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Institutional Analysis for Agricultural Innovation: Synthesis

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Acronyms

ABTM	Assistant Block Technology Manager
ACIAR	Australian Centre for International Agricultural Research
ADMI	Accelerated Development of Minor Irrigation
AFSP	Agriculture and Food Security Programme (under BRAC)
AIMKS	All India Manab Kalyan Society
AIS	Agricultural Innovation Systems
AIS	Agricultural Information Service, Rangpur under Ministry of Agriculture
ASA	Action for Social Advancement
ATMA	Agricultural Technology Management Agency
BADC	Bangladesh Agricultural Development Corporation
BAO	Block Agricultural Officer
BARI	Bangladesh Agricultural Research Institute
BAU	Bihar Agricultural University
BGREI	Bringing Green Revolution to Eastern India
BINA	Bangladesh Institute of Nudear Agriculture (est. 1961 as nuclear tracer laboratory)
BISA	Borlaug Institute of South Asia
BMDA	Barind Multi-purpose Development Agency
BPM	Block Project Manager
BRAC	Bangladesh Rural Advancement Committee (the largest NGO in the world in 2015)
BRLPS	Bihar Rural Livelihood Promotion Society (Jeevika)
BRRI	Bangladesh Rice Research Institute
BSc	Bachelor of Science
BTM	Block Technology Manager
CA	Conservation Agriculture
CARB	Centre for Agricultural Research - Barind
CBO	Community Based Organisation
CDAP	Comprehensive District Agricultural Plan
CDHI	Centre for the development of Human Initiatives
CGIAR	Cooperative Group for International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Centre
CRISP	Centre for Research on Innovation and Science Policy
CRP	Coordinated Research Project
CSIRO	Commonwealth Science and Industrial Research Organisation
CSISA	Cereal Systems Initiative for South Asia
DADO	District Agriculture Development Office
DAE	Department of Agricultural Extension (Bangladesh)
DFAT	Department of Foreign Affairs and Trade
DoA	Department of Agriculture
DoH	Department of Horticulture
DRDA	District Rural Development Agency

DSR	Direct Seeded Rice
DTW	Deep Tubewell
EGP	Eastern Gangetic Plains
FFS	Farmer Field Schools
FIGs	Farmer Interest Groups
FLD	Front Line Demonstration
FSSM	Financial Support Scheme for Farm Mechanization
FTTF	Farmers Technology Transfer Fund
GoB	Government of Bihar
GoB	Government of Bangladesh
GoI	Government of India
GoWB	Government of West Bengal
HYV	High Yielding Variety
ICAR	Indian Council for Agricultural Research
ICARDA	International Centre for Agricultural Research in the Dry Areas
ICAR-RCER	ICAR Research Complex for Eastern Region
ICM	Integrated Crop Management (relates to DAE Farmer Clubs, Bangladesh)
ICT	Information Communication Technology
iDE-B	International Development Enterprises – Bangladesh
iDE-I	International Development Enterprises - India
IFM	Integrated Floodplain Management (relates to DAE Farmer Clubs, Bangladesh)
INGO	International Non Government Organisation
INM	Integrated Nutrient Management
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
ISOPOM	Integrated Scheme of Oilseeds, Pulses, Oil palm & Maize
IWMI	International Water Management Institute
IWMP	Integrated Watershed Management Program
JLGs	Joint Liability Groups
KCC	Kissan Credit Card
KGF	Krishi Gobeshona Foundation (Government sponsored NGO, est. 2007, Bangladesh)
KPS	Kisan Proyukti Sahayaks
KVK	Krishi Vigyan Kendra (Farm science centre)
LGRDC	Ministry of Local Government, Rural Development & Co-operatives (Bangladesh)
LSP	Local Service Providers (Bangladesh)
MoA	Ministry of Agriculture (Bangladesh)
MoU	Memorandum of Understanding
NABARD	National Bank for Agriculture and Rural Development
NAIP	National Agricultural Innovation Project
NARC	Nepal Agricultural Research Council
NFSM	National Food Security Mission
NGO	Non Government Organisation
NHM	National Horticultural Mission
NICRA	National Initiative on Climate Resilient Agriculture
NMMI	National Mission on Micro Irrigation

NP	National Portal
NRLM	National Rural Livelihood Mission
OAZ	Old Alluvial Zone
OFT	On Field Trial
PACS	Primary Area Co-operative Society
PC	Program Coordinator
PD	Project Director
PODF	Producer Organisation Development Fund
PRIs	Panchayati Raj Institutions
PROVA	PROVA Society NGO (Bangladesh)
PTOS	Power Tiller Operated Seeder (Bangladesh)
R&D	Research & Development
RAU	Rajendra Agriculture University
RCHSS	Rajadighi Community Health Service Society
RDA	Rural Development Academy, Bogra (Bangladesh)
RDRS	Rangpur-Dinajpur Rural Services
RI	Research Institution
RIB	Research Initiative Bangladesh, Nilphamari (in charge of a CSIA hub)
RIDF	Rural Infrastructure Development Fund
RKVY	Rashtriya Krishi Vikas Yojana
RRSS	Regional Research Sub Station
RWC	Rice Wheat Consortium
RWRC	Regional Wheat Research Centre (Rajshahi)
SAAO	Sub-Assistant Agricultural Officer of DoE (Bangladesh)
SAO	DAE Agricultural Officers working at Union level
SCI	System of Crop Intensification
SHGs	Self Help Groups (women only)
Sms	Short Message Service
SMS	Subject Matter Specialist
SRFSI	Sustainable and Resilient Farming Systems Intensification
SRI	System of Rice Intensification
STW	Shallow Tube Well
SWI	System of Wheat Intensification
TAWS	Toofanganj Anwesha Welfare Society
UBKV	Uttar Banga Krishi Vishwavidyalaya
UF	Union Federations of RDRS
VOs	Village Organisations
VRP	Village Resource Person
WELP	Women Empowerment and Livelihood Program
WM	Water Management
WRC	Wheat Research Centre (Dinajpur)
WUE	Water Use Efficiency
ZT	Zero tillage

Executive summary

This Internal Discussion Paper presents a synthesis of an Institutional Analysis conducted by CRISP under the auspices of CSIRO and the Food Systems Innovation project for the benefit of the broader *Sustainable and Resilient Farming System Intensification* (SRFSI) project. SRFSI aims to intensify agricultural production of the alluvial Eastern Gangetic Plains (EGP) that span India, Nepal and Bangladesh. The project is funded through Australian Aid via ACIAR and DFAT.

SRFSI is focused on raising the productivity of the rice/wheat farming systems characteristic of the EGP with Conservation Agriculture (CA) practises by introducing higher yielding shorter duration varieties to increase cropping intensity to three crops per year, and CA machinery that reduces inputs (labour, water, seed) while improving soil fertility by retaining and planting into crop residues. These technologies are largely proven and uncontroversial, although they need to be adapted to the local social-ecological systems within the EGP.

The aim of this Internal Discussion Paper is to synthesise a series of four detailed reports that cover two districts each within the four jurisdictions where the SRFSI project is being conducted. CRISP were commissioned to undertake an analysis of the current and possible institutional arrangements for scaling out intensification of smallholder farming systems in each District.

Documentary analysis and 159 key informant interviews were used to generate the reports which detail the constraints and opportunities for scaling out. A World Bank *Agricultural Innovations Systems* approach was used to characterise the landscape of actors, their capacities and limitations and to use this information to diagnose the bottlenecks and entry points for scaling out the intensification of smallholder farming systems with adapted CA technologies.

