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The ACIAR Sustainable Development
Investment Portfolio: Improving food,
energy and water management for
sustainable food systems in the
Eastern Gangetic Plains



98

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Sustainable Development Investment Portfolio:

**Improving food, energy and water management for
sustainable food systems in the Eastern Gangetic Plains**

Tamara Jackson, Kuhu Chatterjee, Rebecca Cotton



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Foreword

The Australian Centre for International Agricultural Research (ACIAR) was mandated, as set out in the Australian Centre for International Agricultural Research Act 1982, to work with partners across the Indo-Pacific region to generate the knowledge and technologies that underpin improvements in agricultural productivity, sustainability and food system resilience. We do this by funding, brokering and managing research partnerships for the benefit of partner countries and Australia.

The ACIAR Sustainable Development Investment Portfolio (SDIP) program was a suite of projects designed to improve the management of water, energy and food resources in 3 major Himalayan river basins – the Indus, Ganges and Brahmaputra. It was funded by the Department of Foreign Affairs and Trade and comprised more than 20 long-term and short-term projects managed by a diverse network of ACIAR research partners. The program investigated the drivers and constraints that affect the development of sustainable food systems in the wider South Asia region. The ACIAR SDIP projects used long-term, gender-inclusive and highly collaborative approaches to understand and implement strategies which increase food security while reducing environmental impacts.

The second phase of the ACIAR SDIP program sought to share Australian expertise, to build and exchange knowledge, facilitate cooperation, and help improve the effectiveness of integrated policies and programs across the region, with an investment of \$42 million between 2016 and 2021.

This ambitious program draws together the aims and results of a large array of projects. The results described in this Technical Report demonstrate the value of this approach, showing clearly that big thinking and a broad approach can deliver lasting results for smallholder farmers and their communities, now and into the future.



Andrew Campbell
Chief Executive Officer
ACIAR

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List of authors

Tamara Jackson

School of Agriculture, Food and Wine
Faculty of Sciences, Engineering and Technology
The University of Adelaide

Kuhu Chatterjee

Australian Centre for International Agricultural Research, New Delhi, India

Rebecca Cotton

Formerly Australian Centre for International Agricultural Research, Canberra, Australia

Co-contributors

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Understanding the gendered implications of changing weed dynamics in farming systems intensification in the Eastern Gangetic Plains (WAC/2018/221): Hom Gartaula, Bhavya Suri.

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Value chain and policy interventions to accelerate adoption of zero tillage in rice-wheat farming systems across the Indo-Gangetic Plains (CSE/2017/101): Adam Loch, Jay Cummins, Alec Zuo and Rohan Yargop.

Understanding women's role in agriculture in the Eastern Gangetic Plains: The macro and micro connections: Sucharita Sen, Sreenita Mondal with Abraham Daniel Raj P, Shreya Chakraborty, Suchita Jain, Soumi Chatterjee and Bibeshna Pradhan.

Political economy analysis of cross border agricultural trade in Bangladesh, India and Nepal: Aditya Pillai and Sagar Prasai.

Regional scale water impacts (WAC/2019/104): Mohammed Mainuddin, Mohammad A Mojid, Michael Scobie, Don Gaydon, Mac Kirby, Sreekanth Janardhanan, Jorge Pena-Arancibia, Sumant Kumar, Phil Davies, Erik Schmidt, Surjeet Singh, Dave Penton.

Unravelling the WEF nexus in WB, India. Does increased access to groundwater irrigation through electricity reforms affect equity and sustainability outcomes? (WAC/2019/151): Aditi Mukherji, Marie-Charlotte Buisson, Archisman Mitra, Partha Sarathi Banerjee, Sujata Das Chowdhury.

Role of groundwater in agrarian change in West Bengal and Bangladesh: A comparative analysis: Aditi Mukherji, Marie-Charlotte Buisson, Archisman Mitra, Anindita Sarkar, Yashodha Yashodha.

Quantifying crop yield gaps across the IGP from new perspectives – production, farmer profit and sustainability of water use (WAC/2018/169): Donald Gaydon (CSIRO), Balwinder Singh (CIMMYT), Apurbo Chaki.

Aquifer characterisation, artificial recharge and reuse of suddenly available water in south Bihar (WAC/2018/211): Dr Prabhakar Sharma, Dr Somnath Bandyopadhyay, Dr Aviram Sharma, Dr Kishore Dhavala.

