80th Plenary Meeting – Virtual

MINUTES

Second Open Technical Session
How Can Regenerative Agriculture Contribute to a Sustainable Cotton Industry?

Schedule: 8:00 – 10:00 am (GMT-5); Australia (Perth, AW): 09:00 pm – 11:00 pm; Europe: 13:00 – 15:00 (GMT)
Chairman/ Moderator: Dr Keshav Kranthi, Chief Scientist, ICAC

The Chair, Dr Keshav Kranthi, opened the session at 08:01 am and welcomed the audience members and speakers, then proceeded to the presentation from the first speaker.

Speaker: Prof. Rattan Lal, Distinguished University Professor of Soil Science, CFAES Rattan Lal Center for Carbon Management and Sequestration, Ohio State University, OH 43210 USA

Topic: Soil Health for Cotton Production and Nature Conservancy

Professor Lal highlighted that cotton is a key determinant of economic growth and development in many countries around the world and is a source of livelihood and major component of export earnings for low- and middle-income countries. Cotton has a large potential role in advancing the Sustainable Development Goals for the 2030 Agenda for the United Nations.

Similar to the drastic increase in grain crop production by adoption of the Green Revolution technologies, cotton production also increased due to intensive inputs of fertilisers, pesticides, energy, irrigation and soil tillage. However, indiscriminate use of chemical inputs has had adverse effects on soil health and environmental quality. Therefore, a prudent strategy is to produce more cotton from less use of land, water, chemicals, energy, with less emission of greenhouse gases. The strategy is to reconcile the need to produce more cotton with the necessity for improving the environment and restoring the health of degraded soils by re-carbonisation of the terrestrial biosphere via increasing stock of soil carbon in the root zone. With its deep root system, cotton grown with conservation tillage and cover cropping and drip fertigation, can sequester atmospheric CO_2 (as humus and secondary carbonates) with long-term positive impacts on adaptation and mitigation of climate change.

Restoration of soil health by restoring soil organic carbon content can also improve soil structure and reduce the risks of flood/drought problems and of anaerobiosis at critical stages of cotton growth. However, farmers and land managers must be motivated to adopt conservation-effective cotton production systems through payments for ecosystem services.

Professor Lal stressed that policy measures, needed to upscale improved technologies for cotton production, must be pro-nature and pro-farmer. The private sector has an important role to play in

translating science into action by providing the needed inputs to make cotton production a solution to environmental issues and an important strategy of advancing Sustainable Development Goals.

During the discussion Dr Akhteruzzaman asked if cotton provided any special benefits for carbon sequestration because it is a deep-rooted crop. Prof Lal replied that although cotton is deep rooted, carbon sequestration can increase with conservation tillage and cover crops. The cotton crop alone does not produce a huge biomass and it is important to include cover crops in the cropping systems to enrich the soil with organic biomass.

Mr Rajeev Baruah asked if soil carbon can be measured accurately using satellite imagery and can be used to reward farmers for enhancing soil carbon. Prof Lal replied that there are several technologies available to measure soil carbon and it is important to identify simple, practical methodologies to assess soil carbon reserves and reward farmers accordingly.

The next speaker was **Prof. Fabio Rafael Echer,** Professor of Cotton Agronomy/Physiology, São Paulo Western University (Unoeste), Presidente Prudente, Brazil

Topic: Improving cotton's sustainability in the tropics

Brazil is the fourth largest producer and the second largest exporter of cotton in the world. Mato Grosso and Bahia account for 90% of the area planted with cotton in Brazil, 92% of which is not irrigated and is dependent on rains. In Mato Grosso, cotton is grown after soybeans in most areas. Evaluations in commercial areas of high cotton yield in Mato Grosso and Bahia (~3200 kg ha of fibre) indicate high soil fertility at depths greater than 40 cm, especially with calcium and boron, in addition there is an absence of aluminium and high soil permeability to air in the deeper layers, which indicates a good environment for root development. In these fields, high enzymatic activity was also observed for arylsulfatase, betaglucosidase and acid phosphatase. The use of crop rotation is essential to increase the carbon stock in tropical soils, cycling and nutrient use efficiency, especially in sandy soils. Increasing yield is the main way to increase the sustainability of cotton over time, since this requires improvement in soil quality, which is only possible with the adoption of conservationist practices such as crop rotation. Increasing the diversity of agricultural crops is the greatest challenge for agricultural systems in the Brazilian Cerrado, and it will improve cotton's performance.

During the discussion on Professor Echer's presentation, Dr Ali Talpur pointed out that crop rotation provides the foundation for long-term weed management. He asked as to which cover crops could be recommended for Pakistan in rotation with cotton, given the fact that over the years, cotton-wheat rotation has evolved as a standard system. Prof Echer replied that Brazil grows soybean which provides excellent organic biomass. Every country will have to identify crops that are best suited to its ecology and cropping systems.

Dr Venugopalan asked if farmers were thinking about going back to long duration varieties in Brazil to get higher yields. Prof Echer replied that the current cotton crop duration fits well with the cotton-soybean rotation. Therefore, the probability of extending the cotton crop duration would not be ideal for the existing cotton-soybean rotation and farmers are not likely to revert to long duration cotton.

Dr Kamrul Islam queried if Brazilian farmers used hybrids or open pollinated varieties to get high yields and wanted to know the spacing. Prof Echer replied that Brazil grows only open pollinated varieties and does not grow hybrid cotton. Brazilian farmers have access to the third-generation varieties. The row to row spacing is 90cm in Mato-Grosso and 76cm in Bahia. Plant population was 60,000 to 100,000 plants per hectare depending on the state.