Key findings from each jurisdiction are:

Terai of Nepal (Sunsari and Dhanusha Districts)

- Sunsari District enjoys a better enabling environment compared to Dhanusha, which is more remote from services, has less sanitation and irrigation infrastructure as well as poor roads. Sunsari District contains the Koshi River irrigation infrastructure, a wide range of public organisations involved in agriculture and a strong urban market pull.
- Coordination of agricultural actors within and between the public, private and civic sectors is poor and is more severe in Dhanusha than Sunsari District.
- There is little coordination between public and private sector agricultural actors. There has been rapid growth of private sector agrovets who are the main source of inputs for farmers. However, given the open border with India and lack of regulatory oversight of input quality, the supply of quality seed is problematic. There are few Department of Agriculture (DADO) technical officers, extension is limited.
- DADO's training centres for technicians and lead farmers form a potential entry point for scaling SRFSI technologies.

West Bengal (Malda and Coochbehar Districts)

- West Bengal is characterised by a rich array of relevant organisations whose various endeavours are highly fragmented. There is a lack of strategic vision and a functional platform to exchange organisational information and learnings. There is little interaction among agency staff below the district level and training is not provided to staff introducing a new scheme, program or project.
- There are some strong community-centric and well connected NGOs. Farmer Clubs are increasingly recognised as an important platform for farmer-to-farmer interaction and knowledge transfer. However the DOA, university, research station and NGOs are independently funded and function in isolation.

Bihar (Madhubani and Purnea Districts)

- Bihar is generally characterised by an entrenched, feudal agrarian structure with a history of political disruption and the breakdown of law and order. Rural development became possible again in 2006 when a range of new initiatives were begun.
- Bihar's institutional landscape is characterised by strong women and poor-centric NGOs that have established extensive social infrastructure in the form of self-help groups. The NGO Jeevika is well connected to all other actors, but there is little interaction or coordination of effort between organisations and no joint or collaborative activities.
- Purnea has better irrigation and marketing infrastructure than Madhubani and significantly more cash cropping (e.g. maize and banana) because of the Kosi surface water irrigation scheme. Extension services are few, have limited budgets and staff, and offer little mechanisation expertise. The vast majority of Madhubani's farmers are tenant sharecroppers without limited access to capital or resources. Only 30% of the district is irrigated.

Northwest Bangladesh (Rangpur and Rajshahi Districts)

- Northwest Bangladesh became a food surplus area following partitioning and a war of independence from Pakistan. Given that both events were entwined with widespread displacement, communal violence and famines, this is in itself extraordinary. However, these gains are currently eroding in the face of population growth and groundwater depletion. Both Districts lie within the upland Barind Tract which is heavily reliant on groundwater using deep tubewells for irrigation and other purposes.
- Agricultural operations are highly mechanised, a result of the liberalisation policies that followed independence that encouraged cheap imports of small scale machinery from China. There are strong research institutes and NGOs, but further strengthening will stimulate synergies. Policy support is required.

In summary, the overarching constraints are:

- There have been several isolated pockets of good CA research, but only small areas of influence. The need to connect CA knowledge and expertise situated in the (publicly funded) research sector to the mass of smallholders and sharecroppers is (and will continue to be) incompletely addressed by the formal (publicly funded) extension sector.

- There are few extension officers. However, an entry point for countering the limited public sector engagement of the mass of the EGP's smallholders and sharecroppers is through an extensive social infrastructure (public sector and NGO farmer groups, Self Help Groups etc).
- Widespread CA adoption requires more functional input markets whereby quality seed, fertiliser, herbicide, CA machinery and services reaches smallholders and shareholders in a timely manner at a reasonable price because private sector agents find it profitable to supply them.
- The organisations relevant to achieving that impact are: distributed across the public, civic and private sectors; are independently funded; and function in isolation.
- There is a lack of strategic vision and a functional platform to exchange organisational information and learnings and drive CA policy and programming in the four jurisdictions. As the CRISP reports on which this synthesis is based indicate, the utility of multi-stakeholder forums to better coordinate this pluralism is already recognised.

It is anticipated this Discussion Document will provide input into the other reports on:

- Node characterisations
- Irrigation access report
- Water resources Assessment (for sister project CSE/2013/099)
- Monitoring and Evaluation of SRFSI Innovation Platforms at the District and Node level.

1 Background

1.1 SRFSI project context

The Sustainable and Resilient Farming System Intensification (SRFSI) project aims to intensify agricultural production of the alluvial Eastern Gangetic Plains (EGP) that span India, Nepal and Bangladesh. The focus is on raising the productivity of the rice/wheat farming systems characteristic of the EGP with Conservation Agriculture (CA) practises by introducing higher yielding shorter duration varieties to increase cropping intensity to three crops per year, and CA machinery that saves reduces inputs (labour, water, seed) while improving soil fertility by retaining and planting into crop residues. These technologies are largely proven and uncontroversial, although they need to be adapted to the local social-ecological systems within the EGP.

SRFSI's agronomic methodology is straightforward: run regional and local participatory on-farm CA trials within five villages per district, in two districts each of the Indian states of Bihar and West Bengal, Northwest Bangladesh and the eastern Terai plains of Nepal. SRFSI has 40 research sites in total. How to ensure development impacts resulted from this methodology, however, has been more contested.

Consequently, the SRFSI proposal went through several iterations in the mid- 2013 to end of 2014 period. These iterations were undertaken by a core writing team (Table One) and continued beyond project inception in July of 2014. These iterations concerned the attempt to better integrate the institutional and technological aspects of SRFSI to support better development impact (scaling) during and after the project.

Table 1 Core SRFSI proposal writing team

Organisation	Key persons	Expertise
ACIAR	Dr John Dixon (Research Program Manager)	Research project design & management
CIMMYT	Dr Mahesh Gathala (SRFSI Project Leader) Dr Pat Wall (ex CIMMYT Consultant)	Agronomy in South Asian context Research project design & management
CSIRO	Dr Toni Darbas (Research Scientist, Adaptive Social and Economic Sciences Program) Dr Peter Brown (Senior Research Scientist, Agriculture & Global Change Program)	Agrarian and institutional change in South Asian context, gender, scaling Natural Resource Management & farming systems
UNE	Dr Julian Prior (Senior Lecturer, School of Environmental & Rural Science)	Extension & scaling

SRFSI has a short and long term scaling targets. The short term target of improving the livelihoods of 8,000 men and women farmers within the project timeline (2014–2018) is challenging for two reasons. Firstly, SRFSI is targeting the small and marginal farmers, including share-croppers, who lack productive assets and bargaining power due to the historically feudal social structures of the EGP. Secondly, the project is targeting women farmers in response to male labour outmigration and the resultant feminisation of agriculture characteristic of the EGP's pattern of agrarian change.

SRFSI's long term target of improving the livelihoods of 3.5 million by 2028 (which is contingent on an as yet unfunded scaling component of SRFSI), means the project needs to act as a catalyst for institutional change. The project's composition of 22 diverse partners seeks to negotiate more integrated and coordinated effort among the multiple organisations involved in agriculture and rural development distributed across the public, civic and private sectors. The use of Innovation Platforms (multi-stakeholder forums) to encourage inter-organisational and inter-sectoral collaboration and coordination, is a major theme of the SRFSI proposal, and the iterations of a scaling variation to the proposal seeking to strengthen the project's development impact.

1.2 Innovation Systems Thinking

A key strategy underpinning these ambitions was the adoption of the Agricultural Innovation System (AIS) paradigm, viewed as a corrective to the shortcomings of the traditional linear transfer of technology (ToT) paradigm. AIS conceptualises agricultural research as part of a system of innovation. An innovation system refers to all the actors and factors involved in the action and governance of producing, diffusing, adapting and enabling the use of knowledge for productive purposes. In these terms, the capacity to innovate is not a function of the skills and resources of individuals and organisations or even the sum of these skills and resources. Instead it relates to the behaviour of the system as a whole, and is an emergent property of the system, where the total is greater than the sum of its sub-systems.

