CALL FOR SUBMISSIONS:
Case studies of agrifood system technologies and innovations for climate action: Call for proposals for the FAO Science and Innovation Forum 2023

Template for submissions (maximum 2000 words in total)

In the context of the upcoming FAO Science and Innovation Forum 2023, the FAO Chief Scientist Office invites you to share illustrative country level case studies of agrifood system technologies and innovations for climate action.

Please use this submission template to share your experience. You can upload the completed submission form online, or, alternatively, send it to fsn-moderator@fao.org.

The Call for Submissions is open until 23 June 2023.
# Template for submissions

## Proponent (name/institution)

<table>
<thead>
<tr>
<th>DR. SADDAM HUSSAIN</th>
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<tbody>
<tr>
<td>DEPARTMENT OF AGRONOMY, UNIVERSITY OF AGRICULTURE FAISALABAD</td>
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## Title for the case study presented

<table>
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<tr>
<th>Plant-based Superabsorbent Polymers for Enhancing Agricultural Productivity in Marginal and Stress-prone Areas</th>
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## Country location

<table>
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<th>Rainfed, salt-affected/arid areas; Punjab, Pakistan</th>
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## Context and background

Agriculture is considered as backbone of Pakistan's economy and millions of people in the country directly rely on this sector for their food and livelihoods. Nevertheless, the rapidly increasing population, shrinkage of land and water resources, climate change, and stagnant agricultural growth are threatening the food security and livelihood of rural population. In Pakistan, approximately 6 mha area is affected by soil salinity, while 5 mha area is covered by Cholistan and Thal. The crop yields in these areas are quite low, and a big yield gap exists between the potential yields and actual yields attained at the farm level. However, these areas may contribute a significant share towards national agricultural production and economy of Pakistan, by adopting appropriate and cost-effective technologies that support soil water conservation, reduce direct evaporation losses, enhance stress tolerance, and improve soil water balance.

The use of biodegradable and superabsorbent polymers (BSPs) is an efficient, sustainable and environment friendly approach to ensure the profitable cultivation of crops in marginal and stress prone areas. Application of BSPs can increase the water and nutrient holding capacity, reduce irrigation requirement (15-50%), ensure uniform water consumption, facilitate rapid root growth, minimize nutrient losses, and enhance soil physical properties. Nevertheless, most of the superabsorbent polymers particularly from synthetic sources are too costly and are difficult to apply on field-scale by resource poor farmers. Moreover, synthetic polymers are not easily degraded in soil after their application, which may increase the environmental pollution. The risk regarding transfer of free radicals into the food items is also a major concern associated with synthetic polymers. It is, therefore, inevitable to focus on the production of BSPs with enzymes, microbes and plants, and their hybrids which are environmentally and economically acceptable for the farming community. In the last five I have developed various novel plant-based BSPs from agricultural waste (e.g. corncob, corn stalk, saw dust, wheat straw and rice straw) in collaboration with the industry, and their efficacy has been tested in different preliminary studies under drought and salt stresses, and the concentrations have been optimized. After two years extensive research trials, I conducted demonstration plots at farmers field in an area of >150 acres. I also arranged around 50 farmer’s gatherings for large-scale commercialization of the technology. For the production and research on BSP technology, I established first BSP research and Production Center.

BSP technology has significantly improved crop yields and farm-scale income in marginal and stress-prone areas of Pakistan. Overall, being a viable, cost-effective and environment friendly approach, it is expected to be widely adopted by the farming community in the future.
Key problem(s) addressed

The rapidly increasing population, shrinkage of land and water resources, climate change, and stagnant agricultural growth are threatening the food security and livelihood of rural population. In Pakistan, approximately 6 mha area is affected by soil salinity, while 5 mha area is covered by Cholistan and Thal. The crop yields in these areas are quite low, and a big yield gap exists between the potential yields and actual yields attained at the farm level. However, these areas may contribute a significant share towards the national agricultural production and economy of Pakistan, by adopting appropriate and cost-effective technologies that support soil water conservation, reduce direct evaporation losses, enhance stress tolerance, and improve soil water balance.

Technological or innovative solutions employed

The invention/disclosure is related to synthesis of natural material based absorbents and their application in Agriculture. In this invention, absorbents are developed by de polymerization of cellulose, grafting of absorbing groups, and re-polymerization into 3D crosslinked material. Cellulose is derived from corncob that is an agro waste and cost-effective as compared to the other synthetic absorbent materials. Cellulosic decomposition is done using alkali and grafted with the chemicals containing hydroxyl groups. Grafting with absorbent groups have increased their water absorbency. Later, absorbents are 3D crosslinked to impart water retention. As an embodiment, the most important features of this invention are retaining the soil moisture and regulate the plant growth. Their application in the soil has enhanced crop establishment, Water use efficiency, nitrogen uptake, and yield.

Key outcomes and measurable impacts achieved

Water saving, Fertilizer conservation, Improved soil health, higher crop growth and productivity

Key actors and stakeholders involved in the development and implementation (please also describe to what extent a multi-stakeholder and participatory approach has been adopted)

Department of Agronomy, Academics, Private sector universities.

Challenges encountered (any types of trade-offs, and how these were managed) and/or efficiencies gained (e.g. win-win situations)

✓ Large scale production

Contact information for further inquiries

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University of Agriculture Faisalabad.

Links and additional materials
Dr. Hussain, the first Biopolymer Research & Production Center at the University of Agriculture Faisalabad for the large-scale production of plant-based polymers. Biodegradable superabsorbent polymers are being synthesized at large scale from cellulose-based agricultural materials such as rice straw, wheat straw, and corn cobs, in collaboration with different private sector industries. These polymers can absorb water up to 500 times of their weight.
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Demonstration and dissemination trials were conducted at farmers’ field on 300 acres in irrigated and rainfed areas in collaboration with different private sector companies.
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TEMPLATE for SUBMISSIONS

Global Forum on Food Security and Nutrition

www.fao.org/fsnforum

Continuous farmers’ gatherings/training programs (50 in different areas) were arranged for the dissemination of the technology.
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