Dr Terry Townsend asked Prof Echer for clarification on his statement: 'Raising yields is the best way to improve sustainability' in the context of organic cotton systems that are known to result in lower

yields compared to conventional systems. Prof Echer replied that Brazil has large farms, that could be more than 10,000 hectares in some cases. Growing organic cotton does not appear to be a feasible option in Brazil, at least not in the Mato-Grosso state, because boll weevil is a big menace for cotton in the country and growing organic cotton on large farms could be too risky. Dr Townsend added that organic might be good for some countries or regions but not suitable for every cotton producing country.

The third speaker was **Dr Kater Hake,** Vice President, Agricultural & Environmental Research, Cotton Incorporated, USA

Topic: Regenerative Agriculture – Implications for the Textile Industry

Dr Hake explained that Regenerative Agriculture (RA) has been recently identified by textile companies as an important consumer concern. Comparing a set of 13 statements about regenerative agriculture from textile companies, two common concerns emerge – climate and soil health. These are linked because soil health can sequester carbon and expand resiliency. The Field to Market Coalition lists 5 regenerative agriculture principles: minimising soil disturbance, maintaining living roots, covering bare soil, maximising plant and microbial diversity, and integrating livestock where feasible.

Although there is no consensus on regenerative agriculture principles, definitions or certifications, regenerative agriculture can be encouraged through support of cotton production protocols that include soil health. Textile consumer concerns about Regenerative Agriculture, climate change, and microplastics offer an unprecedented opportunity for cotton, which in order to fully utilise, requires strengthening cotton's role (both production and processing) in protecting our environment.

In the discussion Mr Rajeev Baruah wanted to know the difference between sustainable and regenerative agriculture and if regenerative agriculture was being rebranded as 'old wine in a new bottle'. Dr Hake clarified that regenerative agriculture was farmer centric and that it was important for farmers to define it and not for brands and retailers.

Dr Kamrul Islam wanted to know if there were any certification standards available for regenerative agriculture. Dr Hake informed that there were no defined standards prescribed for certification of regenerative agriculture and that organic can be considered regenerative as well. However, there are some organisations that are trying to develop a definition of what they think regenerative agriculture should be.

At the end of the questions and answer session, Dr Kranthi moved to the next item: selecting the topic for the 2023 Technical Session at the 81st Plenary Meeting.

Dr Kranthi said that the following three topics were proposed for the Technical Seminar 2023 of the 81st ICAC Plenary Meeting:

1. Women in cotton production and processing: challenges of equity
2. Recent technological innovations as gamechangers in cotton farms
3. Climate smart technologies for cotton production

The delegate of Pakistan suggested that the topics 2 and 3 could be merged for the Technical Seminar 2023. The proposal was supported by the delegates of Australia, India, Egypt, Russia and Bangladesh. The Chair suggested that topic 1 on 'women in cotton production and processing: challenges of equity' could be considered for a separate session in the 81st ICAC Plenary Meeting. The ICAC Chief Scientist was asked to merge the topics 2 and 3 for consideration of the Standing Committee.

Below is the revised topic prepared based on the suggestions made by the distinguished delegates:

Climate smart innovations as gamechangers for cotton production

The recent 'UN Climate Change Conference of the Parties: COP26', held in Scotland in 2021, and COP27, held in Egypt in 2022, reaffirmed the resolve for 'emission reduction targets for 2030' that align with reaching net-zero emissions by 2050 to keep 1.5 degrees or less of global warming within reach. Like other agricultural crops, cotton production also emits greenhouse gases (GHGs) mainly comprised of carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) that cause global warming. The total global annual emissions from cotton farms are estimated to be 57.2 million tonnes of CO_2eq GHG tonnes of CO_2eq GHGs. Recent studies have shown that several climate smart technologies have the potential to reduce GHG emissions and enhance carbon sequestration while concomitantly resulting in improvement of sustainable crop productivity. These climate smart innovations are known to play a significant role not only in enhancing environmental sustainability, conserving biodiversity and rejuvenating soil health, but also in increasing cotton productivity and improving profitability.

- Such climate smart innovations include nanotechnologies to enhance fertiliser-use-efficiency, water-use-efficiency and pesticide-use-efficiency.
- Innovations on micro-irrigation, laser levelling, structured water, satellite imagery and crop evapotranspiration (ETc) based automated irrigation scheduling have proven potential to save water and enhance water-use-efficiency.
- Climate smart innovations that rejuvenate soil health, such as mass production of biochar from farm waste using the Kon-tiki-pit biochar, enhancing carbon sequestration through regenerative technologies, hand-held rapid soil testing kits, satellite imagery for carbon monitoring, drone mediated crop monitoring and robotic-sensor based precision nutrient application and pesticide application have become operational in many cotton farms across the world.
- A recent report (Cotton Leads, 2019) highlights the potential of a simple 'zero-till' technology-based cotton crop biomass in capturing CO_2 to show that '*an acre of no-till cotton actually stores 150 kg more of atmospheric carbon than it emits during cotton production, meaning that cotton's contribution to the carbon equation is net negative'*.
- Technologies such as genome editing, marker assisted breeding and CRISPR-CAS are being used to develop 'climate resilient drought tolerant and high yielding' cotton varieties.

Thus, there are several streams of promising climate smart innovations, technologies and opportunities that have either been developed and validated or are in advanced testing stages, with immense potential for increasing productivity and enhancing environmental sustainability.

The technical seminar will discuss the latest developments in implementable climate-smart technologies with focus on game-changing innovations that have the potential to enhance environmental sustainability and increase cotton production. The seminar will also discuss policies to promote climate-smart technologies and reward carbon-farming.