Creating climate-smart villages in India: Seasonal rainfall forecasts assist cropping decisions

Scanty July rain in Andhra Pradesh, India, has resulted in less than 30% of the rainy season crops being planted in some areas.

Some 450 dryland farmers in Kurnool and Anantapur districts who were forewarned of this rainfall pattern and advised on suitable crop options by ICRISAT researchers at farmer meetings in May and June are considering their cropping options.

With El Niño becoming stronger, the seasonal forecasts were for the normal onset and quantity of rainfall in June, less than normal rain in July and August, and better rainfall in September and October.

This is the third year the ICRISAT Resilient Dryland Systems team have assessed scenarios for various cropping options with the APSIM simulation model using historical weather and crop productivity data for 40 seasons, the Indian Institute of Tropical Meteorology (IITM) seasonal forecasts, local weather patterns and major ocean influences.

In the Kurnool area, which has deep black soils and average rainfall of 750-780 mm annually, the farmers were advised that the 2015 season would suit an intercrop of short duration legumes or a cereal like foxtail millet, combined with a longer season pigeonpea as intercrop which matures when good soil moisture is expected.

Reaping rewards

In 2014, with a similar El Niño predicted, in one village in Kurnool, farmers who adopted these suggested practices harvested 1.5 t ha⁻¹ of foxtail millet, 1.0 t ha⁻¹ of green gram, in addition to 1.5 to 2.2 t ha⁻¹ of pigeonpea grown as an intercrop.

“They made even more money than those who grew commercial crops like cotton and chillies, with a much lower investment,” said Mr V Nageswara Rao, Lead Scientific Officer, Systems Modeling, Resilient Dryland Systems, ICRISAT. “Other farmers who questioned the reliability of the forecasts and planted maize - which requires moisture throughout the season - hardly harvested a quarter of their expected crop.”

Mr K Venkata Subbudu, farms 3 ha of black soil at Hussainapuram near Kurnool. He would have planted cotton if rain had arrived earlier this year, and is likely to grow chickpea/black gram, if there is sufficient rain.
“Last year Mr Rao suggested we plant the black gram two weeks early, in September, and I harvested 20% more than farmers who didn’t take this advice, because the moisture ran out in the late season,” he explained.

In Anantapur area, which has lighter red soils and an annual rainfall of 544 mm, in both 2015 and 2014 the researchers predicted the season would suit short-season legumes like green gram, chickpea or the commonly grown groundnut.

In 2014, the farmers who grew the short season legumes did well, while those who planted longer season pigeon pea found the crop ran out of moisture and the groundnut crops could only be harvested for fodder.

**Climate smart villages**

“Initially when I discuss the seasonal rainfall forecast system and crop management options with farmers they don’t tend to believe it, but some farmers in villages at Kurnool and Anantapur who have experienced the seasonal forecasts, have grown confident since they have tested it for three years now,” Mr Rao said.

That said, such forecasts are probabilistic and such advice is expected to more likely help farmers enhance productivity in years of good rainfall, and limit investment risks during year of low rainfall, in most years, but not all.

The pilot study results will soon be analyzed to assess the value added by the seasonal rainfall and crop forecasts for farmers’ decision making.

The research has been extended to include some 150 farmers in Bijapur district, Karnataka, and more than 100 farmers in three other villages of Andhra Pradesh. The objective is to create Climate Smart Villages with support of the CGIAR Research Program on Climate Change, Agriculture and Food Security.