The AIS paradigm is supported by the World Bank, and the 'research into use' international agricultural development projects associated both with DFID and the Netherland's Wageningen University. AIS principles have emerged from decades of agricultural research and technology promotion experiences (Biggs & Clay 1981, Biggs, 1990, Byerlee & Alex 1998, Chambers & Ghildyal 1985, Hall et al 2002, Hall et al, 2007, World Bank 2006a, World Bank 2006b), which can be distilled as follows:

- Despite emphasis on establishing specialised research centres for developing agricultural technologies, success rarely occurs unless technology users are consulted and involved in the R&D process from an early stage;
- Technology development is a relatively small component of the larger process of technology production, supply and use (i.e. the entire innovation process) and technical change often requires complementary changes in production and marketing;
- Consequently, interaction between diverse players, who embody different information and skills, is necessary for innovation to occur;
- While innovation may involve radical technical changes such as a new crop variety, animal breed or machine, it usually arises from a series of incremental changes (tinkering, adaptation and creative imitation) in technology, organisation and strategy;
- Technology extension needs to adapt to the agricultural, market and livelihood conditions prevailing in specific contexts at specific points in time: in other words, there is no one-size-fits-all recipe. Context specificity means local processes of experimentation and learning assume great importance for innovation;

- It is the institutional context of technology development/ promotion initiatives (i.e. combinations of organisations, and the roles, routines, rule sets and associated ways of working) that determine the extent to which these wider adaptation and learning processes operate effectively and thus whether or not innovation is enabled.
- If the welfare of poor households is to be addressed via innovation, institutional and governance innovations, further to technological innovations, are usually required.

The Centre for Research on Innovation and Science Policy (CRISP), located in Hyderabad India, was duly commissioned by the funding body ACIAR to provide AIS training to the project partners in late 2013. Additional capacity building exercises were also undertaken with eight of SRFSI's socio-economists in Australia via the Food System Innovation (FSI) Project (see http://foodsystemsinnovation.org.au/), a partnership between CSIRO, DFAT and ACIAR. An FSI Symposium was held in June 2014, immediately before SRFSI's inception, and training provided on AIS related topics such as Theory of Change versus Logical Framework thinking, Nutritionally Sensitive Agriculture, Pro-poor value chains, organisational partnering and inter-organisational communication. Subsequent training on Innovation Platforms was provided in-country to the SRFSI staff in late 2014.

Beyond capacity building, however, there was concern that SRFSI also needed a concrete benchmark of the institutional arrangements for irrigated agriculture in each of the eight SRFSI districts.

1.3 The CRISP consultancy & methodology

CRISP were then commissioned to undertake an analysis of the current and possible institutional arrangements for scaling out intensification of smallholder farming systems in each district. The contract specified that a documentary analysis and key informant interviews be used to generate four reports (one for each jurisdiction) to detail the constraints and opportunities for scaling out in relation to the following:

- Access to irrigation waters, including of surface, ground and pond waters, price and timeliness of delivery;
- Access to finance/credit institutions, including risk insurance;
- Access along the value chain to input suppliers;
- Terms of access to public and private marketing agents and markets;
- Availability and quality of extension services;
- Strength and orientation of NGOs involved in developing value chains for smallholders, including those focused on empowering women; and
- Strength and orientation of smallholder groups and associations.

CRISP researchers adapted the four guiding questions for diagnosing innovation capacity contained in the World Bank report Enhancing Agricultural Innovation (2006b) as a common methodology to benchmark these constraints and opportunities (or bottlenecks and entry-points):

1. What actors and organisations are relevant for agricultural innovation (e.g. researchers, farmers, development organisations, cooperatives, agricultural input and output market enterprises), and what role do they play (e.g. technical knowledge, social mobilization, value addition)? Do any act as intermediaries that link organisations to foster coherence within the wider system, perform a policy advocacy function or play a catalytic role in change?
2. What patterns of interaction exist between different players, key groups and organisations (e.g. isolated, linked well integrated), and what does this pattern of interaction deliver (e.g. information exchange, developmental interventions)?
3. What are the habits, traditions, routines, practices and policies driving organisational behaviour that limit or ease interactions ending in the transmission and use of knowledge and innovation?
4. What are the key challenges and opportunities (e.g. technical, policy, market, environmental) being faced by the system's actors and organisations and have they reconfigured their patterns of interaction to meet these challenges? What has prevented or enabled such re-orientation and reconfiguration?

The studies sought to characterise the landscape of actors, their capacities and limitations and to use this information to diagnose the bottlenecks and entry points for scaling out the intensification of smallholder farming systems with adapted CA technologies. Desk reviews, interviews with a range of agricultural actors at the district scale and observation of field settings were combined. The available institutional analyses of agricultural organisations and their interaction were reviewed to understand the past and present activities of agricultural organisations, mandate and role and strengths and weaknesses. Relevant policy documents were reviewed to assess the policy priority and actor roles in agricultural intensification.

Key informants were selected on the basis of their involvement in agriculture intensification in each of the eight districts with the aim of capturing the views of a diverse set of actors. The initial interviews with selected key informants permitted snowballing, the elicitation and nomination of further relevant informants, who were then subsequently interviewed. The total number of informants interviewed is 159, with a range of 13 to 30 interviews per district (Table 2).

Table 2 Interviewee Sample Summary

Jurisdiction	District	No. of interviews
West Bengal	Malda	27
	Coochbehar	30
Bihar	Purnia	19
	Madhubani	26
Bangladesh	Dinajpur & Rangpur	26
Nepal	Dhanusha	17
	Sunsari	14
Total		**159**

The organisations from which the key informants were drawn is provided in Appendix 1.

It could be considered a weakness of the methodology that it assumes inter-organisational interaction can result in a more productive AIS overall and does not enquire into the transaction costs of interaction (which are only implicitly treated as a barrier). Nor does the study consider alternate methods of achieving vertical and horizontal coordination within an AIS other than (implicitly personal) interaction.

A presentation based on the draft reports was given by CRISP Director Rasheed Sulaiman at the SRFSI July Inception Meeting in July 2014.

In March, 2015, the studies were provided to the in SRFSI Innovation Platform training as part of their training materials. During Innovation Platform training provided over a day in Bihar, West Bengal, Bangladesh (only two hours due to civil unrest preventing travel to the SRFSI districts), a summary presentation was given to the participants on the relevant report by CSIRO (either Toni Darbas or Peter Brown). The presentations grouped the agricultural actors identified by CRISP by sector (public, private and civic), a technique used also in this synthesis report. The purpose of this session was 'ground-truthing': to check the accuracy of the report's information with SRFSI's jurisdictional teams. This exercise resulted in the addition of relevant organisations and nuanced commentary to the CRISP reports (indicated by red text). However, on the whole, the SRFSI's jurisdictional teams were satisfied that the reports were both accurate and relevant.

It may assist the reader of this report to be familiar with the terms used for administrative units in the three countries, summarised below in Table 3.

Table 3 Administrative unit terms

Country	Sub-national	Sub-state/ division	Sub-district	Sub-Block/ VDC/Upzilla	Sub-village/ union
India	State	District	Block	Village	Tola (traditionally caste specific)
Nepal	State (est. by first constitution, 2015)	District	Village Development Committee (VDC)	Village	Tola
Bangladesh	Division	District	Upzilla	Union	Village

2 Summary of Key Findings

2.1 Eastern Terai Plains of Nepal: Dhanusha and Sunsari Districts

Nepal is a young, post-conflict and fragile democracy. Nepal's deeply feudal history and rapid agrarian change makes it prone to renewed clashes of interests between its numerous ethic groups. As it possesses one of the most rugged terrains on earth, natural disasters such as earthquakes, landslides, glacial lake outbursts and flooding are also common. Social cohesion on the Terai plains is particularly fragile given its deforestation and agricultural development from the 1960s to 1980s that was followed by a Maoist insurgency from 1996 to 2006.

