetana project. Farmers in this district invariable use high yielding commercial hybrids of maize, and improved management in this district is mainly application of micronutrients and soil water management techniques.

Table 57. Maize yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Haveri district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Byadagi	Maize	16370	5960	8910	18860	7380	9830	24	10
Hangal	Maize	11530	4130	6370	15120	6640	7360	61	16
Haveri	Maize	12600	5160	6430	19020	7820	9620	52	50
Hirekerur	Maize	16150	6740	8240	18670	6930	10160	3	23
Ranebennur	Maize	14860	6100	7580	19860	8050	10230	32	35
Savanur	Maize	12830	5670	6110	16580	7050	8160	24	34
Shiggaon	Maize	12760	5490	6170	20060	7660	10660	40	73
Haveri Mean	Maize	14640	5940	7510	18590	7370	9680	24	29

Grain yield of maize is almost nearly at crop's potential 9680 kg ha^{-1} with improved management during the kharif season 2010 (Table 57). While maize grain yield with farmers management was 7510 kg ha$^{-1,}$ an additional grain yield of 2 t ha^{-1} was obtained by farmers those adopted improved management in this district. Farmers gained by maize fodder yield increase of 1430 kg ha^{-1} with improved management during 2010-11.

Kolar

Groundnut

Groundnut was grown in Mulbagal and Srinivaspur taluks of Kolar district in a target area of 9000 ha, out of which 8250 ha was cropped (92%) during kharif season 2010-11. Due to improved management groundnut mean pod yield was at 1940 kg ha^{-1}, where as mean pod yield with farmers' management was 1460 kg ha$^{-1.}$ Farmers who adopted improved management obtained an additional increase of nearly 500 kg ha^{-1} during the season.

Table 58. Groundnut yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Kolar district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})				Improved management (IM) (kg ha^{-1})				% Yield increase with IM	
		TDM	Stalk	Pod	kernel	TDM	Stalk	Pod	kernel	Stalk	Pod
Mulbagal	Groundnut	3430	1920	1510	1030	4830	2790	2040	1400	45	35
Srinivaspur	Groundnut	2990	1610	1370	890	4020	2220	1800	1170	38	31
Kolar Mean	Groundnut	3250	1790	1460	970	4500	2560	1940	1310	43	33

Additional fodder yield of 770 kg ha-1 was achieved by farmers by adoption of improved management.

Ragi

Ragi is one of the major crop selected under Bhoochetana project covered 74% of target area 28000 ha for ragi in four taluks of kolar with ragi during 2010-11 season. Ragi sowing was done in most parts of the districts during 2-3 weeks of July and late in the 3rd week of August after a long dry spell in August.

Table 59. Ragi yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Kolar district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Bangarpet	Ragi	4520	2350	1700	6640	3370	2520	43	48
Kolar	Ragi	6150	3090	2030	8780	4230	3160	37	56
Malur	Ragi	5150	2920	1590	7310	4110	2340	41	47
Srinivaspur	Ragi	4320	2470	1410	6090	3460	2020	40	43
Kolar Mean	Ragi	5080	2720	1710	7290	3820	2550	40	49

Raichur

Pearl millet

Pearl millet is one of the prominent crop in all 5 taluks of the district with a target area coverage of 28000 ha out of which 27664 ha (98%) was sown during the crop season. All the taluk except Raichur received near normal rainfall and distribution was also uniform upto September. In Raichur taluk there was dry spell in August which affected tillering phase of millet crop, reducing crop yields. Farmers gained an additional grain yield of 270 kg ha^{-1} (21%) as grain yield with improved management was 1530 kg ha^{-1} compared to mean grain yield of 1260 kg ha^{-1} with farmers' management.

Table 60. Pearl millet yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Raichur district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Devadurga	Pearl Millet	3630	1820	1380	4120	2110	1620	16	17
Lingasugur	Pearl Millet	3200	1560	1280	3980	1980	1560	27	22
Manvi	Pearl Millet	3360	1680	1320	4130	2070	1610	23	22
Raichur	Pearl Millet	2580	1290	950	3200	1910	1210	48	27
Sindhanur	Pearl Millet	3240	1480	1300	4150	2210	1540	49	18
Raichur Mean	Pearl Millet	3220	1580	1260	3960	2050	1530	30	21

Pearl millet stalks are used as cattle feed in the district. With improved management farmers stand to gain by additional fodder yield of 470 kg ha^{-1} compared to farmers' management.

Tumkur

Ragi

Ragi was grown on 37900 ha (94%) of the target area of 40065 ha in four taluks of the district. Ragi was sown late between 25th July and 15th August during the season. Rainfall was good in all taluks during July, September and October. There was a dry spell in August coinciding with tillering phase of finger millet as the crop was sown in July.

Table 61. Ragi yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Tumkur district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Cknayakanhalli	Ragi	4550	3210	970	6400	4650	1300	45	34
Kunigal	Ragi	3730	2670	730	4140	3020	830	13	14
District Mean	Ragi	4070	2890	830	4870	3540	980	22	18

Ragi grain yields are low in both treatments proportionate to biomass production. On an average ragi grain yield increased by (150 kg ha^{-1}) 22% when compared mean grain yield of 830 kg ha^{-1} with farmers' management to mean grain yield of 980 kg ha^{-1} with improved management. Fodder yield increase of 650 kg ha-1 or 18% with improved management when compared to fodder yield with farmers management in the district.

Groundnut

Groundnut is the major crop of Pavgada, sira and Koratagere taluks of Tumkur district which has low rainfall. During June and July rainfall was scanty in these taluks, however sowings were completed in second fortnight of July in the district. Groundnut pod yield estimates from Pavagada taluk indicate that pod yield was very low in both treatments in farmers' fields. However there was an increase of pod yield up to 25%as 220 kg ha-1 of additional pod yield was obtained by farmers when compared 1119 kg ha^{-1}of pod yield due to improved management against 899 kg ha^{-1} of pod yield from farmers' management.

Table 62. Groundnut yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Tumkur district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	**Stalk**	**Pod**	**TDM**	**Stalk**	**Pod**	**Stalk**	**Pod**
Pavgada	Groundnut	1948	1049	899	2424	1305	1119	27.3	25.8
Tumkur Mean	Groundnut	1948	1049	899	2424	1305	1119	27.3	25.8

Additional fodder yield of 250 kg ha^{-1} (a cart load) was accrued (27% increase) to farmers who adopted improved management under Bhoochetana project. Groundnut yield valued by farmers in this dryland district as a precious cattle feed.

Yadgir

Green gram

Green gram was one of the major short season legumes selected to grow on 17785 ha with 98%of the target achieved with 17470 ha sown to green gram in the district under Bhoochetana project. Green gram mean grain yield estimated was 540 kg ha^{-1} with farmers' management and 710 kg ha-1 with improved management. Additional gain with improved management was 170 kg ha^{-1}, amounts to 31%increased grain yield with improved management. In this district, although rainfall during June was useful for the crop growth, heavy rainfall during August affected the crop performance, fodder quality and grain yield in both treatments were affected.

Table 63. Green gram yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Yadgir district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	**Stalk**	**Grain**	**TDM**	**Stalk**	**Grain**	**Stalk**	**Grain**
Shahapur	Green gram	1220	410	560	1640	510	730	24	30
Shorapur	Green gram	1310	550	510	1790	690	690	25	35
Yadagir Mean	Green gram	1260	470	540	1710	590	710	26	31

Pearl millet

Pearl millet was grown on 10871 ha which is almost 98% of the target area of 11039 ha in two taluks Yadgir district. Pearl millet grain and fodder yield was better in both treatments as the seasonal conditions were suitable for the crop. A mean grain yield increase of 37% was recorded with improved management over farmers' practice in the district. Mean grain yield increased 690 kg ha-1, as farmers recorded grain yield of 1850 kg ha^{-1} with farmers' management while mean grain yield with improved management was 2540 kg ha^{-1} (Table 64). Additionally fodder yield also increased by almost one ton that amounts to 29%gain with improved management.

Table 64. Pearl millet yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in various taluks of Yadgir district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	**Stalk**	**Grain**	**TDM**	**Stalk**	**Grain**	**Stalk**	**Grain**
Shahapur	Pearl Millet	8910	4400	1930	11850	5450	2750	24	42
Shorapur	Pearl Millet	6240	2140	1760	8370	2990	2330	40	32
Yadagir Mean	Pearl Millet	7570	3270	1850	10110	4220	2540	29	37

Sunflower

Sunflower was targeted in 9095 ha and 38% of area was cropped in Yadgir and in Bijapur 20468 ha was target and 4325 ha (21%) was sown to sunflower for enhancement of crop yields during kharif 2010-11. Reduced area under sunflower indicates farmers loosing interest on the crop in this district probably due to uncertainity in of productivity sunflower. Crop yield of sunflower from Bijapur and Yadgir are presented in Table 65, shows very low yield especially in Yadgir and there was very less difference (80 kg ha^{-1}) in seed yield of sunflower in this district. In Bijapur, sunflower seed yield with improved management was 1060 kg ha^{-1} and seed yield was low at 870kg ha^{-1} with farmers' management. There was margin increase in yield (21%) by nearly 200 kg ha^{-1} with improved management and the stalk yield of this crop has no value to farmers.

Table 65. Sunflower yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in several taluks of Bijapur andYadgir districts.

District	Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
			TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Bijapur	Bijapur	Sunflower	3850	1960	870	4680	2470	1060	26	22
Yadagir	Shahapur	Sunflower	2960	1950	410	3530	2310	490	18	20

Summary of Crop Yields across all Districts

Groundnut

Normal onset and proper distribution of good rainfall in the monsoon helped farmers reap increased groundnut pod yields upto 1.5 t ha^{-1} even with farmers' management, which was well above the long-term average pod yields in the groundnut growing five districts. Groundnut pod yield in Bijapur were exceptional and low in farmers' management as well as improved management due to longer dry spells at floral initiation in July and pod filling at mid September to early October in this district as evident from rainfall in Bijapur.