**New publications**

Impact of Long-Term Application of Domestic Sewage Water on Soil Properties around Hubli City in Karnataka, India

**Authors:** Bincy K Varkey, GS Dasog, Suhas Wani, KL Sahrawat, Manjunatha Hebbara, CR Patil

**Published:** Published: 2015. Agricultural Research 1(5). ISSN: 2249-7218. Springer India

**Abstract:** The effects of application of domestic sewage water for over four decades on physical, chemical and biological properties of soils were studied at three sites in Gabbur, Mavanur and Katnur villages near Hubli city in north Karnataka, India. Long-term use of sewage irrigation improved soil physical properties in terms of decrease in bulk density and dispersion index and increase in aggregate stability and water holding capacity compared to the unirrigated check. Despite long-term irrigation with sewage water with an EC of (1 dS m⁻¹, the EC of soils was low (0.20–0.45 dS m⁻¹). An increase of one-and-half to two times in organic carbon content, available N, P, K and S, in the sewage irrigated soils was observed compared to soils not irrigated with sewage. However, the available Zn, Fe, Cu and B increased only slightly with the exception of Mn which increased substantially. In general there was a decreasing trend of organic carbon, available N, P, K and S with distance away from the stream course. Despite no heavy metals in sewage water, they were detected in soils but not in toxic levels. There were 94, 80 and 60 % more bacteria, fungi and actinomycetes, respectively, in sewage irrigated soils over the non-irrigated soils. Further, coliform bacteria (E. coli) were observed in soil samples, suggesting fecal contamination.

Finger millet and sorghum

Improving productivity and promoting agri-business in western Kenya

Food on the Table, Money in the Pocket was the clarion call given by Mr Moses Osia, County Executive on Agriculture, Busia County in western Kenya. Along with participatory varietal selection and improved agronomic practices, value-added processed products from finger millet and sorghum were showcased in a series of field days.

Mr Osia highlighted progress made by the Busia county government in the agricultural sector including provision of subsidized tractor services, seeds and fertilizer. He further added that the County was constructing a cassava factory that would also process finger millet and sorghum, which are usually mixed with cassava to make composite flours.

The field days focused on participatory varietal selection of finger millet and sorghum varieties (see box); Striga, blast and weed control; row planting; micro-dosing; postharvest management; and value addition. The host group of farmers showcased value-added products from finger millet and sorghum including cakes, crackies, chapatis (flat bread), buns and beverages.

Along with its partners, ICRISAT will target commercial production of finger millet and sorghum, diversification of household-level diets, value addition and processing for food, feed and industry. There is untapped potential for these crops in baked products like bread. Efforts are being made to pilot and incubate SMEs (Small and Medium Entrepreneurs) from among the farmer groups and individuals to develop products for the market.

Dr David Mbakaya, Deputy Center Director KALRO- Alupe, in his address to farmers, urged them to visit the research station as groups and individuals to access R4D technologies in order to improve on-farm productivity, incomes and livelihoods.

Dr Eric Manyasa, Scientist - Breeding (Dryland Cereals), ICRISAT, addressed the farmers and other participants. He challenged them to embrace finger millet and sorghum in their diets as health foods for the future in order to reduce increased incidences of lifestyle diseases among the local population. He also indicated that ICRISAT and partners will work with finger millet and sorghum farmers in improving productivity, value addition and market linkage.

Among the field day participants were representatives from Equatorial Nut Processors Limited – makers of sorghum-based composite flours. They engaged farmers and urged them to consolidate their produce to target the bulk buyers from urban centers. They were impressed by the high variability in finger millet varieties and the value-added products. They saw the potential of incorporating finger millet in their sorghum products.

The field days series was held in Butula, Teso south and Matayos sub-counties between 10 and 29 July. A total of 1,050 farmers attended the field days, 60% of whom were women.

ICRISAT was represented at the event by Dr Henry Ojulong, Scientist - Breeding (Dryland Cereals); Dr Eric Manyasa, Scientist - Breeding (Dryland Cereals), Mr Patrick Audi, Socio-economist and Mr Daniel Otwani, Research Assistant.