Three broad observations were made by the CRISP study on the operating environment for SRFSI in Nepal's eastern Terai districts of Dhanusha and Sunsari. Firstly, Sunsari District enjoys a better enabling environment compared to Dhanusha, which is more remote from services, has less sanitation and irrigation infrastructure as well as poor roads. Sunsari District contains Koshi River irrigation infrastructure, a wider range of public organisations involved in agriculture (see Tables 4 and 5 below) and enjoys strong urban market pull.

Table 4 Dhanusha organisations involved in promoting agriculture

Public	Government Organization (Research & extension) • District Agriculture Development Office (DADO) • District Development Committee (DDC) • District Livestock Service Office • Regional Agriculture Training Center • Fisheries Development &Training Center • Agriculture Research Station (NARC) • Division Irrigation Office		Government Projects (Research & extension) • Agriculture Development Project-Janakpur • National Rice Research Program • Community Groundwater Irrigation Sector Project
Civic	INGOs: • IDE-Nepal • CARE Nepal	NGOs: • Janaki Women Awareness Society • Rural Reconstruction Nepal • Udyam Bikash	Community & Farmer Organisations • Mithala Jilla Krishak Samhuha • Cooperatives • Farmer Groups
Private	Input suppliers • Tractor Dealers (12) • Rice-Wheat Dealers (8-10) • Pipe Dealer (5-6) • Agro-Vet (Wholesale = 94-5) • Agro-Vet (Retailers =100)		Credit Agencies (48) • Regional Agriculture Development Bank • Gramin Bikash Bank

Secondly, coordination of agricultural actors within and between the public, private and civic sectors is poor. Nepal's Agricultural Extension Strategy of 2007 pursues plural, private and decentralised extension services. However, there is resistance to this policy shift and conflicting views on how the District Agriculture Development Office (DADO) and District Development Committee (DCC) should work together. This problem is more severe in Dhanusha than Sunsari District. The linkage between research and extension is weakened by the stronger accountability

of agricultural researchers to their national (head office) agencies than to district stakeholders. The Nepal Agricultural Research Council (NARC) led National Agriculture Technical Working Group (NATWG), arguably a promising Innovation Platform or multi-stakeholder forum for progressing agricultural intensification, operates at the national, regional and district levels. However, the NATWG is not yet a solution to bottlenecks in the AIS because it only meets annually.

Thirdly, there is little coordination between public and private sector agricultural actors. Under economic liberalist settings, there has been rapid growth of private sector agrovets who are the main source of inputs for farmers. However, given the open border with India and lack of regulatory oversight of input quality, the supply of quality seed is problematic. The private sector does not currently provide smallholder adapted CA machinery and addressing this gap requires an initial public sector push. Small and marginal farmers' access to pump-sets is confounded by poor coordination between numerous irrigation agencies, as well as conflicting economic signals due to a variety of irrigation equipment subsidies in addition to market prices. Smallholder access to credit is poor as banks are reluctant to lend to those lacking substantive assets.

Table 5 Sunsari organisations involved in promoting agriculture

Public	Government Organization (Research &Extension) • District Agriculture Development Office (DADO) • District Development Committee (DDC) • District Livestock Development Office • District Forest Office (DFO) • Cooperative Development and Training Division Office • Regional Agriculture Training Centre • Regional Agriculture Research Centre (NARC) • Division Irrigation Office • Resham Farming Development Office • Regional Soil Test laboratory • Regional Seed Test laboratory • National Seed Company • Agri-input Company		Government Projects (Research & extension) • Sunsari Morang Irrigation Project • National Jute Research Program
Civic	INGOs (3 main) • Plan Nepal • Word Vision Nepal • United Mission to Nepal	NGOs (7 prominent) • LIBIRD • Forward Nepal • Rural Reconstruction Nepal • Save the Earth • Janhit Guthi • Sahara Nepal • RSDC Devangang	Community & Farmer Organizations • Cooperatives • Farmer Groups
Private	Input suppliers • Tractor Dealers (12) • Rice-Wheat Dealers (8-10) • Pipe Dealers (5-6) • Agro-Vet (Wholesalers, approximately 8-10) • Agro-Vet (Retailers, approximately 200)		Credit Agencies (30) • Agriculture Development Bank • Commercial Banks

Twenty six of DADO's 46 staff are technical officers, with each servicing two to three VDCs of approximately 5,000 households each. DADO's extension is limited to the distribution of minikits

including improved seed to households. As there is limited interaction between DADO, NGOs and agribusinesses, neither NGOs or agribusinesses have been approached as possible extension agents. National scale agricultural projects are accountable to Nepal's Department of Agriculture (DoA) and Ministry of Agriculture and Cooperatives (MOAC) and do not collaborate with DADO. A consequence is limited and duplicated seed production is undertaken by NARC, the national projects, research stations and farmer groups. Agrovets, the main providers of seeds to farmers, thus continue to sell untested and unregistered seeds obtained from India. However, DADO's training centres for technicians and lead farmers form a potential entry point for scaling SRFSI technologies.

DADO has begun engaging agrovets, Community Based Organisations (CBOs) and NGOs to increase their outreach to farmers, and farmer cooperatives have emerged as extension agents. DADO is also engaged in a CA project in the wheat growing VDCs, but no NGOs have yet been involved in this effort. The DCC has an Agricultural Development Officer to help link agricultural projects, but no link from these projects to NARC research stations has yet been established. NGOs such as LiBIRD, FORWARD and Rural Reconstruction Nepal run operations in Sunsari and could be approached by SRFSI. There is precedent in the Creative Youth NGO organising training with DADO and the Regional Agricultural Research Station.

2.2 West Bengal State of India: Malda and Coochbehar Districts

West Bengal was the centre of very strong peasant movements following the Bengal Famine, which Amartya Sen famously analysed as a failure of entitlement not food availability (Sen, 1981). Due to determined efforts to redistribute land and formalise tenant rights, West Bengal has the flattest social structure of the SRFSI districts; more people own land but own highly fragmented and very small holdings. West Bengal has a strong post-Independence history of public sector support of smallholders as well as local uplift NGOs. West Bengal's institutional landscape could be described as being as densely populated and fragmented as its alluvial plains. The operating environment for SRFSI in West Bengal is characterised by a rich array of relevant organisations whose various endeavours are highly fragmented.

There is a lack of strategic vision and a functional platform to exchange organisational information and learnings. Like Nepal, India has established a co-ordination mechanism in the form of the Agricultural Technology Management Agency (ATMA), which could be described as a multi-scaled Innovation Platform. ATMA has so far failed to achieve 'operational convergence among line agencies', however, the program is currently being re-funded and staffed. ATMA is meant to resolve the limitations of top down district agricultural development programs designed by West Bengal's Department of Agriculture (DoA). The DoA is understaffed, experiences long delays in budget release missing the cropping season in which the activities were meant to be implemented and struggles to source new varieties when they are needed for trial and demonstration. These top-down public sector routines and practices means little interaction among agency staff occurs below the district level and training is not provided to staff introducing a new scheme, program or project.