Groundnut crop mean pod yields varied between the lowest of 320 kg ha^{-1} with farmers' management as compared to pod yield of 470 kg ha^{-1} (47% increase) with improved management including addition of micronutrients in Bijapur district and the highest mean pod yield of 2680 kg ha^{-1} with farmers' management compared to pod yield of 3610 kg ha^{-1} (35% increase) estimated in Haveri district with improved management. Across districts groundnut pod yield increases was between 33% and 49% when compared to groundnut pod yield from farmers' management for the same district.

Groundnut pod yield increase of 33% in Kolar, 49% in Chickballapur, 43%in Gadag with improved management in Bhoochetana project established the fact that farmers can advantageously adopt improved management for enhancing dryland crop productivity and seasonal gains with relatively investment intense crops like groundnut.

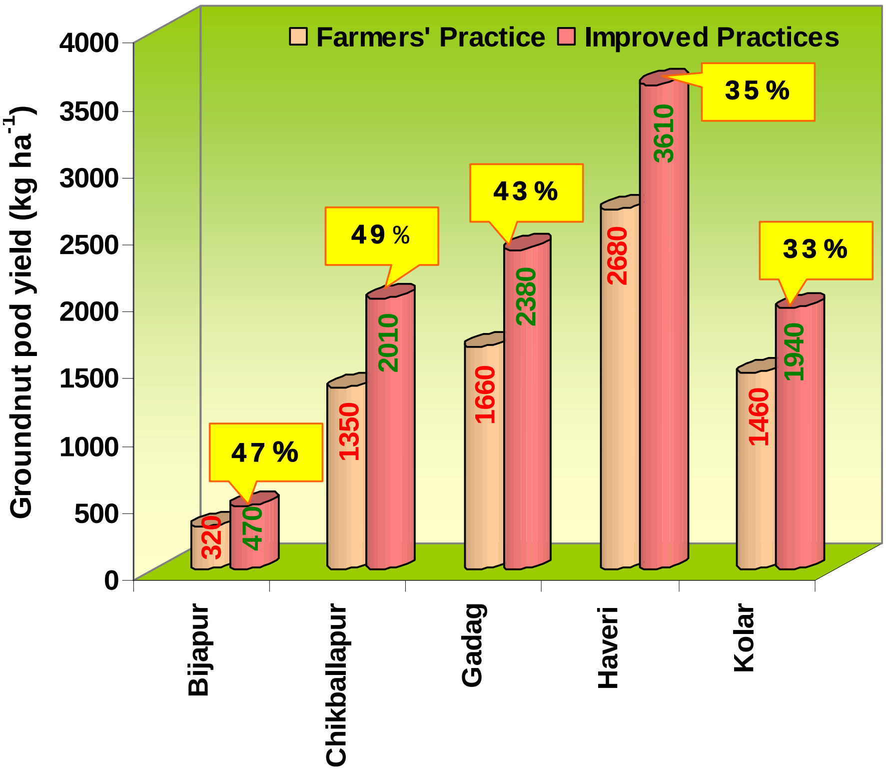


Figure 42. Groundnut pod yield with improved management compared to farmers' management in farmers' fields across five districts of Karnataka during kharif 2010-11.

Green gram

Green gram grain yields across four districts were much lower in this season with farmers' management as well as improved management especially in Bijapur and Gadag as the crop was affected by dry spells in the short growing period of July and August in these districts. A good contrast of useful rainfall in July or August helped farmers for an over all increase in mean grain yields of 870 kg ha^{-1} with farmers' management as well as grain yield of 1200 kg ha^{-1} with improved management in Bidar and mean grain yields of 540 kg ha^{-1} with farmers' management compared to grain yield of 710 kg ha^{-1} with improved management in Yadgir was achieved. Even with low rainfall or good rainfall, the difference between improved management over farmers' management was maintained in terms of grain yield and fodder yield. Grain yield of green gram increased with improved management in the range of 31% in Yadgir to 57%in Gadag, and the highest grain yield of green gram was observed in Bidar.

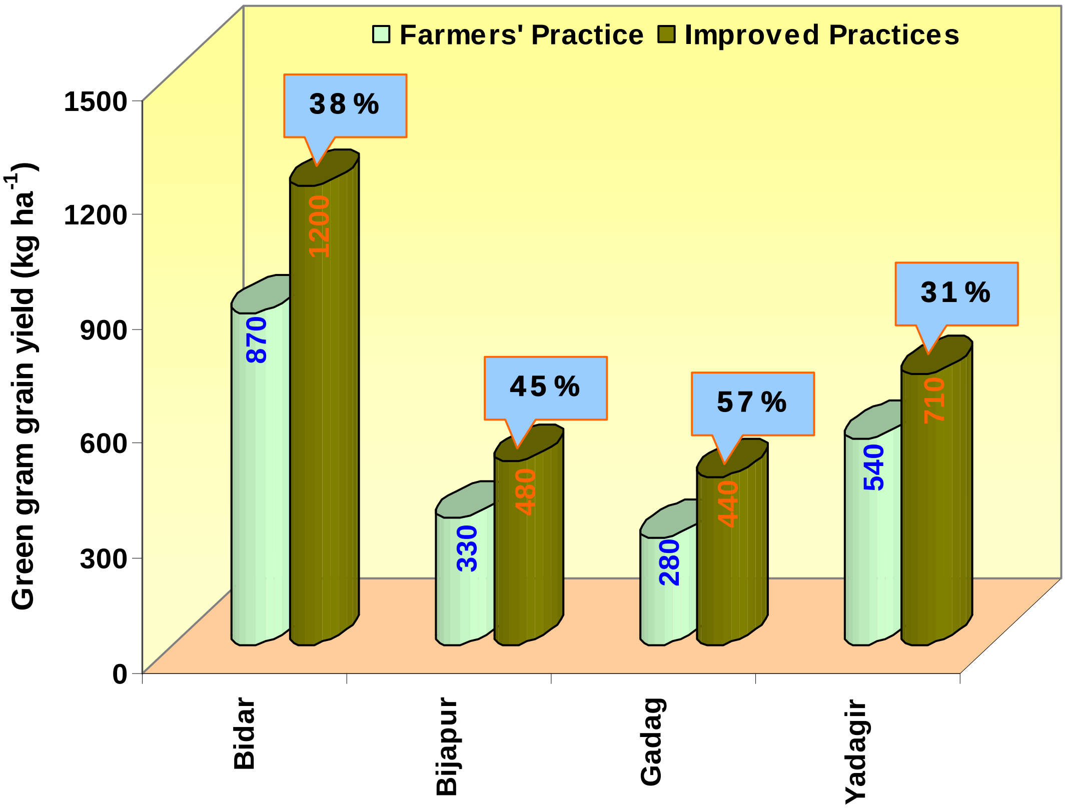


Figure 43. Green gram grain yields with improved practices compared to farmers' management in farmers' fields across four districts of Karnataka during kharif 2010-11 season.

Maize

Maize is one the farmers' favourite crops as the farmers in Karanataka are exploiting higher genetic potential of hybrid maize even in their own management. In a good rainfall season like the year 2010-11, the lowest mean grain yield of 3840 kg ha^{-1} was observed in Chitradura and highest mean grain yield of 7510 kg ha^{-1}was observed in Haveri district with farmers' management itself, indicates the exploits genetic potential of maize farmers in these districts.

However, farmers' fields deficient in macro and micronutrients, these grain yields were proved to be lower when farmers adopted improved management practices including balanced nutrient application. Lower mean grain yield of 5340 kg ha^{-1} maize was observed in Chitradurga and higher mean grain yield of 9680 kg ha^{-1} maize was observed in Haveri. Maize grain yield increase was lowest at 26% in Davangere, followed by 29%in Haveri to a maximum increase of 42%in Bengaluru Rural district, and similar increase in fodder yield was also observed across different districts to provide not feed but fodder security in the rainfed districts of Karnataka.

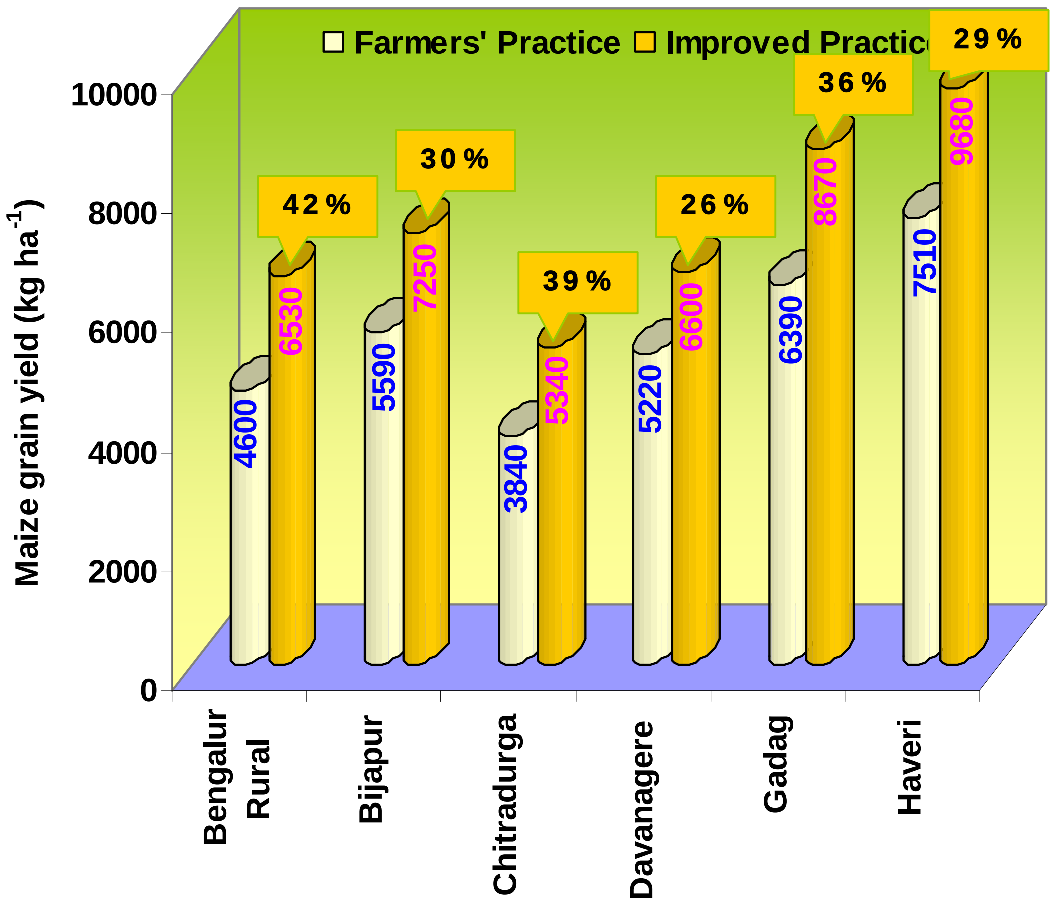


Figure 44. Maize grain yields with improved practices compared to farmers' management in farmers' fields across six districts of Karnataka during kharif 2010-11 season.