### FIELD DAY RESULTS

KALRO and ICRISAT displayed six elite varieties each of finger millet and sorghum for participatory varietal selection by farmers. The results are as follows:

#### Finger millet
- **U15:** Most preferred across all the six sites for:
  - Early maturity
  - Grain color
- **IE 3779:** Preferred for:
  - Resistance to blast disease
  - Tolerance to lodging

#### Sorghum
- **IESV 24029 SH** and **IS 21018:** Selected as favorites across all the field day sites for:
  - High grain yield
  - Good grain color
  - Tolerance to bird damage

Project: Harnessing Opportunities for Productivity Enhancement of Sorghum and Millets in Sub-Saharan Africa and South Asia

Investor: Bill & Melinda Gates Foundation

CGIAR Research Program: Dryland Cereals

Partners: Kenya Agricultural and Livestock Research Organization (KALRO), Sub-County Agricultural Offices (SCAOs) and ICRISAT in collaboration with other stakeholders including Anglican Development Services (ADS-Western), USAID-Kenya Agricultural Value Chains Enterprises Project (KAVES), Agricultural Sector Development Support Programme (ASDSP), equity bank, local farmer groups and Busia Agrovet LTD.
Export more seed of improved varieties to neighboring countries

Help more farmers in neighboring countries by exporting more seed of improved varieties,” said Hon. Pat Breen, Chairperson, Ireland’s Joint Committee on Foreign Affairs and Trade (JCFAT) to partners working within the seed systems of Malawi.

JCFAT visited ICRISAT Malawi on 21 July, accompanied by Her Excellency Áine Hearns, Irish Ambassador to Malawi and Embassy staff.

ICRISAT, through the Irish Aid-funded Malawi Seed Industry Development Project (MSIDP), works with partners to ensure that efficient and viable seed delivery mechanisms are in place. The aim is to ensure that smallholder farmers have access to high quality seeds of improved varieties of groundnut and pigeonpea. Phase I of the project ran from 2008 to 2013. Activities were supported through bridge funds from Irish Aid in 2014 and 2015, and Phase II is likely to commence in 2016.

Malawi Seed Industry Development Project achievements
- Groundnut foundation seed increased almost ten-fold. From 42 tons in 2008 to 400 tons in 2014.
- 8,308 tons of improved groundnut and pigeonpea seed was sold by the private sector local seed companies through the Farm Inputs Subsidy Program.
- 54% of the 8,308 tons supplied was contributed by partners from the private seed sector in the MSIDP project, through the Malawi Seed Alliance, a seed business incubation platform initiated by ICRISAT.

Agribusiness incubator for banana products in Uganda

A new African agribusiness incubator facility – AfriBanana Products Limited (ABP) – to promote young entrepreneurs in the banana value chain and other sub-sectors of agriculture was launched in Uganda.

The ABP incubation facility was inaugurated by Ms Rhoda Peace Tumusiime, Commissioner, Rural Economy & Agriculture, African Union and Dr Yemi Akinbamijo, Executive Director, Forum for Agricultural Research in Africa (FARA). An exhibition of the incubatee products was also organized as a part of the launch program.

ABP has nurtured and incubated 39 entrepreneurs; commercialized six technologies and helped generate employment for over 420 people. This new facility will incubate clients and explore markets under the brand names of Afrifresh, Afribio and Afriseed.

Ms Tumusiime, the Chief Guest at the event, in her address, commended FARA for taking research out of the lab by putting in place UniBRAIN that incubates agricultural value chains that not only create jobs and wealth but also stimulates agricultural production.

Dr Akinbamijo said that the launch of ABP is just a beginning for promoting entrepreneurs in Uganda, and the incubator will initiate steps to scale up its incubation activities so as to benefit agro-entrepreneurs in the country.

“The UniBRAIN initiative is committed to entrepreneurship activities in Africa and contributes immensely to the overall development of different nations,” said UniBRAIN facility coordinator, Mr Alex Ariho.

This is one of the six agribusiness incubators being mentored by ICRISAT’s Agri-Business Incubation (ABI) Program of the Agribusiness and Innovation Platform (AIP) and partners under the UniBRAIN project of FARA.