Table 6 Malda organisations involved in promoting agriculture

Public	Government Organization (Research & extension) • Department of Agriculture • Department of Water Resources • Agricultural Technology Management Agency (ATMA) • UBKV (West Bengal Agricultural University) • KVK (UBKV, ICT, extension, training) • RRSS Manikchak (UBKV Research Station, Old Alluvial Zone) • NABARD • Panchayat (rural infrastructure)	Government Projects (Research & extension) • National Initiative on Climate Resilient Agriculture (NICRA) • Bringing the Green Revolution to Eastern India (BGREI) • National Rural Livelihood Mission (NRLM) • Rashtriya Krishi Vikas Yojana (RKVY) • Integrated Scheme of Oilseeds, Pulses, Oil palm & Maize (ISOPOM),
Civil	NGOs: • AIMKS (All India Manab Kalyan Society) • RCHSS (Rajadighi Community Health service Society)	Community & Farmer Organizations • NABARD Farmers Clubs (189, 100 active) • AIMKS has 200 SHGs, 5 Farmer Clubs & 11 Gram Panchayats • RCHSS has 842 SHGs
Private	Input suppliers • Machinery Suppliers (2 wholesale, 40-50 retail) • Private Input dealers (2000 at district, block & village levels) • Market intermediaries (output sales)	Credit Agencies (48) • Banks (16 Commercial & 98 branches) • Primary Area Co-operative Society (PACS)

Although it is recognized that ICT outreach to farmers is needed and Kissan Call centers have been established, they are not yet functional. DoA and Krishi Vigyan Kendra (KVK) farm science centre staff strength is poor with unfilled positions common. Both the DoA and KVKs are poorly linked to West Bengal's Department of Water Resources. There are multiple uncoordinated community seed production efforts as well as multiple organisations promoting ZT which generates overlaps and leaves gaps. Nonetheless, CA equipment hire hubs are beginning to be established in both the public and civic sectors and the DoA provides pump set subsidies.

Malda District (Table 6) enjoys strong community-centric and well connected NGOs such as the Rajadighi Community Health service Society (RCHSS) and All India Manab Kalyan Society (AIMKS), which between them have a strong social infrastructure in the form of more than 1,000 Self Help Groups (SHGs) of poor rural women. Similarly, the National Bank for Agriculture and Rural Development's (NABARD) Farmer Clubs are at the forefront of agricultural development, and interact with NGOs, KVK, West Bengal Agricultural University (UBKV) and its research stations, the DoA, banks and farmers. Farmer Clubs are increasingly recognised as an important platform for farmer-to-farmer interaction and knowledge transfer. However the DOA, university, research station and NGOs are independently funded and function in isolation.

These observations apply equally to Coochbehar (Table 7) where Farmer Clubs at the forefront of agricultural development, interact with NGOs, KVK, UBKV, DoA, NABARD, Banks and farmers and are increasingly recognised as a platform for farmer-to-farmer interaction and knowledge transfer. Relevant NGOs in this district include the Centre for Development Human Initiatives (CDHI), which is experienced with developing and promoting water management technologies and also run Mistri (mechanic) Co-operatives. Satmile Satish specializes in community mobilization for agricultural development and has established an implements hub to make CA attachments to two

and four wheel tractors available for hire. As in Malda, multiple CA activities are run by NGOs, UBKV, KVK, NABARD and DoA, but are not coordinated.

Table 7 Coochbehar organisations involved in promoting agriculture

Public	Government Organization (Research & Extension) • Department of Agriculture • Department of Water Resources • ATMA • UBKV (West Bengal Agricultural University) • KVK (UBKV ICT, extension, training) • NABARD • Panchayat (rural infrastructure)	Government Projects • National Initiative on Climate Resilient Agriculture (NICRA) • Bringing the Green Revolution to Eastern India (BGREI) • National Rural Livelihood Mission (NRLM) • Jute mini mission II • All India Coordinated Research Project on Wheat & Barley
Civil	NGOs • Centre for development Human Initiatives (CDHI) • Satmile Satish Farmers Club • Toofangani Anwesha Welfare Society (TAWS), works with (SHGs: 198), (Farmer Clubs: 14), (producer organisations:4)	Community & Farmer Organizations • NABARD Farmers Clubs (600, 200 active), Joint Liability Groups (2,500), Self Help Groups (37,000) & Farmers' Club Association
Private	Input suppliers/output marketers • 1,500 wholesalers registered with DoA • Fertilizer & Agri Input dealers association sub-units in 11 blocks • Market intermediaries (183 rural haats)	Credit Agencies • Banks (141 branches) • Primary Area Cooperative Society (PACS) (184; 84 dormant)

2.3 Bihar State of India: Purnea and Madhubani Districts

Bihar's political history, like West Bengal's, has been volatile but did not involve widespread land redistribution of large Zamindar estates or prosecution of rights for the tenants that worked them. However, pockets of rural development have occurred in the north of Purnea District which was extended a Green Revolution package in the late 1960s. This arose from the construction of the Kosi surface water irrigation scheme that spans the Indian/Nepalese border in conjunction with Intensive Agricultural Area and High Yielding Varieties Programs (Clay, 1982; Ladejinsky, 1969). The bamboo shallow tubewell (STW) technology was invented in Bihar as a result, although its widespread uptake occurred first in Bangladesh due to more conducive policy settings. Consequently, Purnea has better irrigation and marketing infrastructure than Madhubani and significantly more cash cropping (e.g. maize and banana).

Despite this, Bihar is generally characterised by an entrenched, feudal agrarian structure that has generated regular outbreaks of violence. Discontent eventually welled up through political representation of Muslim and 'backward castes' during the Laly Prasad Yadav era (1990-2005), during which time law and order broke down completely.

Rural development became possible again in 2006 under National Democratic Alliance governments. Jeevika was inaugurated by the State Government in late 2006 as the innovative Bihar Rural Livelihoods Project (BRLP) with World Bank funding of US$63 million in six districts, including Madhubani and Purnea. Agriculture was again prioritised with Agriculture Road Maps in

2008 and 2012. The BRLP has now been scaled up state wide under the National Rural Livelihoods Mission (Datta, 2015). Jeevika is an experiment in hybrid governance. It operates in an NGO modality to uplift poor rural women through SHGs that qualify for grants and loans by establishing a group saving record. It has been 'mainstreamed' within Bihar's Department of Rural Development, and is underpinned by a second tranche of World Bank funding. Jeevika has approximately 250 staff in Purnea and 280 in Madhubani in addition to the large number of its community cadres (Village Resource Persons, Master Resource Persons, community mobilisers and community co-ordinators). It works closely with local NGOs in both districts, including Digital Green, an NGO that makes agricultural videos in local dialects.

Bihar's institutional landscape is thus characterised by strong women and poor-centric NGOs with that have established extensive social infrastructure in the form of SHGs. The older SHGs are better connected and resourced, indicating the program is successful. Bihar also has an array of research institutions: Bihar Agricultural University (BAU); the Borlaug Institute of South Asia (BISA); Rajendra Agriculture University (RAU); and Indian Council for Agricultural Research - Research Complex for Eastern Region (ICAR-RCER). There is some tension between the NGOs (including Jeevika) and the research institutes in that the former extend the system of rice and wheat intensification (SRI/SWI) to farmers, while the latter consider this technology discredited in agronomic and economic terms.

Apart from Jeevika, the DoA is the central actor in Bihar but suffers the same limitations as in West Bengal. The department is limited by the unavailability of timely, quality seed, not all Block Agricultural Officer positions are filled, and it deals with titled land owners rather than the mass of tenant sharecroppers. DoA tubewell subsidies are restricted to land-owners of more than half an acre (although this can have flow on effects in that the tubewell can irrigate two acres).

In Purnea specifically (Table 8), the KVK has an extension mandate, holds Kissan choupals (farmer workshops), and has infrastructure in the form of the Jalalgarh Research Station. However, KVK's remote location restricts extension services to surrounding villages due their limited budget and staff. Neither do KVK have any farm mechanisation expertise. Jeevika works closely with local NGOs Digital Green and Action for Social Advancement (ASA) which works with women on water harvesting structures (tanks). ATMA serves as a platform for coordinating the activities of line departments relevant to agriculture and dispenses funds for some extension activities, but as in West Bengal, has no staff. Beyond Jeevika, which is well connected to all other actors, there is little interaction or coordination of effort between organisations and no joint or collaborative activities.