Finger millet (Ragi)

Finger millet is the staple food crop in most of the rural northern and north eastern Karnataka districts. Farmers consider it as low input requiring hardy crop with low productivity in rainfed areas. However, with improved varieties and improved management of nutrients and water farmers now started believing the higher potential of finger millet, gradually improving the management for this crop also under Bhoochetana project.

Grain yield estimations during kharif crop season 2010-11 from ragi growing five districts in Karnatak indicate that over all crop yield even with farmers' management was relatively higher with good monsoon rainfall conditions prevailed during the season. The exceptions were low rainfall during August in Kolar and low rainfall during July and August in Davangere that must have reduced yield in both the treatments. Ragi mean grain yield was lowest at 1420 kg ha^{-1} in Davangere district and heighest at 2610 kg ha-1 in Chickballapur during khair season 2010-11 from farmers' management. Corresponding estimates for ragi grain yields with improved management were also lower at 1850 kg ha^{-1} in Davangere with an increase of 30% over farmers' management in the same district, while higher grain yields of 3710 kg ha^{-1} was an increase of 42%compared to farmers' management in Chickballapur. In adjoining districts, ragi grain yield increase was 49% in Kolar, 35%grain yield increase in Bengaluru rural and 31%grain yield increase in faraway district Chitradurga when compared to grain yield with farmers' management in the same district. More or less similar trend was observed with increase in fodder yield of ragi in these districts.

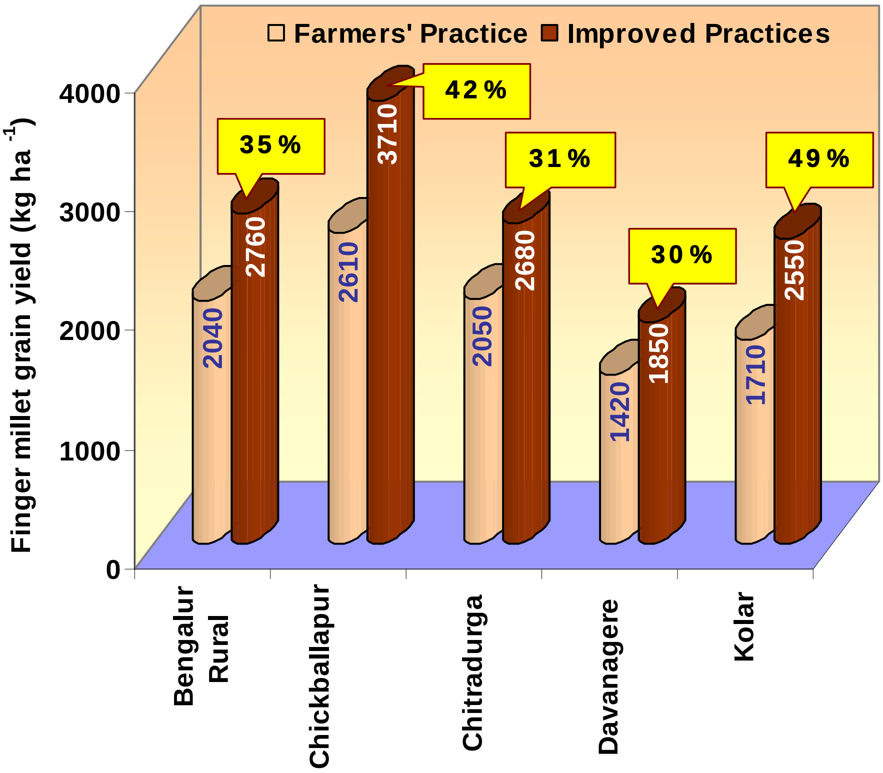


Figure 45. Finger millet (Ragi) grain yields with improved practices compared to farmers' management in farmers' fields across five districts of Karnataka during kharif 2010-11 season.

Pearl millet

Pearl millet is a staple food crop in parts of Bijapur, Raichur and Yadgir mostly on lighter Alfisols intercropped with pigeonpea or groundnut. Area cropped to pearl millet was 17314 ha in Bijapur, 27664 ha in Raichur and 10871 ha in Yadgir. Pearl millet was sown in the month of June in Bijapur and Yadgir, but was sown late in the first fortnight of July in Raichur.

Pearl millet mean grain yield varied from a minimum of 1260 kg ha^{-1}in Raichur to mean grain yield at a maximum of 1960 kg ha-1 with farmers' management. While mean grain yield was at minimum of 1530 kg ha^{-1} in Raichur to a mean grain yield at a maximum of 2670 kg ha^{-1} in Bijapur with improved management. In Bijapur, pearl millet grain yield was higher even with low amounts of rainfall during the crop vegetative phase in June and early July followed up by good rainfall in July-August helped pearl millet crop during grain filling stage. Contrastingly pearl millet was sown late in July, and crop grain filling synchronized with dry spells in September affecting reduction in grain yield in farmers' management as well as improved management in Raichur district. However, mean grain yield in pearl millet increased by 21% in Raichur, 36% in Bijapur and 37% in Yadgir with improved management compared to farmers' management in the same district. Similar trends were observed with fodder yield increase of 35%in Bijapur, 30% in Raichur and 29% in Yadgir as pearl millet stalk is generally used as fodder.

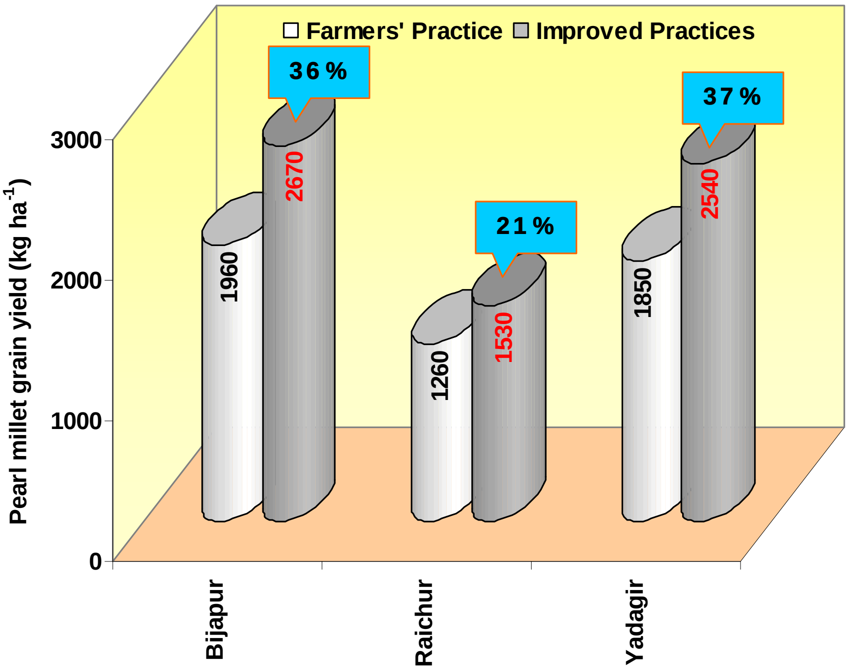


Figure 46. Pearl millet grain yields with improved practices compared to farmers' management in farmers' fields across three districts of Karnataka during kharif 2010-11 season.

Sorghum

Rainy season sorghum was grown in Bidar, Chamarajanagar, Davangere and Gadag to a total extent of 36000 ha under Bhoochetana project during 2010-11. Sorghum was sown during April and May in Chamarajanagar, and in Gadag sorghum was sown in 4th week of May to 2nd week of June. In Bidar and Davangere sorghum was sown in the 2nd week of June to 2nd week of July.

Sorghum mean grain yield estimates available from Bidar and Davangere indicate that grain yield of 2320 kg ha^{-1} with improved management was an increase of 25% compared to grain yield of 1780 kg ha^{-1} with farmars' management in Davangere. Mean grain yield of 2290 kg ha^{-1} with improved management was an increase of 39% compared to mean grain yield of 1630 kg ha^{-1} sorghum with farmers' management in in the same Bidar.

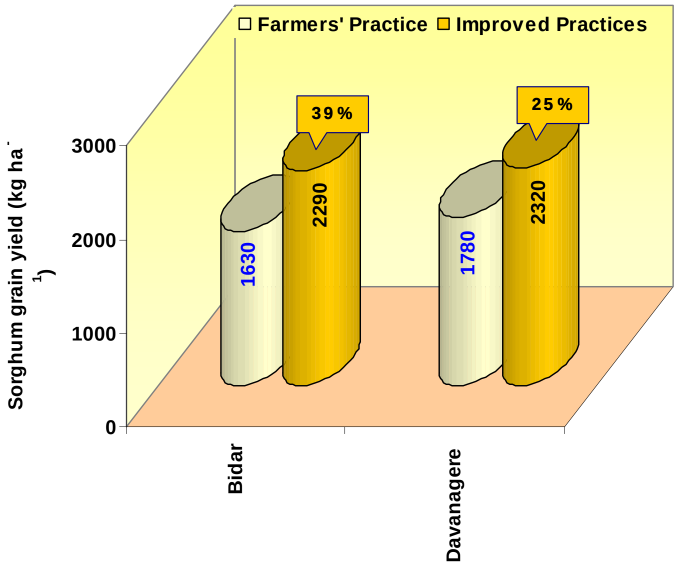


Figure 47. Sorghum grain yields with improved practices compared to farmers' management in farmers' fields across two districts of Karnataka during kharif 2010-11 season.