Identifying Eastern Gangetic Plains Soil Constraints (CROP/2018/210): Neal Menzies, Abhas Kumar Sinha, Akbar Hossain, Shukra Raj Shrestha, Umesh Acharya, Ram Dalal, Peter Kopittke, Cristina Martinez, Apurbo Chaki.

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Acronyms

Shortened term	Definition
ACIAR	Australian Centre for International Agricultural Research
ASEAN	Association of Southeast Asian Nations
AUD	Australian dollar
CASI	Conservation Agriculture based Sustainable Intensification
CASPA	Conservation Agriculture Service Providers Association
CIMMYT	International Maize and Wheat Improvement Center
CO ₂	Carbon dioxide
CO ₂ -e	Carbon dioxide equivalent
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DFAT	Department of Foreign Affairs and Trade
GDP	gross domestic product
INR	Indian Rupee
NGO	Non-Government Organisation
NITI Aayog	Policy Commission, Government of India
SAARC	South Asian Association for Regional Cooperation
SDIP	Sustainable Development Investment Portfolio
SRFSI	Sustainable and Resilient Farming Systems Intensification
USD	United States dollar
VMP	Versatile Multi-crop Planter

Units

Unit	Definition
ha	hectare
kg	kilogram
km	kilometre
m	metre
t	tonne

Summary

The ACIAR Sustainable Development Investment Portfolio (SDIP) program goal is to **maximise agriculture's contribution to sustainable food systems in the Eastern Gangetic Plains**, for improved food, energy and water security. Over 8 years, the program has transitioned from understanding and promoting sustainable farming technologies based on conservation agriculture, to include the wider context of the food system and a deeper understanding of the various external factors that influence sustainable food production. ACIAR SDIP has focused on sustainable food systems as a way of integrating different sectors at a range of scales, and ensuring gender-inclusive planning processes and outcomes. The aim was to promote resilient and inclusive food systems supported by robust institutional arrangements, policies and strategic regional planning, to address the challenge of scaling sustainable and inclusive farming systems in the context of a changing food system.

In Phase 1, the Sustainable and Resilient Farming Systems Intensification (SRFSI) project tested and promoted sustainable farming systems based on Conservation Agriculture based Sustainable Intensification (CASI). This allowed work in Phase 2 to focus on what was needed in the wider enabling environment to allow these systems to be used at scale; to understand the big drivers of food systems in the Eastern Gangetic Plains, and how these impact on farming systems. In Phase 2, the ACIAR SDIP program worked with a wide range of stakeholders from policymakers and implementers, including

food policy and gender researchers to understand constraints to, and impacts of, scaling sustainable farming systems. This included deepening understanding of how institutional and social factors, markets and technologies interact to constrain or enable the adoption of sustainable intensification technologies. Additional work explored biophysical constraints such as soil and weed dynamics, and a better understanding of the context for water and energy resources management. The growing challenges of climate change, and the need to promote gender equality by empowering women and girls, are themes that were integrated in activities across the program.

Highlights from the ACIAR SDIP program include:

Scaling of CASI approaches, with an increasingly nuanced understanding of the science behind the scaling. CASI farming practices increase productivity and farm incomes, reduce labour requirements and farm level water use, and have emission reduction benefits. In total, around 120,000 farmers (25% female) are now using more productive, profitable and gender-inclusive farming systems. The cumulative impacts of this adoption over the life of SDIP includes an estimated additional AUD100 million in farm household income, 60,000 tonnes of CO₂-e mitigated and 63,000 megalitres of water saved, and positive benefits for women in households using CASI. Importantly, CASI is now integrated into state government programs and policies in West Bengal, and will continue to scale without project support.

Helping our partners to bring together the 'big picture' related to sustainable food systems through application of foresight processes in the Eastern Gangetic Plains. This work has included engaging key stakeholders in informed dialogue on the drivers and trends for regional food, water and energy security through enhanced foresight and scenario processes; synthesising the current status of key influencing factors and their potential future trajectories; and using future-focused processes at the local level as a dialogue tool to probe deeper into existing situations, and to determine future pathways for food systems transformation.