ABP was launched on 25 July at Biharwe in Uganda.
Integrated approach for irrigation development in Zimbabwe

The need for adopting an integrated approach that considers technical as well as socio-economic issues for irrigation development in Zimbabwe was one of the key points that emerged at a workshop on Irrigation Water Management that had top international development agencies in attendance.

The workshop highlighted the need for creating an enabling environment for successful irrigation development that included policies and institutional issues, and on linking the irrigation systems to markets so that farmers can make investments in irrigation.

The three-day proceedings focused on the current state of knowledge in the irrigation sector in Zimbabwe and drew lessons from regional and international experiences. There was sharing of technical information as well as identifying the challenges and the opportunities primarily within knowledge systems.

It is the Government of Zimbabwe’s thrust to ensure food security and self-sufficiency, in line with the objectives of the Zimbabwe Agenda for Sustainable Socio-Economic Transformation (ZimAsset); a developmental and economic blueprint for the country. The government is working within the Food and Nutrition Cluster of ZimAsset to increase functional area under irrigation from 160,000 ha to 220,000 ha.

Mr Ringson Chitsiko, Permanent Secretary, Ministry of Agriculture, Mechanisation and Irrigation Development, Government of Zimbabwe

It was agreed that there is a need for a research project to identify the current challenges and opportunities in smallholder irrigation systems. The findings would then guide the identification of interventions that could be put in place, on the lines of the Farmer Field School (FFS) approach.

Some key issues that could steer the research agenda in irrigation development include:

- Setting up a framework for crop value chain analysis and building up a spectrum of crops to be part of a value chain that meets the household food needs, income, and for local and export markets
- Bringing in private investors who can provide capital and finance for infrastructure to enable storage of commodities to meet year-round food supply
- Leveraging the use of ICT in agriculture, as well as engaging youth and women
- Working on improvement of crop production through capacity building, promotion and up-scaling of tools and technologies to assist farmers (embedded in the realities that are found in these irrigation schemes).

The workshop on “Sustainable Irrigation Development and Water Management for Food Security and Rural Livelihoods Improvement in a Changing Environment” was organized by ICRISAT in collaboration with the Ministry of Agriculture, Mechanization and Irrigation Development in Zimbabwe, and McGill University from 22-24 July in Harare, Zimbabwe.

The workshop was attended by more than 65 participants from international development agencies in Zimbabwe including the Swedish Development Cooperation (SDC), Food and Agriculture Organisation (FAO), European Union (EU), and the Australian Center for International Agricultural Research (ACIAR).

There is a need to move from a supply-driven irrigation system to a more efficient demand-driven system that can be controlled, coupled with soil moisture monitoring for improved efficiency. The opportunities that exist in southern Africa in terms of water and land resources are yet to be fully exploited for increased and sustainable production in irrigated area.

Dr Chandra Madramootoo
Chair, ICRISAT Governing Board

Analyzing key problems and opportunities

Having 50% women on watershed committees has ensured that their concerns are addressed in decision making. It has also empowered them to have an equal say in the affairs of the community.

Special Webinar on Digital Agriculture

By
David Bergvinson
Director General
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

Science and business work in tandem in Eastern and Southern Africa

Deployment of nutrient-enhanced groundnut products by Nkhoma Hospital, working on mycotoxins and health, following aflatoxin screening by ICRISAT was one of the highlights shared by partners at a one-day scientific symposium in Malawi. The aim of the event was to showcase innovations; and draw lessons from research and partnerships to inform improvement and scaling out.

Partners share experiences

A demonstration by Mr Whyston Sakala from the Eastern Province Farmers’ Cooperative in Zambia showed how his organization exported 120 tons of groundnut to South Africa, following ICRISAT interventions.