Pigeonpea

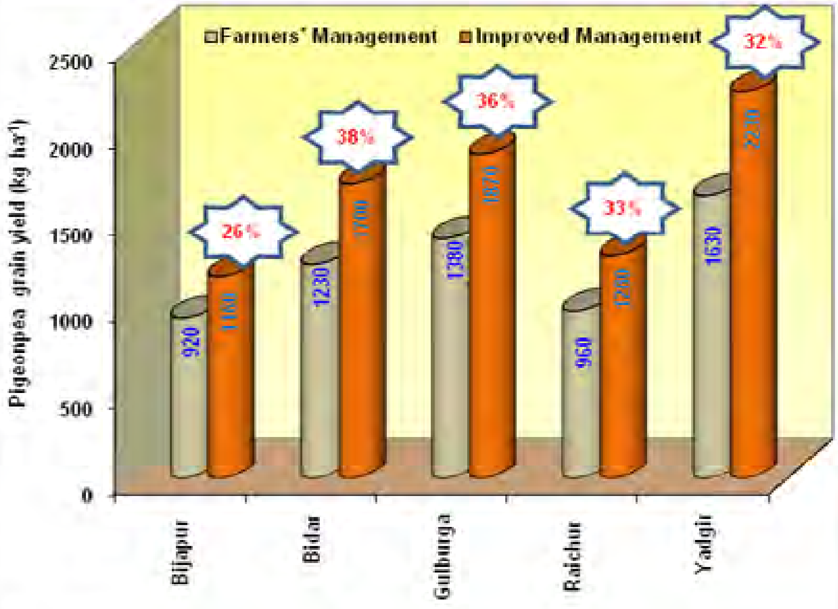


Figure 48. Pigeonpea grain yields with improved practices compared to farmers' management in farmers' fields across five districts of Karnataka during kharif 2010-11 season.

Post Rainy Season Crops

Major Crops and Area Sown

In the post-rainy season 2010-11, Bhoochetana activities were targeted to cover an area of 3,64,933 (3.64 lakh) hectares with improved management to enhance rainfed crop productivity and achieved a coverage of 3,33,626 (3.33 lakh) hectares, by reaching the target up to 91.4% with rabi sorghum, chickpea, sunflower and safflower cropping in 10 districts of Karnataka (Table 66).

Table 66. District-wise target cropping area sown to major crops during Rabi crop season 2010-11.

S. No.	District	Major rainfed crop	Target area	Area sown	% Achieved
1.	Bidar	Chickpea	12807	12807	100
		Safflower	4238	4238	100
		Rabi sorghum	6388	6388	100
2.	Bijapur	Rabi sorghum	10000	5318	53
		Chickpea	30000	17415	58
3.	Chamarajanagar	Chickpea	3000	2650	88
4.	Dharwad	R. Sorghum	18000	18000	100
		Chickpea	20000	20000	100
5.	Davangere	Rabi Sorghum	1450	680	47
		Chickpea	550	890	162
6.	Gadag	Rabi Sorghum	17500	16057	92
		Chickpea	30000	32330	107
		Sunflower	10000	8002	80
7.	Gulburga	Rabi Sorghum	31000	31000	100
		Chickpea	50000	50000	100
8.	Haveri	Rabi sorghum	24000	23000	96
		Chickpea	7000	4300	61
		Safflower	7000	1400	20
9.	Raichur	Chickpea	30000	30000	100
		Rabi Sorghum	38000	35300	93
10.	Yadgir	Rabi Sorghum	4000	4000	100
		Chickpea	10000	9851	98
Total	All districts	All crops	364933	333626	91.4

Nutrient Recommendations for Rabi Season Crops

Nutrient recommendations were prepared by ICRISAT based on the nutrient status of soils in each taluk. Nutrient recommendations of N, P, K for different crops were based on DoA soil analysis data and boron, zinc and sulfur recommendations (Table 67) were based on ICRISAT evaluations in the farmers' fields up to Kharif, was further modified based on scientists meeting recommendation (Proceedings attached in Annexure 1). These recommendations were transformed into quantities of commercially available grades of fertilizers (Table 68) for reach taluk considering soil analysis and were suggested to farmers for Rabi crops.

Table 67. Nutrient recommendation for rabi crops in various districts of Karnataka based on crop requirement.

Crop	Nutrient Recommendations (kg ha^{-1})					
	N	**P**	**K**	**S**	**B**	**Zn**
Rabi sorghum	60	35	0	30	0.5	5
Chickpea	25	50	0	30	0.5	5
Sunflower	50	25	25	30	0.5	5
Safflower	35	50	25	30	0.5	5

** If borax is applied in stead of Agribor, quantity needs to be doubled*

Table 68. District/Taluk-wise Fertilizer dosage adjusted for soil test nutrients status and recommended nutrient requirement for rainfed crops in various districts for Kharif 2010-11

Crop	District/Taluk	Fertilizers recommended (kg ha^{-1})					
		Urea	**DAP**	**MoP**	**Gypsum**	**ZnSO$_4$**	**Agribor**
Rabi sorghum	Raichur/Raichur	116	38	0	200	25	2.5
	Haveri/Savanur	101	76	0	200	25	1.25
	Dharwad/Dharwad	50	38	0	200	13	1.25
Chickpea	Chitradurga/Hiriyur	12	109	0	200	25	2.5
	Haveri/Haveri	6	54	0	200	25	2.5
	Raichur/Raichur	33	54	0	200	25	2.5
Sunflower	Raichur/Sindhanur	44	27	21	100	25	1.25
	Yadgir/Surpur	88	54	21	200	13	2.5
	Chitradurga/ C'durga	88	54	21	200	25	2.5
Safflower	Haveri/Hirekerur	55	54	21	200	13	1.25
	Dharwad/Kalghatagi	0	109	21	200	13	2.5

If borax is applied in stead of Agribor, quantity needs to be doubled

Input Distribution during Rabi Season Crops

During Rabi season also, Bhoochetana project was implemented in 10 districts to enhance crop productivity of rabi season crops, and inputs supply and distribution targets were set by DoA to cover the target area with improved management. Accordingly inputs were supplied to the farmers in the respective villages by RSKs and distribution by Agricultural staff of DoA coordinated/facilitated by ICRISAT technicians in each district. Seed supplies were organized by DoA/ICRISAT staff in case improved varieties of sorghum and chickpea were adopted by farmers.

Bidar district achieved first place in micronutrient distribution and use by farmers with more than 40% of the target achieved in use of $ZnSO_4$ and Borax, but gypsum was used ony up to 12.8% of the target. In Gadag farmers used higher quantities (2735 tones) of Gypsum and achieved first place by distribution and use of 23.8% of the target quantities set for the district.

Table 69.Target quantities of Fertilizers and micronutrient inputs required for the target area during post-rainy season and those quantities actually distributed to farmers at their doorstep in the selected Bhoochetana villages in the districts

SN	District	Crops	Target quantity			Quantity distributed (% target)		
			Gypsum	$ZnSO_4$	Borax	Gypsum	$ZnSO_4$	Borax
1	Bidar	Sorghum, chickpea	4685	173	88	600 (12.8%)	70 (40.5%)	42 (47.7%)
2	Bijapur	R. sorghum, chickpea	6450	1612.5	89.4	349 (5.4%)	16.9 (1%)	4.8 (5.3%)
3	Chamarajanagar		817	40.9	20.4	50 (6.1%)	0.800 (2%)	0.2 (1%)
4	Dharwad							
5	Davangere							
6	Gadag	R. Sorghum, chickpea, Sunflower	11500	863	25	2735 (23.8%)	0	0
7	Gulburga	R. sorghum, chickpea	14272	3568	340			
8	Hassan							
9	Haveri	R. sorghum, chickpea, sunflower	7600	380	95	916 (12.1%)	50 (13.2%)	10 (10.5%)
10	Raichur	Chickpea, sunflower, groundnut	12540	1020	340	325 (2.6%)	105 (10.3%)	3.2 (1.0%)
11	Yadgir	R. Sorghum, Chickpea	2800	350	70	200 (7.1%)	14 (4.0%)	9.0 (12.9%)

Window of Sowing Opportunity during Rabi Season

Rabi sorghum and chickpea sowing were completed in most of the Northern Karnataka districts between second fortnight of September to 2nd fortnight of October as the rainfall in August was quite high followed by September rainfall. Bidar, Davangere, Dharwad, Haver where black gram and green gram are grown in Kharif season, farmers have the opportunity to sow rabi sorghum early in September and October. However, rabi sorghum and chickpea sowings were extended in some taluks of Bijapur, Guburga, Gadag, Raichur and Yadgir due to low rainfall in September or October, and sowings were actually completed in late November. Safflower was taken up in Bidar, Dharwad and Haveri district during late September and extended upto last week of October.

Among rabi season crops across 10 districts, Chickpea cropped area is more than 180000 ha occupying first position in rabi crops. Rabi sorghum which was grown in nine districts occupies second position in term of area cultivated at 13743 ha during the year 2010-11. Safflower was grown on smaller area of 5638 ha in Bidar and Haveri districts during rabi season 2010-11.

Table 70.indow of sowing opportunities during Rabi 2010-11 for crops in different districts of Karnataka under Bhoochetana project

District	Major rainfed crop	Sowing window of opportunity
Bidar	Chickpea	3rd week, September to 2nd week, October
	Safflower	3rd week, September to 2nd week, October
	Rabi sorghum	3rd week, September to 2nd week, October
Bijapur	Rabi sorghum	15th September to 7th November
	Chickpea	15th October to 30th November
Chamarajanagar	Chickpea	3rd week, September
Dharwad	R. Sorghum	
	Chickpea	
Davangere	Rabi Sorghum	2nd week, September to 4th week, September
	Chickpea	2nd week, September to 1st week, October
Gadag	sorghum	1st week, September to 1st week, October
	Chickpea	2nd week, September to 4th week, November
	Sunflower	1st week, September to 4th week, November
Gulburga	Rabi Sorghum	3rd week, September to 1st week, November
	Chickpea	1st week, October to 1st week, November
Haveri	Rabi sorghum	4th week, September to 3rd week, October
	Chickpea	1st week, October to 3rd week, October
	Safflower	1st week, October to 4th week, October
Raichur	Chickpea	15th October to 25th November
	Rabi Sorghum	1st October to 31st October
Yadgiri	Rabi Sorghum	4th week, September to 1st week, November
	Chickpea	1st week, October to 3rd week, November

Farmers' Participatory Varietal Trials

During rabi season, ICRISAT provided support for planned varietal demonstration with farmers' participation, by encouraging them with supply of 2700 kg of chickpea improved cultivars (JG-11, ICCV 10, JACKI- 9218) and 150 kg seed of improved sorghum cultivars (SPV 1411, SPV1359), and requested JDA of each district to support farmers with subsidized fertilizer inputs. ICRISAT provided guidance with the involvement of ICRISAT technician to followup the layout of demonstration in accepted farmers' fields. ICRISAT provided seed material for 90 trials of chickpea and 50 trials of sorghum in 10 districts (Table 71) where farmers volunteered for trials. ICRISAT provided guidance on suitability of cultivars of each major crop of the district to evaluate in the farmers' fields.