The vast majority of Madhubani's farmers are tenant sharecroppers without limited access to capital or resources. Only 30% of the district is irrigated, which may be why the DoA believes that CA has been demonstrated but was not popular as it is difficult to control planting dates and seed germination when relying on rainfall. Jeevika and DoA are the main actors. DoA experiences a high attrition of their 325 Kisan Salahkars (para extension workers) who are poorly renumerated and need capacity building.

Unlike Purnea, Madhubani's ATMA has a dedicated Director and Deputy and as yet unfilled Block Technology Manager positions. ATMA has also formed 21 Farmer Interest Groups in the district (one for each block) with whom it has conducted training but not on CA. A major local NGO Sakhi, like Jeevika works only with poor, marginalised women via SHGs and is focused upon fish

production. Sahki has 60 staff and community cadres and links with gram Panchayats. NABARD has adopted 2 Gram Panchayats, is linked to Jeevika program and offers a 40% subsidy on tubewell. The KVK is administered by an NGO, relies upon ICAR funding and has good training facilities, but is restricted to extension to its surrounding 'adopted' villages due to insufficient staff. RAU is an important facility for producing new seed varieties and, again, provides extension to surrounding villages. As in Purnea, apart from Jeevika which is well connected to all agencies, little interaction or coordination of effort currently occurs between actors (Table 9).

Table 8 Purnea organisations involved in promoting agriculture

Public	Government Organization (Research & extension) • Department of Agriculture • Department of Horticulture • Department of Water Resources (canal only) • Jeevika (now under Dep.t of Rural Dev.) • ATMA • Bihar Ag. Uni.: KVK, Jalalgarh Station & Sabour College • Panchayet – rural infrastructure/development • District Rural Dev. Agency (solar pumpsets) • District	Government Projects (Research & extension) • DoA responsible for RKVY, NFSM & BGREI (implemented via MKSP) • DoH resp. for National Horticultural & Micro-irrigation Missions • Jeevika implements BRLPS & NFSM • Grameen Vikas Trust, Navratan Hatta, District Project Office – wasteland utilisation, soil & water conservation with 550 HHs
Civic	NGOs: • Action for Social Advancement (ASA) implements part of BRLPS	Community & Farmer Organizations • Jeevika's women SHGs (15,237) & village organisations (894)
Private	Input suppliers • District, block & village input retailers (wholesalers registered with DOA) • Rajkumar Agro Engineers Pty Ltd Nagpur (ZT)	Credit Agencies • NABARD Farmer Clubs & Joint Liability Groups • PACS (where functional) • Jeevika SHG funding/micro-credit

Table 9 Madhubani organisations involved in promoting agriculture

Public	Government Organization (Research &Extension) • Department of Agriculture • Department of Horticulture • Jeevika (Under Dep.t of Rural Dev. 2007) • ATMA • Rajendra Ag. Uni.: KVK, Pusa resource & knowledge centre & Jhanjharpur Rice Research substation	Government Projects • DoA responsible for RKVY, NFSM & BGREI (implemented via MKSP) • DoH resp. for National Horticultural & Micro-irrigation Missions • Jeevika implements BRLPS & NRLM • NABARD Women Empowerment & Livelihood Program) in 2 blocks
Civil	NGOs • Jeevika's 280 staff • Sakhi 60 staff • Digital Green in 3 blocks (local dialect videos)	Community & Farmer Organizations • Jeevika's women SHGs (16,185) & village organisations (887) • Sakhi women SHGs
Private	Input suppliers/output marketers • Retailers at district, block & village level, DoA registered wholesalers (100) • Rajkumar Agro Engineers Pty Ltd Nagpur – ZT manufacturer	Credit Agencies • NABARD Farmer Clubs (300) & Joint Liability Groups(1000) • Commercial banks (22) with 235 branches • PACS (where functional) • Jeevika micro-credit

2.4 Northwest Bangladesh:

Northwest Bangladesh became a food surplus area following partitioning and a war of independence from Pakistan. Given that both events were entwined with widespread displacement, communal violence and famines, is in itself extraordinary. However, these gains are currently eroding in the face of population growth and groundwater depletion. Rangpur and Rajshahi Districts, within Northwest Bangladesh both lie within the upland Barind Tract, which is heavily reliant on groundwater using deep tubewells (DTW) for irrigation, industrial and domestic purposes. However, groundwater that is accessible by tubewells has fallen from 30-40 feet to 150-200 feet due to increased boro rice cultivation, making DTW installation by the state or STW installation by individual farmers very costly.

The need for water use efficiency (WUE) forms a strong rationale for CA adoption in the Barind Tract. The DTW manager, Barind Multipurpose Development Agency (BMDA), is encouraging WUE via metering, diversification away from water intensive boro rice, is promoting wheat and is interested in CA. These motivations have not yet been harnessed via strong linkages to agricultural agencies with CA expertise.

Although still labour intensive, agricultural operations are highly mechanised, a result of the liberalisation policies that followed independence that encouraged cheap imports of small scale machinery from China. Use of tractors, power tillers, DTW, STW and low lift pumps increased dramatically. The total number of these machines increased from 36,400 in 1977 to 7.3 million in 2008 (Bangladesh Agricultural Census, 2008). A huge number of manually operated weeders and sprayers are also used in the country. Today there are over one million small horsepower diesel irrigation pump-sets and nearly 400,000 diesel two wheel tractors. There are also tens of thousands of small-scale mechanised rice, wheat and maize thresh¬ers, mainly powered by the Chinese diesel engines (Biggs et al 2011).

Bangladesh's history of conflict and famine left a twofold institutional legacy. The effort to achieve national food security after one of the largest food aid flows in history has resolved into a strong policy focus on agriculture, although this has not yet resulted in the formulation of a CA policy. Secondly, Bangladesh's civic sector is internationally renowned. For example, the Bangladesh Rural Advancement Committee (BRAC) has grown into the largest NGO in the world. Nonetheless, small and marginal farmers dominate agriculture in both Rangpur and Rajshahi districts and productivity levels are low.

Bangladesh has developed strong emphasis and skills on wheat research and extension in both districts. The Department of Agricultural Extension (DAE) is a central actor but has not formed a view on CA and training in the use of new agri-machinery is very limited. DAE has formed over 500 Integrated Crop Management (ICM) farmer clubs in each district to manage the Sub-Assistant Agricultural Officer (SSAO) to farming household ratio of 1: 2,000 to 2,500. Its subsidies for farm machinery do not yet include CA equipment and it has limited vehicles and training facilities. The Agricultural Information Service (AIS) under the Ministry of Agriculture (MoA) promotes agricultural technologies via print and electronic media but is not engaged in promoting CA.