Partners also demonstrated labor-saving technologies for groundnut from harvesting, stripping, shelling, and manufacturing peanut butter. Presentations were made by Mr Savemore Ngiraze a groundnut breeder from Zimbabwe and NtchenaNtchena a women’s seed producer group. Other agencies like Peacock seeds, Women in Agribusiness in Sub-Saharan Africa Alliance (WASAA) and National Smallholder Farmers’ Association of Malawi (NASFAM)-Commercial demonstrated their seed products.

Highlights of DARS and ICRISAT work

Department of Agriculture Research Services (DARS) and ICRISAT showcased new varieties, research work on groundnut and pigeonpea and the production and productivity opportunities they have unlocked in the country and region.

- Medium-duration pigeonpea (see box for more), a technology necessary for crop niche expansion was presented by Ms Esnart Yohane of DARS.
- Nutrient dense, resilient legumes and cereals developed by ICRISAT were presented as the next generation of crop varieties under development.
- Sustainable intensification results in Zambia, Malawi and Mozambique were presented, reporting productivity increase by 30-50%.
- Aflatoxin and mycotoxin burden and mitigation (in Malawi, Tanzania and Zambia): Presentations were led by Dr Sam Njoroge, Scientist, Cereal/legume Pathology and Dr Anitha Seetha, Consultant Scientist, ICRISAT and Dr Limbikani Matumba, DARS. The team also shared research highlights on the epidemiology of groundnut rust in Malawi which is an increasing threat.
- Improving seed access: Together with partners, ICRISAT accounts for 54% of legume seed accessed by farmers in Malawi. A business incubation model for seed companies – the Malawi Seed Alliance that has produced viable seed companies such as Peacock seeds, NASFAM-Commercial and WASAA was presented. A NASFAM representative gave a presentation on Strategic Partnership for Impact Delivery whilst Dr Takuji Tsusaka, Associate Scientist, Production Economics, ICRISAT presented on impacts and imperatives for impact delivery.

The sessions included (i) The country strategy and development context; (ii) parallel sessions on knowledge and technology generation, ie crop improvement and agronomy, as well as crop protection and food safety respectively; (iii) delivering innovations and impacts; iv) an exhibition by partners.

Hon. Felix Jumbe, Member of Parliament and Chairman of the Committee of Parliament on Agriculture, Malawi; Mr David Kamangira, Deputy Director, DARS; Ms Grace Mijiga, Executive Director, WASAA; Mr Fraser Mataya of NASFAM; Mr Kennedy Kanenga of Zambia Agriculture Research Institute; from ICRISAT Dr Peter Carberry, Deputy Director General-Research, and Dr Moses Siambi, Regional Director ESA, were among those who attended. DARS scientists, students, partners working in Eastern and Southern Africa also attended the meet.
Changes in work patterns and incomes in Jharkhand

A study of work patterns and household income in Jharkhand has revealed a move away from dependence on agricultural work towards increased employment in the non-farm sector. At the same time, women are playing an increasing role in the workforce in both the farm and non-farm sectors.

These changes were documented in a VDSA study across Ranchi and Dumka districts of Jharkhand from 2010 to 2014. As part of the study 40 households from two villages in each district are being tracked.

The state of Jharkhand in eastern India consists largely of a tribal population where educational opportunities and skills training are lacking. More than 40% of the population lives below the poverty line. The region is characterized by high rainfall, poor soil fertility, undulating land and lack of agricultural infrastructure.

VDSA insights

Study reveals that the farm sector is still the biggest employer, but the share is declining and the proportion of non-farm workers is increasing. The number of participants in the workforce has also increased, for both male and female workers.

One interesting trend is an increase in the number of women in the workforce – increasing from 3.95% to 10.84% in self-employed agriculture, and from 4.82% to 16.06% in the non-farm sector. Whilst the figures reveal that women are increasingly taking charge in farming activities, in the non-farm sector they are moving away from low-paid domestic work towards unskilled jobs (construction worker, shops, etc.).

However, the need for further education and skills training for women still remains an issue. Low levels of female literacy lead to lower earning capacity and at present only 17-18% of the female population in the region are literate above primary level.