Table 71. Seeds of sorghum and chickpea improved cultivars' supplied from ICRISAT for Rabi trials in Bhoochetana project for different districts of Karnataka.

Sl No	District	Sorghum cultivars' seed	Quantity (kg)	Chickpea cultivars' seed	Quantity (kg)
1	Bijapur	-	-	JG11	225
		-	-	ICCV10	225
2	Dharwad	SPV1411	27	JG11	225
		SPV1359	3	ICCV10	225
3	Bidar	-	-	ICCV10	225
4	Gadag	SPV1411	27	JG11	225
		SPV1359	3	ICCV10	225
5	Raichur	SPV1411	27	JACKI-9218	225
		SPV1359	3	ICCV10	225
6	Gulbarga	SPV1411	27	JACKI-9218	225
		SPV1359	3		
7	Yadgir	-	-	JG11	225
8.	Haveri	SPV1411	27	JACKI-9218	225
		SPV1359	3		

Post Rainy Season Crop Yield Estimation

During post rainy season, farmers preferred chickpea cropping in 10 districts in view of higher achievable grain yield of chickpea, and generally good marketability and value of grain in the market. Farmers indicated in Raichur and Haveri that preference was given to chickpea in place of more popularly grown rabi sorghum which is also a staple food for the people in the region.

Table 72. Chickpea yields in farmers' fields with improved management compared to farmers' management during rabi crop season 2010-11 in several taluks of Bidar district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stover	Grain	TDM	Stover	Grain	Stalk	Grain
Aurad	Chickpea	4200	1960	2230	5610	2660	2950	36	32
Basvkalyan	Chickpea	3740	1910	1830	4970	2500	2470	31	35
Bhalki	Chickpea	3460	1800	1660	4650	2420	2220	34	34
Bidar	Chickpea	2220	1060	1150	3040	1280	1750	21	52
Humnabad	Chickpea	2730	1310	1420	3720	1560	2160	19	52
District mean	Chickpea	3270	1610	1660	4400	2090	2310	30	39

Bidar

Chickpea

Chickpea was grown in all 5 taluks of Bidar, and this season farmers harvested good chickpea crop owing to more than normal rainfall at the beginning of rabi season and higher levels of stored soil moisture in the profile as reflected by crop yield estimations in both management treatments. Chickpea mean grain yield varied between a minimum of 1150 kg ha^{-1} in Bidar taluk to a maximum of 2230 kg ha^{-1} in Aurad taluk, and over all mean grain yield of 1660 kg ha^{-1} with farmers' management in the district. With improved management chickpea mean grain yield varied between a minimum of 1750 kg ha^{-1} in Bidar to a maximum of 2950 kg ha^{-1} in Aurad taluk was observed (Table 73). Variability in chickpea grain yields as a response to managements was consistant across all taluks in the district. Grain yield increase with improved management was between 32% and 52% across taluks with district mean increase in grain yield was 39% compared to farmers' management.

Table 73. Chickpea yields in farmers' fields with improved management compared to farmers' management during rabi crop season 2010-11 in several taluks of Bidar district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stover	Grain	TDM	Stover	Grain	Stalk	Grain
Aurad	Chickpea	4200	1960	2230	5610	2660	2950	36	32
Basvkalyan	Chickpea	3740	1910	1830	4970	2500	2470	31	35
Bhalki	Chickpea	3460	1800	1660	4650	2420	2220	34	34
Bidar	Chickpea	2220	1060	1150	3040	1280	1750	21	52
Humnabad	Chickpea	2730	1310	1420	3720	1560	2160	19	52
District mean	Chickpea	3270	1610	1660	4400	2090	2310	30	39

Bijapur

Chickpea

In Bijapur chickpea was grown in five taluks of the district, and chickpea grain yield was lower with low rainfall and erratic distribution of rainfall, especially in September and October and even November the rainfall was less than normal in the district.

Chickpea mean grain yield varied between a minimum of 910 kg ha^{-1} in Sindagi to a maximum of 1750 kg ha^{-1} in Bijapur with farmers' management. While chickpea mean grain yield varied between a minimum of 1210 kg ha^{-1} in Sindagi to a maximum of 2270 kg ha^{-1} in Bijapur taluk with improved management (Table 74). There was grain yield increase of almost 300 -500 kg ha^{-1} for farmers with adoption of improved management. Grain yield increase across taluks varied between 28% and 35% with district mean increase of 30% over the farmers' management.

Table 74. Chickpea yields in farmers' fields with improved management compared to farmers' management during rabi crop season 2010-11 in several taluks of Bijapur districts.

Taluks	**Crop**	**Farmers' management (FM) (kg ha^{-1})**			**Improved management (IM) (kg ha^{-1})**			**% Yield increase with IM**	
		TDM	**Stover**	**Grain**	**TDM**	**Stover**	**Grain**	**Stalk**	**Grain**
B.bagewadi	Chickpea	1740	820	920	2440	1190	1240	45	35
Bijapur	Chickpea	3080	1330	1750	4150	1880	2270	41	30
Indi	Chickpea	1800	820	990	2320	1030	1290	26	30
Muddebihal	Chickpea	1970	880	1090	2430	1040	1390	18	28
Sindagi	Chickpea	1840	910	930	2400	1190	1210	31	30
Mean		2190	990	1200	2890	1320	1560	33	30

Chickpea grain yield in Bijapur taluk was almost higher at 750 kg ha^{-1} than in other taluks of the district with farmers' management and grain yield of one ton higher than neighbouring taluks of the district. Although rainfall in all taluks during September to November was less than normal, it is understood that farmers in Bijapur taluk keep their Vertisol lands fallow during kharif and sow chickpea on full profile of stored soil moisture while farmers in other taluks of Bijapur district invariably take up a crop in kharif season, hence chickpea yield variability is signifant in Bijapur compared to other taluks.

Rabi sorghum

Rabi sorghum was grown on 5318 ha which was 53% of the target area suggestive of lower percent of rabi season sown due to less than normal rainfall from September onwards in Bijapur. Sorghum mean grain yield in Bijapur varied between a minimum of 730 kg ha^{-1} in Indi taluk to a maximum of 1330 kg ha^{-1} in Bijapur taluk was observed with farmers' management while sorghum mean grain yield was minimum at 980 kg ha^{-1} in Indi taluk to a maximum of 1840 kg ha^{-1} in Bijapur taluk in response to improved management.

In Bijapur taluk, sorghum grain yield was significantly higher in both treatments compared to sorghum grain yields in other taluks of Bijapur district as most of the farmers in Bijapur taluk leave their lands fallow during rabi, store moisture in the profile during kharif and grown sorghum rabi hence crop yield was higher than in other taluks of the district where sorghum was grown in the second season after the kharif season crops were harvested. Sorghum grain yield increase with improved management was 250 kg ha^{-1} in Indi taluk and

510 kg ha^{-1} grain yield increase in Bijapur taluk compared to grain yield with farmers'management. Percent yield increase across taluks varied between 33% and 38%, and grain yield mean increase was 38% for rabi sorghum in the entire Bijapur district.

Table 75. Rabi sorghum yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in several taluks of Bijapur district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Bijapur	Rabi sorghum	4080	2390	1330	5280	2950	1840	23	38
Indi	Rabi sorghum	3120	2030	730	3950	2600	980	28	34
Muddebihal	Rabi sorghum	4170	2850	1080	6000	4140	1530	45	42
Bagewadi	Rabi sorghum	3420	2060	1110	4830	3000	1480	46	33
District mean		3770	2350	1110	5070	3130	1530	33	38

Raichur

Chickpea

In Raichur chickpea was grown in five taluks on targeted 30000 ha, achieved 100% target for chickpea crop in the district, and farmers' preference for this crop is evidenced by target achievement during rabi season 2010-11. Chickpea farmers are adopting short duration improved cultivars of ICRISAT like JG-11 and ICCV 10 replacing traditional and more popular variety Annegiri in this district.

Table 76. Chickpea yields in farmers' fields with improved management compared to farmers' management during rabi crop season 2010-11 in several taluks of Raichur district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stover	Grain	TDM	Stover	Grain	Stalk	Grain
Devadurga	Chickpea	3500	2180	1310	4280	2570	1710	18	31
Lingasugur	Chickpea	3510	2160	1350	4410	2690	1730	25	28
Manvi	Chickpea	3500	2150	1350	4320	2560	1760	19	30
Raichur	Chickpea	3520	2120	1400	4370	2730	1640	29	17
Sindhanur	Chickpea	3210	1920	1280	4190	2540	1650	32	29
Mean		3450	2110	1340	4320	2620	1700	24	27

Chickpea mean grain yields across five taluks varied between a minimum of 1280 kg ha^{-1} in Sindhanur taluk to a maximum grain yield of 1400 kg ha^{-1} in Raichur taluk, and district over all mean of 1340 kg ha^{-1} with farmers' management, while mean grain yield at a minimum of 1640 kg ha^{-1} in Raichur taluk to a maximum of 1760 kg ha^{-1}, and the district over all mean grain yield of 1700 kg ha^{-1} with improved management was observed (Table 76). Grain yield increase varied between 17% and 31% across taluks, and a mean grain yield increase of 27% for the district with improved management. Chickpea grain yields varied in narrow range for both treatments across all taluks. Chickpea grain yield increase was 240 kg ha^{-1} in Raichur, and 410 kg ha^{-1} in Manvi taluk.