Table 10Rangpur-Dinajpur organisations involved in promoting agriculture

Public	Government Organization (Research & extension) • Wheat Research Centre, (WRC) Dinajpur • Department of Agricultural Extension (DAE) • BRAC's Agriculture and Food Security Program (AFSP) • Agricultural Information Service (AIS), Rangpur Ministry of Agriculture (MoA) • Rural Dev.t Academy (RDA) Bogra, Ministry of Local Gov.t, Rural Dev.t & Co-operatives (LGRDC) for seed technologies • Hajee Mohammad Danesh Science & Technology University, Dinajpur • Bangladesh Agricultural Development Corporation (BADC) • Barind Multipurpose Development Agency (BMDA), includes Dinajpur • BARI on farm research division • Ministry of Agriculture (MoA) Agricultural Information Service (AIS) • Government Projects (Research & extension) • CGIAR Cereal Systems Initiative (CSISA) for South Asia, implemented by BRAC, includes Rangpur	
Civic	NGOs: • Rangpur-Dinajpur Rural Services (RDRS) • Research Initiative Bangladesh (RIB), Nilphamari (Est. 2002 Netherlands) • iDE Bangladesh	Community & Farmer Organizations • Integrated Crop/Floodplain Management Clubs, Concerted Interest Groups etc names differ according to project funding (approx.674); RDRS farmer federations (approx. 400)
Private	Input suppliers/marketing • Uttaran Engineering Works • Reshma Engineering Workshop • ACI Motors • Private input suppliers & market intermediaries	Credit Providers • Bangladesh Central Bank (indirect funding to commercial and private banks only) • Microfinance Institute

In the Rangpur-Dinajpur Districts (Table 10), the Wheat Research Centre (WRC) at Dinajpur under the Bangladesh Agricultural Research Institute (BARI) offers CA mechanisation and engineering training to operators and manufacturers but is limited by its dependence on external funding. The CSISA project has promoted CA in Rangpur since 2009 using the NGO, Research Initiatives Bangladesh (RIB), as a hub manager. CSISA is linked to the DAE through a Technical Working Group comprising agricultural research agencies, universities, local service providers and implementing NGOs. Training infrastructure is also good. The Rural Development Academy (RDA) at Bogra also promoted bed planters in nearby districts. The Hajee Mohammad Danesh Science & Technology University, in Dinajpur, offers BSc degrees in Agriculture and Agri-business. Dinajpur also has two major agricultural machinery firms with expertise in manufacturing CA machinery.

SRFSI partner RDRS is a large NGO in Rangpur and builds on the DAE groups; the names and foci of which vary according to the source of project funding drawn upon. RDRS organises its SHGs into Union Federations (UF) using a farmer field school (FFS) methodology and promotes CA machinery and intensification. BRAC's Agricultural and Food Security programme (AFSP) employs 100 staff and includes Rangpur where it works with 5,000 farmers and forms an important potential outscaling partner. BRAC is less dependent upon external funding. In short, there are a rich range of organisations involved in promoting agricultural development and CA. However, synergies are lacking as each organisation implements their programs independently such that integrated, collaborative efforts at the operational/field level are rare.

Table 11 Rajshahi organisations involved in promoting agriculture

Public	Government Organization (Research & Extension) • Regional Wheat Research Centre (RWRC) of Bangladesh Ag. Research Institute (BARI), Rajshahi • Department of Agricultural Extension (DAE) • Barind Multipurpose Development Agency (BMDA), includes Rajshahi • Rajshahi University • Bangladesh Agricultural Development Corporation (BADC) • BARI on-farm research division	
Civic	NGOs • PROVA crop diversification in Barind via 20,000 farmers in 15 Upzillas spread over 4 Districts • iDE Bangladesh • Helvetas, Rajshahi • Caritas, Bangladesh • Centre for Agricultural Research Barind (CARB)	Community & Farmer Organizations, • Integrated Crop/Floodplain Management Clubs, Concerted Interest Groups etc names differ according to project funding (approx. 551), formed by the DAE, but few are active
Private	Input suppliers/marketing • Padma Engineering Works • Central Diesh & Engineering Works • Vhai Vhai Engineering Workshops • Land preparation & seeding service Providers • Private input suppliers & market intermediaries	Credit Providers • Bangladesh Central Bank (indirect funding to commercial and private banks only) • Rajshai Krishi Unnan Bank • Microfinance Institute

Rajshahi District has the Regional WRC at its BARI campus which has wheat breeding, soil and water management and agricultural engineering programs. It has a strong record of introducing new CA machines and collaborative projects with CGIAR centres and donors but is currently faced with technical staff and funding shortages due to dependence on external funding. However, the RWRC has trained several youth as CA service providers and one service provider has established a growing business providing bed planter and strip planter services to farmers. The main NGOs in Rajshahi include PROVA, Caritas Bangladesh and iDE Bangladesh, all of whom have an interest in promoting CA.

Strengthening interactions between RWRC, DAE, BMDA and NGOs will stimulate synergies for upscaling SRFSI interventions in Rajshahi. Despite lengthy experimentation and extensive expertise on the use of CA machinery and crop intensification, little cross-sharing of these experiences occurs, CSISA lessons have not been distilled, and little uptake has occurred beyond project villages. Systematic involvement of DAE is necessary to provide CA machinery subsidies and extension programs. A clear and unifying CA policy to drive CA promotion by multiple actors distributed across the public, civic and private sectors is required.

3 Bottleneck & entry point messages going forward

Significant Conservation Agriculture (CA) adaptive research effort in regard to both crops and machinery has already been undertaken in the Eastern Gangetic Plains (EGP) region, for example by:

- West Bengal's agricultural university UBKV, and associated farm science centres (KVKs);
- The Regional Wheat Research Centre (RWRC), Bangladesh Agricultural Research Institute (BARI), and Cereal Systems Initiative for South Asia (CSISA) in Northwest Bangladesh;
- Bihar and Rajendra Agricultural Universities (BAU and RAU), Indian Council for Agricultural Research - Research Complex for Eastern Region (ICAR-RCER) and Borlaug Institute of South Asia (BISA) in Bihar.

The major and overarching constraint is that these research efforts, by their nature, have only yielded small islands of influence. Where there is recurrent funding, such as in India, the extension efforts of agricultural universities and their associated KVKs form an island of influence among the 'surrounding villages' that the organisation has sufficient resources to reach. Where there is heavy dependence on external funding (bilateral and multilateral) for CA projects, which is often the case in northwest Bangladesh, resources are time bound and discontinuous, prone to shifting donor priorities. Consequently, projects have an island of influence upon 'project villages', which lapses when funds end.

The need to connect CA knowledge and expertise situated in the (publicly funded) research sector to the mass of smallholders and sharecroppers is (and will continue to be) incompletely addressed by the formal (publicly funded) extension sector: the Department of Agriculture (DoA) in India, Department of agricultural Extension (DAE) in Bangladesh, and the District Agricultural Development Office (DADO) in Nepal. The ratio of extension officers to farming households in northwest Bangladesh is on average 1:2,250 and in the Terai is even more formidable at 1:5,000. Extension officer positions are often unfilled (India), poorly renumerated, and lack operational resourcing (e.g. vehicles or fuel for fieldwork). The entrenched top-down nature of public sector routines and practices means:

- long delays in budget release missing the cropping season in which the activities were meant to be implemented;
- difficulty sourcing quality seed in a timely manner for trials and demonstrations;
- little interaction among agency staff occurs below the district level;
- failure to provide training to staff introducing a new scheme, program or project; and
- the restriction of services, for example input subsidies, to titled (male) land owners

However, an entry point for countering the limited public sector engagement of the mass of the EGP's smallholders and sharecroppers is through an extensive social infrastructure which is available in the Indian and Bangladeshi districts. A kaleidoscope of farmer groups, arising from both public sector and NGO effort exists in the form of Self Help Groups, Integrated Catchment

Groups, Farmer Interest Groups, Farmer Federations etc. In the case of Jeevika in Bihar, this social infrastructure arises from a hybrid public/civic effort supported by a multilateral donor and itself constitutes a significant innovation. Given the ratio between the small number of public extension officers and mass of farming households prevents one-on-one extension efforts, animation and leverage of this extensive social infrastructure is the only viable strategy for widespread promotion and uptake of CA practises.