Exploring effective institutional arrangements to support sustainable food systems. A better understanding has been generated about the current alignment of policies and delivery mechanisms related to knowledge transfer, risk management, water rights, and inclusion and empowerment. Knowledge transfer to farmers, especially on new technologies, offers promise on multiple fronts, but its benefits are not universally accessible because of the delivery apparatus, with women particularly disadvantaged but (ironically) having much to gain from better transfer mechanisms (like mobile phones). Water access in the region is intimately tied to energy and the incentives for using energy differently. Leveraging diverse preferences around pumping technologies offers promise for further developing groundwater markets and widening water access. Policies that are seemingly focused on risk reduction (for example, input subsidies, energy policies) are producing perverse impacts and require a rethink in terms of how they are rolled out. Additional international support around broadening better governance and financing systems can have important benefits in agriculture. In Nepal, the Roadmaps process has proved to be an

effective institutional process connecting farmers' groups, policymakers, machinery owners and scientists to improve agricultural productivity in Province 1 and 2, which have the potential to be the food bowl of Nepal. This project addressed a key demand for mechanisms to promote coordination and develop a plan for agricultural machinery use that supports CASI technologies.

Creating new approaches to research and new knowledge which promotes a more nuanced macro and micro understanding of women's roles in agriculture in the Eastern Gangetic Plains, and the impacts of systems change. This research challenges policymakers, academics and donors to ensure they target their interventions based on an appreciation of both the macro and micro drivers which affect the success of women farmers. Several projects have contributed to a better understanding of the role of women in agriculture, highlighting the heterogeneous situation across the Eastern Gangetic Plains. A chief concern is the low female workforce participation in Bihar and West Bengal, which has declined to as little as 10% in some districts. Other work has looked at how inclusive CASI approaches are, finding that it reduces women's workloads, and offers opportunities to diversify into alternative income generating activities.

Contributing new knowledge to support sustainable groundwater development in the Eastern Gangetic Plains, using a food-energy-water nexus lens. Individual projects have looked at patterns of availability and access to groundwater, local level water management solutions (such as CASI managed aquifer recharge), and the impacts of commonly used policies that aim to influence groundwater development and sustainability. Results indicate the links are not always as expected. For example,

increased access to electricity has not resulted in a strong change in groundwater use or productivity in West Bengal; and water savings at the farm scale do not always result in reduced groundwater use overall. In the Eastern Gangetic Plains, impacts of climate change will result in delayed monsoons and increased incidence of flooding, which makes summer crops more vulnerable to water stress (both too much and too little). Groundwater resources, which in many places are annually recharged (as at least 4 ACIAR SDIP studies have confirmed), are more resilient to climate change and offer assured irrigation in the dry winter months.

Identifying options that contribute to mitigation of emissions and adaptation to climate change. CASI-based systems reduce the emissions footprint of food production systems in the Eastern Gangetic Plains by 6 to 18%. Emissions reductions vary by cropping system, and so any changes to the cropping system can have wider impacts on the carbon intensity of the agricultural sector. There is potential for significant impact if these systems are adopted widely; for example, increasing the use of CASI to 20% of the area of rice, wheat and maize systems in the Eastern Gangetic Plains would reduce carbon emissions by over 740,000 tonnes of CO₂-e. CASI systems also have a positive impact on both the amount and types of carbon present in the upper soil layers. Identifying and managing soil acidity through better management of nitrogen fertiliser also has potential to reduce emissions. Importantly, these reductions do not need to come at the expense of productivity or profitability, creating win-win situations for farmers, rural agribusinesses and governments alike, which are all struggling to find ways to adapt to climate change and reduce future levels of emissions.

Developed new knowledge on the challenges and opportunities for Nepal's food systems in the context of federalisation. The changed federal structure gives more power to local governments at the municipal level, adds a provincial level of government for facilitation and support, and changes the role of the federal government to policy, governance, knowledge and oversight issues. This restructuring brings enormous opportunities for agriculture sector services to be prioritised and managed at the local level, but a coordinated and cooperative mechanism is essential for success. Work has been undertaken to define the context, and understand priorities at different levels of government, to reach a consensus on preferred pathways towards sustainable food systems. In particular, there has been a focus on planning for sustainable agricultural mechanisation by offering a linking mechanism for one part of the agricultural system at the provincial level; and on enhancing linkages within the extension system.

The ultimate goal of the ACIAR SDIP program was to engage in applied research that promotes agricultural development in a sustainable and equitable way, so that future food systems can provide what is needed while still working within sustainable extraction limits.