77. Rabi sorghum yields in farmers' fields with improved management compared to farmers' management during 2010-11 crop season in several taluks of Bijapur district.

Taluks	Crop	Farmers' management (FM) (kg ha^{-1})			Improved management (IM) (kg ha^{-1})			% Yield increase with IM	
		TDM	Stalk	Grain	TDM	Stalk	Grain	Stalk	Grain
Bijapur	Rabi sorghum	4080	2390	1330	5280	2950	1840	23	38
India	Rabi sorghum	3120	2030	730	3950	2600	980	28	34
Muddebihal	Rabi sorghum	4170	2850	1080	6000	4140	1530	45	42
Bagewadi	Rabi sorghum	3420	2060	1110	4830	3000	1480	46	33
Mean		3770	2350	1110	5070	3130	1530	33	38

Chickpea grain yield across three districts (Bidar, Bijapur, and Raichur) were presented (Figure 49) to compare the yield advantage of improved management over farmers' management in the district. In Bidar and Raichur, chickpea was sown in September after the soil profiles were saturated at the end of kharif season with more than normal rainfall in August. While seasonal rainfall was scanty during kharif, September and October rainfall was less than normal in Bijapur, low response due to moisture stress limiting crop uptake of water and nutrients resulted in low productivity of chickpea in both improved management and farmers' practice as well.

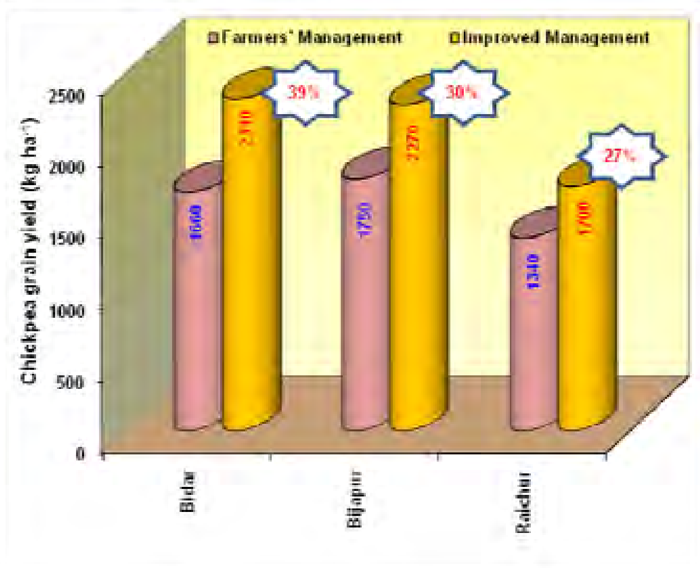


Figure 49. Grain yield of Chickpea (Kg ha-1) in three districts with farmers practice and improved management practice under Bhoochetana during rabi seasons 2010-11

Although confined by localized soil constraints and seasonal conditions, on an aveage farmers in Bidar enhanced chickpea grain yied to the tune of 650 kg ha^{-1}(39%), in Bijar chickpea grain yield increased by 360 kg ha^{-1} (30%) and in Raichur also farmers gained by 360 kg ha^{-1} (27%) with improved management compared to usual farmers' management under Bhoochetana project.

Impacts of Enhanced Productivity

Qualitative Impacts of Technology Interventions

In groundnut, shelling percentage improved in the range of 1% to 2% in three districts out of five districts for which data is available. Due to application of micronutrients within improved management treatment, their availability helped pod filling improved considerably at that crop stage and fully-filled pods were responsible for shelling percentage or out-turn in market parlanes. Variation in shelling percent (Table 78) has considerable value to the farmers, as they could fetches good price for groundnut pods with higher shelling percentage in the market. Shelling percentage with improved management was not accentuated due to low rainfall in September and October in Bijapur, Chitradurga and Kolar in this year.

Table 78. Effect of micronutrients on groundnut pod filling with improved management compared to farmers' management in different districts of Karnataka.

District	FM % Shelling	IM+micronutrients % Shelling
Bijapur	67	67
Chickballapur	65	67
Gadag	65	66
Haveri	68	69
Kolar	67	67

It was observed during crop growth by farmers and DoA officials that root growth and tillering were profuse in ragi with improved management compared to farmers' management in Chickballapur as shown in Figure 50a.

In Haveri, farmers exhibited fully-filled maize cobs from his field where improved management was practiced and he expected during the season a harvest of seven ton per hectare crop

Figure 50a. A Maize plant with profuse rooting with IM in farmers fields of Davangere district

Figure 50b. An official displaying differnces in groundut poding with FM and IM

Economic Impacts of Technologies to Farmers

We estimated the economic impact of investment in improved management as compared to farmers' management for enhancing productivity of rainfed crops in Bhoochetana project. Additional investment for purchase of recommended full dosage of sulfur in the form of gypsum at the rate of 200 kg ha^{-1}, zinc in the form of $ZnSO_4$ at the rate of 25 kg ha^{-1}, and boron in the form of borax at the rate of 5 kg ha^{-1} was considered at the open market price.

Market prices of nutrient fertilizers were gypsum at Rs. 3.2/kg, ZnSO4 at Rs. 29/kg, and borax at Rs. 38/kg in the open market for this estimation purpose, although these were made available to farmers from nearby Rythu Samparka Kendra on 50% incentive to farmers in Bhoochetana.Total investment on micronutrients per hectare is estimated as Rs.1580 per hectare at full cost to farmers. Fodder price of maize and pearl millet @ Rs.2000 per tractor load of 3.5 tons, fodder price of ragi @ Rs. 3500 per tractor load of 2.5 tons, and fodder price of groundnut @ Rs. 4000 per tractor load of 2 tons as quoted by local farmers in the respective districts was considered for cereals fodders and groundnut fodder. Green gram, black gram stalk was not considered as fodder due to incessant rains at harvest resulted in poor quality of fodder; chickpea, pigeonpea, soybean and sunflower stalks were not considered for fodder value as farmers were not using them for fodder purpose. Pigeonpea stalks have uses for thatching and fire wood which was not considered. Crop yield as pod yield or grain yield which ever is marketable was considered at the minimum support price of the produce as announced by Government of India (Table 79) effective for kharif and rabi seasons 2010-11.

Simple measure of additional income per every rupee of additional investment was calculated based on additional net income a farmer fetches on increased yield of fodder and pod or grain per hectare with improved management over the farmers' management and divided by the additional investment on new technology i.e. investment on micronutrients per hectare.

Table 79. District-wise crop yield increase in farmers' fields with improved management compared to farmers' management under Bhoochetana project, 2010-11.

Crop	**District**	**Farmers' Management (kg ha^{-1})**		**Improved management (kg ha^{-1})**		**% increase in production**		**Additional Income at MSP (` ha^{-1})**	**Additional income per Rupee Invested**
		stalk	**grain**	**stalk**	**grain**	**% stalk increase**	**%grain increase**		
Ragi	Bengaluru R	4730	2040	6240	2760	32	35%	9060	**5.7**
	Chikballapur	2090	2610	3290	3710	57	42	12300	**7.8**
	Chitradurga	2820	2050	3730	2680	32	31	7350	**4.7**
	Davangere	2970	1420	3970	1850	34	30	5550	**3.5**
	Hassan	4020	1650	5420	2290	35	39	8140	**5.1**
	Kolar	2720	1710	3820	2250	40	49	6750	**4.3**
	Tumkur	2890	830	3540	980	22	18	2360	**1.5**
	C'raja-nagar	1930	1331	2183	2093	13		7710	**4.9**
Maize									
	Bengaluru R	3460	4600	4450	6530	29	42	17550	**11.1**
	Bijapur	3160	5590	4130	7250	31	30	15160	**9.6**
	Chitradurga	2160	3840	2850	5340	32	39	13590	**8.6**
	Davangere	2170	5220	2860	6600	32	26	12540	**7.9**
	Gadag	3210	6300	4920	8340	53	32	18930	**12.0**
	Haveri	5940	7510	7370	9680	24	29	19910	**12.6**
	C'raja-nagar	5333	1776	9194	3078	72	73	13660	**8.6**
Pearl millet									
	Gulburga	1600	1590	2060	2080	29	31	4580	**2.9**
	Bijapur	2020	1960	2730	2670	35	36	6650	**4.2**
	Yadgir	3270	1850	4220	2540	29	37	6620	**4.2**
	Raichur	1580	1260	2050	1530	30	21	2650	**1.7**
Sorghum									
	Bidar	1840	1630	2500	2290	36	40	6190	**3.9**
	Davangere	3420	1780	4230	2320	24	30	5220	**3.3**
	C'raja-nagar	2227	1428	3031	2215	36	55	7390	**4.7**
Black gram									
	Bidar	1690	930	2460	1260	46	35	9570	6.1
Green gram									
	Bidar	1310	870	1790	1200	37	38	10460	6.6
	Bijapur	460	330	620	480	35	45	4760	3.0
	Gadag	590	280	820	440	39	57	5070	3.2
	Gulburga	1520	460	2180	590	43	28	4120	2.6
	Yadgir	470	540	590	710	26	31	3800	2.4

Pigeonpea								
Bidar	5990	1230	7950	1700	33	38	14100	8.9
Bijapur	1870	920	2550	1160	36	26	7200	4.6
Gulburga	5090	1380	6620	1870	30	36	14700	9.3
Raichur	1470	960	1860	1280	27	33	9600	6.1
Yadgir	8520	1630	11080	2230	30	37	18000	11.4
Groundnut								
Bijapur	680	320	950	470	40	47	3990	**2.5**
Chikballapur	1090	1350	1760	2010	61	49	16520	**10.5**
Dharwad	1737	2062	2090	2906	20		20118	**12.7**
Gadag	1750	1590	2580	2230	47	43	16380	**10.4**
Haveri	3100	2680	3950	3610	27	35	23090	**14.6**
Kolar	1900	1460	2560	1940	47	33	15780	**10.0**
Tumkur	1049	899	1305	1120	27	25		
C’raja-nagar	1105	1109	1553	1733	41	56	15248	**9.7**
Soybean								
Bidar	890	2100	1260	2910	42	39	11660	7.4
Haveri	900	1790	1540	2230	71	25	6340	4.0
Dharwad	3033	1516	4810	2333	59	55	11770	7.4
Sunflower								
Bijapur	1960	870	2470	1060	26	22	4470	2.8
Yadgir	1950	410	2310	490	18	20	1880	1.2

Table 80. Minimum support price (MSP) announced by Government of India on 20-10-2010, effective for kharif and rabi crop harvests in 2010-11.