It should be noted, however, that these groups are highly variable due to the organisational and funding priorities conditioning their establishment, composition and activities. They are gendered (SHGs are women only and Farmer Groups male only) so do not capture the household's economic interests as a totality, and are prone to become 'inactive' once project funding lapses. However, encouragement of collaborative effort between the technical strength of the research institutions and the social mobilisation skill of NGOs both within and beyond SRFSI could reanimate and leverage this social infrastructure.

This entry point is less evident in Nepal, which is faced with the task of building such social infrastructure by increasing coordinated outreach to farming communities by an array of agricultural actors currently fragmented both within and between the public, private and civic sectors. One possible advantage for SRFSI's scaling in Nepal is the opportunity for embedding such principles in the design of the new machinery government necessitated by the new federal constitution.

Ultimately, widespread CA adoption requires more functional input markets whereby quality seed, fertiliser, herbicide, CA machinery and services reaches smallholders and shareholders in a timely manner at a reasonable price because private sector agents find it profitable to supply them. Unfortunately, such markets need initially at least to be coaxed into existence. Working through the abovementioned social infrastructure of farmer and self help groups could serve to strengthen demand (backward linkages) for these services by aggregating and centralising individual farmer demand. This strategy would also assist farmer bargaining power regarding price and quality of inputs and services.

The need to import existing CA machinery (rice transplanters, zero till drills, laser levellers), often from China, can only be addressed by SAARC, as regional agreement on free movement of farming machinery and limits upon import duties is needed. This is a long-term goal and the role of influencing SAARC is already being fulfilled by CSISA. Locally manufactured smallholder adapted CA implements that can be attached to two and four wheel tractors are also needed. Addressing this gap requires an initial public sector push, for example, by training young rural mechanical entrepreneurs – a successful strategy used by the RWRC in Rajshahi District. West Bengal and Bangladesh have initiated implement hubs for hire, initiatives that have occurred both in the public and civic sector but need to become widespread.

In short, that substantive CA research and extension has not added up in a synergistic manner to widespread development impact reflects the fact that the multiple organisations relevant to achieving that impact are: distributed across the public, civic and private sectors; are independently funded; and function in isolation. There is a lack of strategic vision and a functional platform to exchange organisational information and learnings and drive CA policy and programming in the four jurisdictions. As the CRISP reports on which this synthesis is based indicate, the utility of multi-stakeholder forums to better coordinate this pluralism is already

recognised. India has established the multi-level Agricultural Technology Management Agency (ATMA), Nepal has established a multi-level National Agricultural Technology Working Group (NATWG) and CSISA links to relevant agencies in Bangladesh via a Technical Working Group. These are all at least incipient Innovation Platforms.

4 Where to next?

The CRISP reports set a useful benchmark of the degree of concerted effort to promote widespread CA practices across the EGP that form a reference point against which to measure SRFSI's development impact going forward. These studies of how current institutional arrangements limit widespread CA adoption and where they could be leveraged for better effect could be fruitfully integrated with bottlenecks and entry points identified in SRFSI's other lines of inquiry, namely:

- The node characterisation reports for each of SRFSI's eight districts that seek to understand the wide range of farming system situations and rank the main problems that need to be addressed in each of the 40 nodes;
- The International Water Management Institute (IWMI) irrigation access report;
- The IWMI Water Resources Assessment for sister project CSE/2013/099;
- Monitoring and Evaluation of SRFSI Innovation Platforms at the district and node levels.

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6 Appendix Detailed District Interview Samples

Organizations contacted in Dhanusha
District Agriculture Development Office(DADO),Janakpur
National Rice Research Program, Hardinath (2)
Janakapur Agriculture Development Project
Regional Agriculture Training Center, Nactajij
Community Ground Water Irrigation Sector project
IDE,Nepal, Janakapur
Rural Reconstruction Nepal
Bhudev Agro-Concern Jankapur
Dahal, Agro-Concern
Janaki Women Awareness Center
Sonalika Tractor Dealers
Regional Agriculture Development Office
Agriculture Research Station
Mithila District Farmer Association
Janaki Farmers Group
Ram Janaki Agriculture Cooperative
Total = 17

Organizations contacted in Sunsari
District Agriculture Development Office(DADO), Inaruwa
District Development Committee(DDC), Inaruwa
Regional Agriculture Research Station, Tarhara (3)
Plan Nepal
Agro-Vet, Duhabi (2)
Youth Creation NGO (2)
Ram Machinery Center, Inaruwa
Akash Deep Suppliers,Inaruwa
Pakali VDC-2 Badhara (2)
Total = 14

Organizations contacted in northwest Bangladesh
Department of Agricultural Extension, Dinajpur
Agricultural Engineer, Dinajpur
Uttaran Engineering Works (Pty) Ltd, Dinajpur
Reshma Engineering Workshop, Rangpur-Dinajpur
Wheat Research Centre, Dinajpur (2)
Research Initiatives Bangladesh, Nilphamari
Agricultural and Food Security Programme, BRAC, Regional Office, Rangpur
Ministry of Agriculture, Agriculture Information Service, Rangpur
CIMMYT Extension Agronomist
Upzilla Agriculture Officer, Gangachara, Rangpur
RDRS (2)
Machine Operator, Gangachara & Mithapukur (2)
Service Provider, Gangachara
Durgapur Union Federation, Co-ordinator, Farmer Field School
Farmers in Pierehat, Monthona, Borobil, Dokkhin Kolkondo villages of Gangachara (6)
Farmers of Mithapukur (3)
Total = 26

Organizations contacted in Malda
NABARD
Department of Agriculture
Agricultural Technology Management Agency (ATMA)
KVK (2)
Regional Research Sub Station, Manikchak (2)
All India Manav Kalyan Samiti (AIMKS)
Manikchak Farmers Club, Manikchak Block (2)
Sabuj Bahini Farmers club, Chanchal II Block (2)
Modipur Farmers Club (3)
Gourangapur Farmers Club, Gazoul Block (3)
Kalinagar Bibekananda Farmers Club, Gazoul Block (3)
Binay Sindhu Enterprises, Malda
United Bank of India
RCHSS (4)
Total = 27

Organizations contacted in Cooch Behar
NABARD
Central Bank of India
Department of Agriculture (2)
Agricultural Technology Management Agency (ATMA)
KVK (3)
UBKV (3)
Toofangani Anwesha Welfare Society, Lambapara, Toofanganj (3)
Mansai Shakti Farmers club, Toofanganj II (3)
Satmile Satish Farmers' Club "O" Pathagar, village chat elajan, cooch behar I, Cooch Behar Farmers Club Federation (6)
CDHI, Jalpaiguri (4)
Department of Soil Conservation, Cooch Behar
Input Dealers Association, Cooch Behar
Laxmi Trading machinery provider
Total = 30

Organizations contacted in Purnia
DRDA (District Rural Development Agency)
DoA (Department of Agriculture)
DoH (Department of Horticulture)
KVK (farm science centre) (2)
Bhola Prasad Shastri College of Agriculture
BAU (Bihar Agricultural Uni), Sabour
BRLPS (Bihar Rural Livelihood Promotion Soc.) (5)
Digital green/Jeevika (3)
Village Rampuri tiila, Banmankhi Block (2)
NABARD, Purnia
Central Bank of India, Purnia
Total = 19

Organizations contacted in Madhubani
DRDA (District Rural Development Agency)
DoA Department of Agriculture (2)
KVK (Krishi Vigyan Kendra = farm science centre) (2)
DoH (Department of Horticulture)
ATMA (Ag. Technology Management Agency) (2)
BRLPS (Bihar Rural Livelihood Promotion Soc.) (5)
Central Bank of India, Madhubani (3)
NABARD, Madhubani
Sakhi NGO (6)
Krishi Seva Kendra, Madhubani
Digital Green, Madhubani (2)
Total = 26

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FOR FURTHER INFORMATION

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