Wage rates of both male and female workers increased in the VDSA villages over the four years of the survey, with the male wage still higher than the female wage and the wage rate for agricultural activities substantially lower than that for non-farm activities.

Conclusion

While the movement of labor from farm to non-farm sector has resulted in more people in the workforce and higher wages, one of the major impediments to growth is the lack of infrastructure. The state suffers from a lack of electricity, proper drainage, drinking water, canals and tube wells, manageable distances from metalled roads and banks. These issues need to be addressed by the government for significant growth to be achieved.

Another challenge facing the state is the population growth: 40 - 49% of the population in these areas is under 20 years of age and three-quarters of the population live in rural areas. Unless substantial educational opportunities, skills training and infrastructure are put in place this population explosion could be viewed as either the state’s “greatest asset—or a demographic disaster if it doesn’t get appropriate work opportunities.”

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Welcome

Dr Michael Vabi, a Cameroon national, joined ICRISAT-Nigeria as Country Project Manager, on 29 July. He obtained his MSc and PhD in Rural Sociology and Agricultural Extension from the University of Ibadan (Nigeria).

Dr Vabi has over 31 years of experience within government and international agricultural and forest-environment sector NGOs in countries of Central Africa.

Dr Vabi has worked for SNV Netherlands Development Organization from 2009 to 2015 on a cocoa and forest program. He was on a project to support implementation of the Congo Basin Forest Fund as the lead technical expert from SNV. Between 2005 and 2008, he worked for IITA on the cassava-legume up-scaling project funded by USDA in the forest-savannah belt of Cameroon.

Farewell

Dr Madhusudan Bhattarai, Principal Scientist – Economics, Research Program - Markets, Institutions and Policies, India, concluded his assignment with ICRISAT on 6 August after over three years of valuable and dedicated service to ICRISAT.

We wish him all success in his future endeavors.

Readers’ comments

Thank you very much for information on the launch of 100 voices. I congratulate you on this imaginative program.

Your Happenings at ICRISAT is really meaningful. I wish you continued success in spreading messages of hope.

Excerpts from Dr MS Swaminathan’s letter

The problems of small and marginal farmers should be addressed. It is a well-known fact that the increase in population causes decrease in land holdings. As a result we see the farmers in this category (small and marginal group) increasing. Hence, there is an urgent need to design agricultural methods to suit them. The high-end agriculture research carried out may not be relevant and useful. The farmers in this group mostly practice rain-fed agriculture. These farmers usually go for loans to banks or local money lenders. When they find their produce do not fetch the desired amount they resort to suicides. So, there is a big question of "How to save these farmers?" I feel we have to think seriously about this issue and come out with some concrete methods to stop suicides in the country.

The government, no doubt, is doing all it can in the present situation in Telangana State but some modifications are needed in the execution of the schemes. For instance, the banks must give crop loans and also collect particulars of their produce after harvesting. Thereby assessing their income from agricultural activity. The collection of the loan has to be done based on the status of the small farmer. This may be a heavy work on the banks but this has to be done to stop suicides in the state.

V Vijaya Kumar

Congratulations

Dr Surya Mani Tripathi, an Indian national, has taken up the role of Manager-Technology Transfer and Compliance, Agribusiness Innovation Platform (AIP) at ICRISAT-India, on 3 August. He holds a doctorate in Plant Science and a degree in law with specialization in intellectual property rights.

Previously, he worked as Visiting Scientist (Legal & IPRs Consultant) at AIP and Platform for Translational Research on Transgenic Crops (PTTC). Prior to joining ICRISAT, he worked as CSIR Research Fellow at RBS College, Dr BR Ambedkar University, Agra, India.

We welcome Dr Vabi and Dr Tripathi and their families to Team ICRISAT and wish them the very best.

Dr SS Rao, Principal Investigator (AICSIP-Physiology), Visiting Scientist, Kansas State University