Crop	**MSP (Rs/ quintal)**	**Crop**	**MSP (Rs/ quintal)**
Ragi	965	Cotton	(J-34) 2500
Sorghum	(Hybrid) 880		H-4 (3000)
	(Maldandi) 900	Safflower	1800
Pearl millet	840	Sesamum	2900
Maize	880	Pigeonpea	2300
Groundnut	2300	Green gram	2760
Soybean	1440	Black gram	2100
Sunflower	2350	Chickpea	1730

During this season groundnut was the best earner for farmers across seven districts in a range of Rs. 10 to Rs. 14.5 per every rupee of additional investment on micronutrients as pod yield and groundnut fodder fetches good market price. Maize was also valued by farmers as the second best earner with an additional income in the range of Rs. 8 to to Rs.12.6 as it produced higher quantum of grain and fodder yield in good seasonal conditions in seven districts. Pigeonpea as sole in some districts and intercrop with groundnut, green gram or millet fetched higher additional returns in the range of Rs. 4.5 to 11.5 per every rupee invested by farmers. Lower additional income recorded for every rupee of investment with soybean in the range of Rs. 4 in Haveri to Rs. 7.4 in Bidar and Dharwad; additional income recorded with ragi in the range of Rs. 1.5 for Tumkur farmer to Rs. 7.8 for Chickballapur farmer for every rupee of investment. With green gram, black gram, sorghum and pearl millet farmers gain moderately in the range of Rs. 1.7 to Rs. 6.6 across different districts. Sunflower farmers were the lowest gainers in the range of Rs.1.2 in Yadgir district and Rs. 2.8 in Bijapur for a rupee of additional investment on imporoved management.

Field Days and Field Visits

ICRISAT Staff coordinated field days in all 16 districts with the full support and participation of DoA district-level staff during the cropping season in the months of October (black gram and green gram), November and December (ragi, groundnut, maize and sunflower) coinciding full grown mature or harvest-ripe kharif crops in most of the districts. The list in table 81 indicates the extent of coverage with field days and number of farmers attended even during crop harvest season in some instances. Whereever long season kharif crops (pigeonpea and cotton) and rabi crops (chickpea and rabi sorghum) were grown field days were organized to demonstrate crop growth and yield enhancement with improved management including use of micronutrients and suitable improved varieties in Bidar, Raichur, Gulburga districts during the month of February 2011. Besides, ICRISAT-DoA staffs were making several field visits to contact farmers and guide on rabi crops management to ensure proper sowing and appropriate plant stand which are more important for higher productivity.

Table 81. Details of field days held in different districts of Karnataka during 2010-11 cropping seasons.

Sl. No	District	No. of Field Days held	No. of Farmers participated	Men	Women
2	Bidar	14	1954	1774	180
3	Bijapur	18	1240	817	423
4	Chamarajanagar	14	310	261	49
5	Chickballapur	5	215	155	60
6	Chitradurga	10	1360	660	700
7	Davanagere	39	5072	3043	2029
8	Dharwad	65	2390	2170	220
9	Gadag	6	489	448	41
10	Gulbarga	5	775	624	151
11	Hassan	14	800	565	235
12	Haveri	16	1672	1387	285
13	Kolar	4	450	335	115
14	Raichur	2	400	350	50
15	Tumkur	31	1840	1300	540
16	Yadgiri	5	407	307	100
	TOTAL	**203**	**15493**	**10939**	**4554**

* Besides above mentioned field days, ICRISAT organized a Bhoochetana Farmers' day in Model watershed at Neeralkatti village in Dharwad district on 26 October 2010, in which 900 farmers and 100 officials of government of Karnataka participated.

Field day in Bidar

More than 600 farmers attended the Field Day held on 27 August in Chambole village of Bidar Taluk. The Agriculture Minister Karnataka, SA Ravindranath was the Chief Guest and inaugurated the ICRISAT stall. Farmers who adopted the Bhoochetana package of improved practices expressed confidence that their crop yields increasing the crop yields by 30-40%. black gram, soybean and green gram intercropped with pigeonpea in increased crop productivity.

Participation in Krishi Utsavs

ICRISAT Scientists, Scientific officers and Research Technicians actively participated in week-long campaigns known as “Krishi Utsavs” organized by DoA staff in many of the Bhoochetana districts. ICRISAT put up stall for demonstration of improved varieties seed, posters display on Bhoochetana activities and Tropicultor implements adjacent to stall and demonstrated the use of implements to farmers. ICRISAT’s participation was conspecious in Bidar, Chickballapur and Dharwad districts as seen from the figure. Talukwise KRISHI UTSAVA was also attended in the month of November in the Taluks Hubli, Navalgund & Kundagol with more than 2500 farmers participation in Hubli Taluk , 300 to 400 farmers participation in Kundagol, and more than 3000 farmers in Navalgund in a function involving all government public private welfare departments & organisation as well as some seed companies.

ICRISAT-DoA Bhoochetana Farmers’ Day in Dharwad

ICRISAT co-sponsored a “Krishimela” (farmers day) held at the University of Agricultural Sciences (UAS), Dharwad from 2 to 5 October. About 0.74 million farmers from across Karnataka as well as the surrounding states of Maharashtra and Andhra Pradesh participated in the Krishi mela. The Krishimela started on 2 October with the Awards Ceremony for progressive farmers. On 3 October, the mela was inaugurated under the chairmanship of the Honorable Minister of Agriculture, Mr Umesh Katti. Mr Jagdish Shetter, Honorable Minister of Rural Development and Panchayat Raj; Mr CM Udasi, Honorable Minister of PWD; Mr VH Kageri, Honorable Minister of Primary and Secondary Education; and other elected representatives of local institutions also participated. Two ICRISAT publications based on the Bhoochetana collaborative project between the Government of Karnataka and ICRISAT were released by the dignitaries on the dais. A seven-member ICRISAT team led by SP Wani, participated and put up a stall in the agricultural exhibition section.

Inaugurating the ICRISAT stall with other dignitaries, UAS Vice-Chancellor Dr RR Hanchinal highlighted the ongoing collaboration between ICRISAT and UAS through the Bhoochetana initiative. Many farmers visited ICRISAT stall where they got practical information about the soil health of their villages along with knowledge of other improved technologies for managing rainwater, soil, crops and pests management. The stall also featured a good display of our mandate crop seeds as well as a number of posters in the local language. Several farmers registered their names at our stall for small quantities of improved cultivar seed.

Audio-Visual and Print Media Publicity

Doordarshan Crop Seminar

DoA State level senior officials and visiting scientists participated in the crop seminar organized by state owned Doordarshan Chanel cand interacted with farmers to clarify farmers questions, and emphasize about good agriculture practices.

Figure 51. Doordarshan organized a crop seminar with DoA officials, University Scientists and lead farmers' and policy makers to discuss from the same flat form

Documentary on Bhoochetana: Short Video

A video film for the duration of 30 minutes was produced with the help of DoA staff coordinated by ICRISAT technicians in the districts and sent to ICRISAT for production in the studios at Hyderabad. A good quality film was developed with an aim to introduce farmers, policy makers in the newly introduced districts to understand the goal and objectives of Bhoochetana and quickly acquaint themselves of the technologies, and the success of these technologies from the real beneficiary farmers' groups of the neighbouring districts, as the video includes farmers assessment of the program in enhancing their crops productivity and incomes.

Figure 52. A Short film DVD (30 m) on Bhoochetanan project activities, technologies implement and success stories of farmers during 2009-10 crop season

ICRISAT-DoA Publications on Bhoochetana

During the first yfear of project progress, besides awreness campaigns and publicity material, ICRISAT-DoA jointly brought out publications of booklets and a training manual.

Figure 53a. A 30 page booklet (English) on Bhoochetana project activities, technologies and achievements published jointly by ICRISAT-DoA during 2010

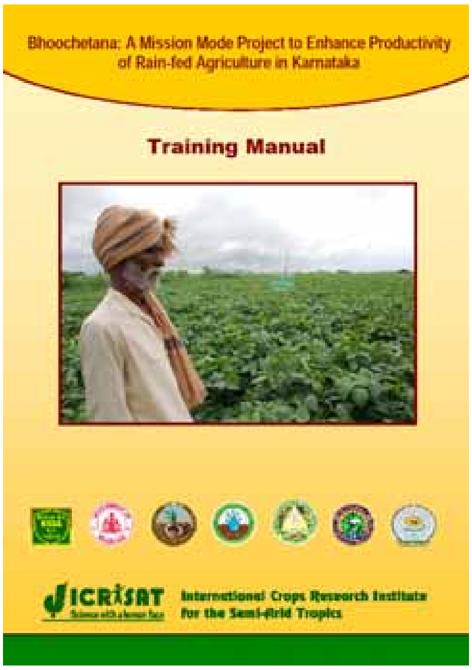


Figure 53b. A training manual on Bhoochetana technologies, methods of implementation and recommendations for stakeholders

Figure 54a. Release of Booklet on Bhoochetana project (English) activities and achievments in the first year 2009-10

Figure 54b. Release of Booklet on Bhoochetana Project (Kannada) activities and achievments in the first year 2009-10 by Hon. Chief Minister B. S. Yeddyurappa

A four-page flyer was prepared with brief content aimed at policy makers (English) and farmers (Kannada) to impress upon Bhoochetana concept, goals, activities and successes increasing rainfed crops productivity any where between 32 to 66% during the first year of inception of the project in different districts. It was a collective effort of ICRISAT with DoA and other consortium partners contributed with their suggestions and inputs for the flyer.

Bhoochetana

Mission to Enhance Productivity of Rainfed Crops in Karnataka

Figure 55a. A flyer (English) on Bhoochetana Project activities and acheiements during 2009-10

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Figure 55b. A flyer (Kannada) on Bhoochetana Project activities and acheiements during 2009-10

Learnings

1. Dryland farming Community in Karnataka are receptpive to knowledge-based improved agricultural practices and come forward willingly to undertake evaluations through participatory research as evident from good coverage up to 40 per cent area with micro nutrients in Bidar district during rabi season can be effectively organized and utilized for increasing productivity of dryland agriculture.
2. For achieving the desired impact in terms of increasinig agricultural prouctiivty of dryland systems, small and marginal farmers need to be enabled through training, exposure, demonstrations, ensuring availability of necessary inputs and handholding support.
3. Timely availability of inputs as well as quality of the inputs are becoming bottlenecks for scaling-up the Bhoochetana inspite of good efforts from the DoA
4. Supply chain for quality inputs need to be strengthened and put in place ahead of the beginning of the season i.e., April end for northern Karnataka districts Mission project need to be treated as Mission for which team building to enhance commitment by one and all calls for attitudinal change.
5. During second year of the mission program farmers in six districts where program was launched adopted the imprpoved management practices iin higher number than the new ten districts. However, due to efforts of committed JDA new district like Bangalore rural achieved 52% of targeted borax distribution which is a commendable effort to be emulated in other districts.
6. Internalization of soil-test-based recommendations amongst DoA officials has to be a continuous process as new officers coming with some fixed ideas need to be sensitized as well as made aware with the mission strategy and approach. Such officiers do pull back the implementation in particular districts.
7. Regular review meetings conducted by DoA are good and showing its impact and Director and Commissioner have put good efforts which have contributed largely for the success as evident from the results during the second year. Similarly regular video conferencing improved the adoptping with increased clarity and accountability.
8. In new districts early identification of beneficiaries, farm facilitators and ensuring publicity and awarensss building is must. Good officers in the district can do the job

of achieving the mission target well as evident in select districts e.g., Bangalore (R) during kharif and Bidar during rabi season.

9. Frequent meetings of the SCC at regular interveals are very effective and such meetings facilitated the mission project and helped in overcoming the bottlenecks to an extent and such meetings are must.
10. Scientific approach and technical support enabled dryland farmers to enhance crop productivity significantly (32 to 66%) not only in the first year of implementation in 6 districts, but also continued and exceedingly well over a larger areas in sixteen districts with significant increase in crop producitity by 21 to 57 per cent during rainy season for different crops.
11. Availablity of good quality seeds of mprpoved cultivars of groundnut, pigeonpea, ragi, chickpea, green gram, black gram is a problem in many districts. Development of Seed banks by farmers' groups within villages help farmers to get quality seeds of their choice variety at cheaper rates. Concerted efforts are needed to scale-up village seed bank initiative with polcy and financial support along with needed technical backstopping.
12. In spite of unfavourable rainfall situation in particular districts, improved management practices showed increased croop yields over the farmer's practices suggesting that improved practices are also proving as good adaptation stratgies to cope with unfavourabel rains.

Some reasons for lesser application of micronutrients input by farmers in the districts and issues need to be addressed to improve the use of micronutrients in Bhoochetana project areas.

- Although target area projections were done rightly, micronutrient requirement were under-projected based on recommendations (lower dose of micronutrients) given in package of practices to individual crops in different districts, ignoring soil test based recommendations provided by ICRISAT at the review and planning meeting in Bengaluru to each district JDA and associated staff.
- Based on experiences in the previous year monsoon conditions and difficulties in the distribution of left over stocks in the previous year, officials took a conservative approach of partial stock positioning, and accordingly indented for partial requirement of micronutrients, with a view to supply micronutrients as and when the demand arises.

As the demand had arisen in short span, the problem of non-availability of micronutrients raised for short period of sowing opportunity.

- Although early monsoon forecasted, based on recent year experiences, official machinery not fully prepared for a good monsoon rainfall. Good amounts of rainfall in most of the districts caught the farmers and officials unprepared and farmers went a head for sowing of crops like groundnut in Kolar, Chikkaballapur and pigeonpea in Gulburga and Bidar with good monsoon rains quite early. These districts where sowings have been completed more than 50%, the supply of one or all the micronutrients (ZnSO4 in some districts) were either insufficient to meet the demand or was not available (Ex. Boron in Raichur) at that time when farmers needed it most.
- Even though 50% incentive was available on all micronutrients, increased nutrient cost added to the unaffordability and less interest to poor farmers hence opting for lower doses of micronutrients than recommended.
- Ragi is a major crop at least in 4-5 districts, and less adoption for ragi farmers as farmes as well as researchers to additionally consered it as a nonresponsive crop it will obviously take more seasons to fully appreciate the impact of micronutrients, and hence nutrient uptake is relatively lower in these districts.
- Although a complete package of nutrients need to be supplied to enhance crop yields, involvement of local polity in politically sensitive areas to demand issue of selective nutrients and quantities also affected the implementation, reflecting low in take of micronutrients at district level.

Administrative issues:

- Capacity building and awareness campaigns were taken up at all levels quite intensively by DOA with ICRISAT technical assistance. However, facilitators and lead farmers trained through these efforts and their services to the required level were not available before the sowings at least in some districts as was observed. Full strength of facilitators and lead farmers need to be restored during 2011-12, where ever insufficiency was observed.
- Difficulties with attrition of new staff appointed by ICRISAT in the Bhoochetana districts covered previous year, as older staff were posted to new districts for vigorous implementation.
- There were instances of problems related to transporting nutrients to farmers' door steps as the suppliers dumped fertilizers at taluk RSKs, and there were difficulties in storage

and supply fertilizers to farmers in the watershed villages. Transportation costs and storage space problems need to be addressed sooner.

However there is still time for further intake of micronutrients in some districts as the sowings are in progress, and we will be able to achieve higher target before the sowing season completes.

Highlights

- Analysis of massive scale soil samples collected from farmers' fields in the districts to map nutrient status of soils using GIS and used the analysis to operationalsie soil test-based talukwise fertilizer recommenations which is a novel and one of its kind mission initiative in the country. It has established a proff of concept by documenting B: C ratios of 1.2 to 14.6 for additional income using market prices for the inputs.
- The mission project has established good practices for knowledge dissemination, data recording, crop cutting and recording ields for computing state statistics and lot more need to be done yet to fully harness the agricultural potential in the state.
- It is piloting a new extension system on a large scale using farm facilitators and consortium approach for capacity building by linking knowledge generating institutions with knowledge dessminating line departments.
- Farmer-friendly technologies besides improving soil quality helped farmers increased crop productivity in the range of 32 to 66% in rainfed groundnut, finger millet, maize and soybean during kharif 2009, and promise continued to sustain by increase crop yields as observed during 2010 kharif and rabi season also.
- A unique project in mission mode project aimed at increasing rainfed crop productivity by 20% in four years in 25 districts has been extended to 30 districts of Karnataka by GoK based on established successes with farmers.
- A project that takes up the integrated genetic and natural resource management through consortium of national and international research institutions to take care of the entire 'seed to food' chain. Bringing improved agricultural technologies, seeds and other inputs for farmers' doorstep, besides building capacities of stake holders.
- Intense monitoring by high-power State Coordination Committee at regular intervals, helped with midcourse corrections, ensured project deliverables in time and achieve the objective to an extent.

Appendix - A

Proceedings of the Meeting on Recommendation of Gypsum and Micronutrients under Bhoochethana Scheme Held On 02-09-2010 at Commissionarate of Agriculture, Bengaluru.

The Director of Agriculture welcomed the gathering and briefed about the recommendation followed by department of Agriculture on application of gypsum and micronutrients in dry land agriculture under Bhoochetana scheme and invited suggestions from the participants.

There was detailed deliberation in line with differences in Agriculture University and ICRISAT recommendations, effect of high dosage of zinc sulphate application in dry lands especially on the availability of other nutrients.

Dr. Wani and Dr. Sharawat from ICRISAT expressed that for the first time soil sampling has been done from the farmer's field and has been analyzed for the micro-nutrient status. They also felt the need for optimization of the dosage of micro-nutrients.

After detail discussions following suggestions were made:

- Recommending ZnSo4 @ 15 kg/ha every year in zinc deficit soils and @ 10 kg/ha every year in normal soils.
- ZnSo4 should be appliied along with FYM in the ratio of 1:1 ($ZnSO_4$: FYM).
- Advice farmers not to apply ZnSo4 along with DAP.
- Micronutrients could be applied upto 20 days after sowing in short duration crops and up to 30 days after sowing in long duration crops.
- Only basal dose of micronutrients to be applied in short duration pulses.
- Soil health cards to be distributed to only those farmers from whose field samples are collected and analysed.
- State Agricultural Universities to involve actively in Bhoochetana programme by visiting the Bhoochetana plots and giving necessary feedback.

Meeting concluded with vote of Thanks

-Sd-

Commissioner for Agriculture

Officers Present:

Sl. No.	Name : Sri/Smt.	Designation
1.	Dr.Babu Rao Mudbi , I A S	Commissioner for Agriculture
2.	Dr. K.V. Sarvesh	Director of Agriculture
3.	Dr. B.K. Dharmarajan	Additional Director of Agriculture, (Crop development and Planning)
4.	Sri T.V. Gurudevaiah	Additional Director of Agriculture, (Organic Farming)
5.	Sri. Siddaraju	Joint Director of Agriculture (Inputs)
6.	Smt.S.M.Deepaja	Deputy Director of Agriculture(Food Crops)
7.	Smt.S.S.Lalitha Reddy	Deputy Director of Agriculture(Soil Health)
8.	Dr. C.V. Patil	Member Krishi Mission, Karnataka
9.	Dr.Kanwar L.Sahrawat	Scientist, ICRISAT
10.	Dr.S.P.Wani	Project co-coordinator, ICRISAT
11.	Dr. K. Krishnappa	Scientists, ICRISAT
12.	Dr.S.L. Patil	Dean (Agri), UAS, Dharwad
13.	Dr. Yeledhalli	C.S.O. DOR, U.A.S, Dharwad
14.	Dr.P.S.Hugar	Senior Inf.Splt., DOE, U.A.S Dharwad
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About ICRISAT

ICRISAT
Science with a human face

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 644 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT belongs to the Alliance of Centers of the Consultative Group on International Agricultural Research (CGIAR).

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